MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)

SYLLABUS OF
BACHELOR OF SCIENCE IN ELECTRICAL, ELECTRONIC AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRICAL, ELECTRONIC AND COMMUNICATION ENGINEERING (EECE)

JANUARY 2021

CERTIFICATE

The undergraduate course curriculum of the department of Electrical, Electronic and Communication Engineering (EECE) of Military Institute of Science and Technology (MIST) has been reviewed by the committee as mentioned below and will be implemented from Level-1 of academic session 2020-21 (Batch EECE-19).

A. President

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B. Internal Members

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C. **<u>BUP Members</u>**

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D. **External Members**

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E. **Members (External: Professional Organization/ Industry)**

1. ____

Abdul Mubin Ahmed
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Akter Ul Alam
Chief Strategy Officer
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3. ____

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Executive Director
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CHAPTER 1

GENERAL INFORMATION

1.1. Introduction to MIST

The necessity of establishing a technical institute for the Bangladesh Armed Forces was felt in the late eighties. In the absence of such an institution, officers of Bangladesh Armed Forces had been graduating from Bangladesh University of Engineering and Technology (BUET), Bangladesh Institute of Technology (BIT), and other foreign institutions of science and technology. With a view to meet the increasing demand for the development and dissemination of engineering and technological knowledge, Bangladesh Armed Forces established the Military Institute of Science and Technology (MIST) on 19 April 1998. Upholding the motto – “Technology for Advancement”, MIST promises to provide facilities for higher technical education both for the officers of Bangladesh Armed Forces as well as for civil students from home and abroad. MIST started its journey on 31 January 1999 by offering a four-year bachelor degree in Civil Engineering (CE). Bachelor degree in Computer Science and Engineering (CSE) course started on 2001**.** Bachelor degree in Electrical, Electronic and Communication Engineering (EECE) and Mechanical Engineering (ME) started from 2003. Bachelor degree in Aeronautical Engineering (AE), and Naval Architecture and Marine Engineering (NAME) started from 2009 and 2013, respectively. Besides, four new departments started their academic session from 2014-2015, which are Nuclear Sceince and Engineering (NSE), Biomedical Engineering (BME), Environmental, Water Resources and Coastal Engineering (EWCE) and Architecture (Arch). From 2016 another two departrments, viz. Industrial and Production Engineering (IPE) and Petroleum and Mining Engineering (PME), strated their academic sessions.

1.2 Vision and Mission of MIST

Vision: To be a center of excellence for providing quality education in the field of science, engineering and technology and conduct research to meet the national and global challenges.

Mission: MIST is working on following missions:

a. Provide comprehensive education and conduct research in diverse disciplines of science, engineering, technology, and engineering management.

b. Produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet the socio-economic development of Bangladesh and global needs.

c. Conduct collaborative research activities with national and international communities for continuous interaction with academia and industry.

d. Provide consultancy, advisory, testing, and other related services to government, non-government and autonomous organization including personal for widening practical knowledge and to contribute in sustainable development of the society.

1.3 Motto and Values of MIST

Motto: As an institution without gender biasness, MIST is steadily upholding its motto **“Technology for Advancement”** and remains committed to contributing to the wider spectrum of national educational arena, play a significant role in the development of human resources and gradually pursuing its goal to grow into a ‘**Centre of Excellence**’.

Values:

a. **Humanity-** MIST not only makes our students graduates but also strives to make them humane.

b. **Discipline-** Discipline remains the corner stone of continuous success stories of MIST.

c. **Morality -** Morality is innate. MIST helps nurture it and develops our students as Quality Engineers with Morality.

d. **Quality -** MIST keeps focusing on quality education with inspiration to life-long learning so that our graduates are recognized in the world and can prove their acquired skills.

1.4 Eligibility of Students for Admission in MIST

The students must fulfill the following requirements:

a. **Bangladeshi Students:** Minimum qualifications to take part in the admission test are as follows:

(1) The applicant must have passed the SSC/Equivalent examination obtaining a minimum GPA of 4.00 (without fourth subject) and HSC/Equivalent examination obtaining minimum total grade point 17 in four subjects (Mathematics, Physics, Chemistry, and English).

(2) The applicant must have passed the GCE 'O' Level obtaining minimum 'B' grade in five subjects including Mathematics, Physics, Chemistry, and English, and GCE 'A' Level obtaining minimum 'B' grade in Mathematics, Physics, and Chemistry.

(3) Applicants who have passed HSC or GCE 'A' Level or Equivalent examination in current year or one year before the notification for admission can apply.

b. **Foreign Students.** Maximum 3% of overall vacancies available will be kept reserved for the foreign students and will be offered to foreign countries through Armed Forces Division (AFD) of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:

(1) Educational qualifications as applicable for Bangladeshi students or equivalent.

(2) Must have security clearance from respective Embassy/ High Commission in Bangladesh.

In the event of non-availability of foreign students, the vacancies will be filled up by Bangladeshi civil students as per merit.

1.5 Seat Capacity.

Department wise seat allotment for four years Bachelor Degree in Engineering programmes (Unit–A) and five years Bachelor Degree of Architecture programmes (Unit–B) are as follows:

SEAT ALLOCATION

Ser	Unit	**Department**	**Seats**
1	**A**	Civil Engineering (CE)	60
2		Computer Science and Engineering (CSE)	60
3		Electrical, Electronic and Communication Engineering (EECE)	60
4		Mechanical Engineering (ME)	60
5		Aeronautical Engineering (AE)	50
6		Naval Architecture and Marine Engineering (NAME)	40
7		Biomedical Engineering (BME)	40
8		Nuclear Science and Engineering (NSE)	40
9		Environmental, Water Resources and Coastal Engineering (EWCE)	60
10		Industrial and Production Engineering (IPE)	50
11		Petroleum and Mining Engineering (PME)	25
12	**B**	Architecture (Arch)	25
		Total	570

The total number is 570. In general, about 50% seats will be allocated to military officers. However, in case of the requirement of military students vacancy is less in any particular year, the deficient vacancy will be filled up by civil students. MIST also maintains quota as mentioned below:

Ser	Quota Allocation	Seats
1	General Candidates	54%
2	Children of Military Personnel	40%
3	Children of Freedom Fighters	2%
4	Tribal Citizen	1%
5	International Students	3%
	Total	100%

1.6 Admission Procedure

1.6.1 <u>Syllabus for admission test.</u> Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English subjects of HSC examination. Admission test will be conducted out of 200 marks and the distribution of marks is given below:

Ser.	Subjects	Marks
a.	Mathematics	80
b.	Physics	60
c.	Chemistry	40
d.	English	20
	Total	**200**

1.6.2 <u>Final Selection</u>. Students will be selected on the basis of results of the admission test only. Individual choice for selection of departments will be given preference as far as possible. In case of tie in the result of admission test, difference will be judged on the basis of marks obtained in Mathematics, Physics, Chemistry and English respectively in admission test.

1.6.3 <u>Medical Checkup</u>. Civil candidates selected provisionally are to undergo medical check-up at MIST medical centre. They will have to produce test reports of urine for R/E, blood for HBs Ag and blood grouping before the MIST medical authority. The medical authority will decide on the physical fitness of candidates for admission in MIST.

1.7 <u>Students Withdrawal Policy</u>

1.7.1 <u>For Poor Academic Performance</u>.

The under graduate (B.Sc) Engineering programs for all engineering disciplines are planned for 04 regular levels, comprising of 08 regular terms (for Architecture programme it is planned for 5 regular levels, comprising of 10 regular terms). It is expected that all students will earn degree by clearing all the offered courses in the stipulated time. In case of failure the following policies will be adopted:

a. Students failing in any course/subject will have to clear/pass the said course/subject by appearing it in supplementary examination as per examination policy. Students may also retake the failed subject/course in regular term as per the Examination policy.
b. Maximum grading for supplementary examination of failed subjects will be B+ as per examination policy.
c. One student can retake/reappear in a failed subject/course only twice. However, with the Permission of Academic Council of MIST, a student may be allowed for third time as last chance.
d. In case of sickness, which leads to missing of more than 40% classes or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw temporarily from that term and repeat the whole level with the regular level in the next academic session, subject to the approval of Academic Council of MIST. Students may retain sessional courses of that term if applies and approved by Academic council. `VW' as grading of each course to be reflected in concerned tabulation sheet, grade sheet

and transcript. However, he/she has to complete the whole undergraduate program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.

e. Minimum credit requirement for the award of bachelor degree in Engineering (BSc. Engg) and Architecture (B. Arch) will be decided by the respective department as per the existing rules. However the minimum CGPA requirement for obtaining a bachelor degree in engineering and Architecture is 2.20.

f. Whatever may be the cases, students have to complete the whole undergraduate program within 06 (six) academic years (for Architecture 07 academic years) from the date of registration.

g. All other terms and condition of MIST Examination Policy remain valid.

1.7.2 Withdrawal on Disciplinary Ground

a. **Unfair Means**. Adoption of unfair means may result in expulsion of a student from the programme and so from the Institution. The Academic Council will authorize such expulsion on the basis of recommendation of the Disciplinary Committee, MIST and as per policy approved by the affiliating university. Following would be considered as unfair means adopted during examinations and other contexts:

(1) Communicating with fellow students for obtaining help in the examination.
(2) Copying from another student's script/ report /paper.
(3) Copying from desk or palm of a hand or from other incrimination documents.
(4) Possession of any incriminating document whether used or not.

b. **Influencing Grades.** Academic Council may expel/withdraw any student for approaching directly or indirectly in any form to influence a teacher or MIST authority for grades.

c. **Other Indiscipline Behaviors.** Academic Council may withdraw/expel any student on disciplinary ground if any form of indiscipline or unruly behavior is seen in him/her which may disrupt the academic environment/programme or is considered detrimental to MIST's image.

d. **Immediate Action by the Disciplinary Committee of MIST.** The Disciplinary Committee, MIST may take immediate disciplinary action against any student of the Institution. In case of withdrawal/expulsion, the matter will be referred to the Academic Council, MIST for post-facto approval.

1.7.3 Withdrawal on Own Accord.

a. **Permanent Withdrawal.** A student who has already completed some courses and has not performed satisfactorily may apply for a withdrawal.

b. **Temporary Withdrawal.** A student, if he/she applies, may be allowed to withdraw temporarily from the program, subject to approval of Academic Council of MIST, but he/she has to complete the whole program within 06 (six) academic years (for Architecture 07 academic years) from the date of his/her registration.

CHAPTER 2

RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAM AT MIST

Introduction

2.1 MIST has started course system for undergraduate studies from the academic session 2017-18. Therefore, the rules and regulations mentioned in this paper will be applicable to students for administering undergraduate curriculum through the Course System. This policy will be introduced with an aim of creating a continuous, even and consistent workload throughout the term for the students.

The Course System

2.2 The salient features of the Course System are as follows:

a. Number of theory courses will be generally 06 or as per syllabus in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow upto 07 courses in exceptional cases if department can accommodate within 24 cr hr.

a. Students will not face any level repeat for failing.

b. Students will get scope to improve their grading.

c. Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences.

d. Continuous evaluation of students' performance.

e. Promotion of student-teacher interaction and contact.

2.3 Beside the professional courses pertaining to each discipline, the undergraduate curriculum gives a strong emphasis on acquiring thorough knowledge in the basic sciences of mathematics, physics and chemistry. Due importance is also given on the study of several subjects in humanities and social sciences.

2.4 The first two years of bachelor's degree programs generally consist of courses on basic engineering, general science and humanities subjects; while the third and subsequent years focus on specific disciplines.

Number of Terms in a Year

2.5 There will be two terms *Spring Term (Jan-Jun) and Fall Term (Jul-Dec)* in an academic year.

Duration of Terms

2.6 The duration of each of Spring Term and Fall Term (maximum 22 weeks) may be as under:

Ser	Events	Durations
1.	Classes before Mid Term	7 weeks
2.	Mid Term Vacation	1 week
3.	Classes after Mid Term	7 weeks
4.	Makeup Classes and Preparatory leave	2/3 weeks
5.	Term Final Examination	2/3 weeks
6.	Term End Vacation	1/2 week

Course Pattern and Credit Structure

2.7 The undergraduate program is covered by a set of theoretical courses along with a set of laboratory (sessional) courses to support them.

Course Designation System

2.8 Each course is designated by a maximum of three/four letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

a. The first digit corresponds to the year/level in which the course is normally taken by the students.

b. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.

c. The last digit is an odd number for theoretical courses and an even number for sessional courses.

2.9 The course designation system is illustrated as Follows:

EECE 101 **Electrical Circuits I**

Course Title
Odd digit designates a theoretical course
Reserved for departmental use
Signifies 1st Year/ 1st Level course
Department identification code

EECE 102 **Electrical Circuits and Simulation Laboratory I**

Course Title
Even digit designates a sessional course
Reserved for departmental use
Signifies 1st Year/ 1st Level course
Department identification code

Assignment of Credits

2.10 The assignment of credits to a theoretical course follows a different rule from that of a sessional course.

a. Theoretical Courses: One lecture per week per term is equivalent to one credit.

b. Sessional Courses: Credits for sessional courses is half of the class hours per week per term.

Credits are also assigned to project and thesis work taken by the students. The amount of credits assigned to such work varies from one discipline to another.

Types of Courses

2.11 The types of courses included in the undergraduate curricula are divided into the following groups:

a. Core Courses: In each discipline, a number of courses are identified as core courses, which form the nucleus of the respective bachelor's degree program. A student has to complete all the designated core courses of his/her discipline.

b. Prerequisite Courses: Some of the core courses are identified as prerequisite courses for a specific subject.

c. Optional Courses: Apart from the core courses, the students can choose from a set of optional courses. A required number of optional courses from a specified group have to be chosen.

Course Offering and Instruction

2.12 The courses to be offered in a particular term are announced and published in the Course Catalog along with the tentative Term Schedule before the end of the previous term. The courses to be offered in any term will be decided by Board of Undergraduate Studies (BUGS) of the respective department.

2.13 Each course is conducted by a course teacher who is responsible for maintaining the expected standard of the course and for the assessment of students' performance. Depending on the strength of registered students (i.e. on the number of students) enrolled for the course, the teacher concerned might have course associates and Teaching Assistants (TA) to aid in teaching and assessment.

Teacher Student Interaction

2.14 The new course system encourages students to come in close contact with the teachers. For promotion of a high level of teacher-student interaction, each student is assigned to an adviser and the student is free to discuss all academic matters with his/her adviser. Students are also encouraged to meet any time with other teachers for help and guidance in academic matters. However, students are not allowed to interact with teachers after the moderation of questions.

Student Adviser

2.15 One adviser is normally appointed for a group of students by the BUGS of the concerned department. The adviser advises each student about the courses to be taken in each term by discussing the academic program of that particular term with the student.

2.16 However, it is also the student's responsibility to keep regular contact with his/her adviser who will review and eventually approve the student's specific plan of study and monitor subsequent progress of the student.

2.17 For a student of second and subsequent terms, the number and nature of courses for which he/she can register is decided on the basis of academic performance during the previous terms. The adviser may permit the student to drop 1 or more courses based on previous academic performance.

Course Registration

2.18 Any student who uses classroom, laboratory facilities or faculty-time is required to register formally. Upon admission to the MIST, students are assigned to advisers. These advisers guide the students in choosing and registering courses.

2.19 Registration Procedure. At the commencement of each term, each student has to register for courses in consultation with and under the guidance of his/her adviser. The date, time and venue of registration are announced in advance by the Registrar's Office. Counseling and advising are accomplished at this time. It is absolutely essential that all the students be present for registration at the specified time.

2.20 Pre-conditions for Registration.

a. For first year students, department-wise enrollment/admission is mandatory prior to registration. At the beginning of the first term, an orientation program will be conducted for them where they are handed over with the registration package on submission of the enrolment slip.

b. Any student, other than the new batch, with outstanding dues to the MIST or a hall of residence is not permitted to register. Each student must clear their dues and obtain a clearance certificate, upon production of which, he/she will be given necessary Course Registration Forms to perform course registration.

c. A student is allowed to register in a particular course subject to the class capacity constraints and satisfaction of pre-requisite courses. However, even if a student fails in a pre-requisite course in any term, the concerned department (BUGS) may allow him/her to register for a course which depends upon the pre- requisite course provided that his/her attendance and performance in the continuous assessment of the mentioned pre- requisite course is found to be satisfactory.

2.21 Registration Deadline. Each student must register for the courses to be taken before the commencement of each term. Late registration is permitted only during the first week of classes. Late registration after this date will not be accepted unless the student submits a written application to the registrar through the concerned Head of the department explaining the reasons for delay. Acceptable reasons may be medical problems with supporting documents from the Medical Officer of MIST or some other academic commitments that prohibit enrollment prior to the last date of registration.

2.22 **Penalty for Late Registration**. Students who fail to register during the designated dates for registration are charged a late registration fee of Tk. 100.00 (One hundred only) per credit hours. Penalty for late registration will not be waived.

Limits on the Credit Hours to be taken

2.23 A student should be enrolled for at least 15 credit hours and is allowed to take a maximum of 24 credit hours. Relaxation on minimum credit hours may be allowed. A student must enroll for the sessional courses prescribed in a particular term within the allowable credit hour limits.

2.24 In special cases where it is not possible to allot the minimum required 15 credit hours to a student, the concerned department (BUGS) may permit with the approval of the Commandant, a lesser number of credit hours to suit individual requirements. Only graduating students may be allowed to register less than 15 Cr Hr without approval of Commandant. A list of all such cases to be forwarded to the Register Office, ICT Directorate and Controller of Exam Office by the respective Department.

Course Add/Drop

2.25 A student has some limited options to add or drop courses from the registration list. Addition of courses is allowed only within the first two weeks of a regular term. Dropping a course is permitted within the first four weeks of a regular term. Add or drop is not allowed after registration of courses for Supplementary-I and Supplementary-II Examination.

2.26 Any student willing to add or drop courses has to fill up a Course Adjustment Form. This also has to be done in consultation with and under the guidance of the student's respective adviser. The original copy of the Course Adjustment Form has to be submitted to the Registrar's Office, where the required numbers of photocopies are to be made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student. All changes must be approved by the adviser and the Head of the concerned department. The Course Adjustment Form has to be submitted after being signed by the concerned persons.

Withdrawal from a Term

2.27 If a student is unable to complete the Term Final Examination due to serious illness or serious accident, he/she may apply to the Head of the degree awarding department for total withdrawal from the term before commencement of term final examination. However application may be considered during term final examination in special case. The application must be supported by a medical certificate from the Medical Officer of MIST. The concerned student may opt for retaining the sessional courses of the term. The Academic Council will take the final decision about such applications. However, the total duration for graduation will not exceed 6 academic years.

The Grading System

2.28 The total performance of a student in a given course is based on a scheme of continuous assessment, for theory courses this continuous assessment is made through a set of quizzes, class tests, class evaluation, class participation, homework assignment, midterm examination and a term final examination. The assessments for sessional courses are made by evaluating performance of the student at work during the class, viva- voce during laboratory hours and quizzes. Besides that, at the end there will be a final lab test. Each course has a certain number of credits, which describes its corresponding weightages. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of earned credits also have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be given as follows:

Grading System		
Numerical Markings	**Grade**	**Grade Points**
80% and above	A+	4.00
75% to below 80%	A	3.75
70% to below 75%	A-	3.50
65% to below 70%	B+	3.25
60% to below 65%	B	3.00
55% to below 60%	B-	2.75
50% to below 55%	C+	2.50
45% to below 50%	C	2.25
40% to below 45%	D	2.00
below 40%	F*	0.00
	AB	Absent
	DC	Dis-collegiate
	VW	Voluntary Withdrawn
	X	Project/ Thesis Continuation
	E	Expelled
	S	Satisfactory

* Subject in which the student gets F grade shall not be regarded as earned credit hours for the calculation of Grade Point Average (GPA).

Distribution of Marks

2.29 Theory. Forty percent (40%) of marks of a theoretical course shall be allotted for Continuous Assessment, i.e. assignments, class tests, pop quizzes, observations, projects and mid-term assessment. These marks must be submitted to Office of the Controller of Examinations before commencement of the final exam. The rest of the marks will be allotted to the Term Final Examination. The duration of final examination will be three (03) hours. The scheme of continuous assessment that a particular teacher would follow for a course will be announced on the first day of the classes. Distribution of marks for a given course per credit is as follows:

Class Performance	5%
Class Attendance	5%
Class Test/Assignment	20%
Mid-Term Assessment (Exam/Project)	10%
Final Examination (Section A and B)	60%
Total	100%

Basis of awarding marks for Class Attendance will be as follows:

Attendance	Marks
90% and above	100%
85% to less than 90%	90%
80% to less than 85%	80%
75% to less than 80%	70%
70% to less than 75%	60%
Below 70%	00%

Note:

a. In final exam, each section can be used for achieving not more than two course outcomes (COs). The remaining COs should be attained from mid-term assessment or class tests. Course teacher has to inform the student at the beginning of the terms.

b. Course teacher of a particular course has to inform the department whether he/she wants to assess mid-term through exam or project within first two weeks of beginning of a term. The duration of mid-term examination should not be more than 50 minutes which has to be conducted in between 6^{th} to 9^{th} week of a semester. If mid-term assessment is done through project, then there should be project report and presentation.

c. The weightage of class performance can be assessed through checking attentiveness during classes or arranging unnoticed pop quizzes.

d. The number of class tests shall be n for 3.0 and above credit courses and (n-1) shall be considered for grading where n is the number of credits of the course. However, for courses having credits below 3.0, the considered class tests shall be 2 out of 3.

e. All class test will carry 20 marks each. Exam software system will finally convert these achieved marks into total class test marks as per credit hour. i.e for n=1(20), n=2 (40), n=3 (60), n=4(80), etc.

f. Irrespective of the result of the continuous assessment (class performance, class test, mid-term assessment), a student has to appear in the final examination (where applicable) for qualifying/passing the concern course/ subject.

2.30 **Laboratory/ Sessional/ Practical Examinations.** Laboratory/Sessional courses are designed and conducted by the concerned departments. Examination on laboratory/ sessional/ practical subjects will be conducted by the respective department before the commencement of term final examination. The date of practical examination will be fixed by the respective department. Students will be evaluated in the laboratory/ sessional courses on the basis of the followings:

Conduct of Lab Tests/Class Performance	25%
Report Writing/Programming	15%
Mid-Term Evaluation (exam/project/assignment)	20%
Final Evaluation (exam/project/assignment)	30%
Viva Voce/Presentation	10%
Total	100%

Note: the above distribution of percentage is a general guideline. Department can rearrange to some extent if required.

2.31 **Sessional Course in English**. The distribution will be as under:

Class performance/observation	10%
Written Assignment	15%
Oral Performance	25%
Listening Skill	10%
Group Presentation	30%
Viva Voce	10%
Total	100%

2.32 **Class attendance**. Class attendance may be considered as a part of continuous assessment. No mark should be allotted for attending classes.

Collegiate and Non-collegiate

2.33 Students having class attendance of 85% or above in individual subject will be treated as collegiate, and less than 85% and up to 70% will be treated as non-collegiate in that subject. The non-collegiate student(s) may be allowed to appear at the examination subject to payment of non-collegiate fee/fine of an amount fixed by MIST/BUP. Students having class attendance below 70% will be treated as dis-collegiate and will not be allowed to appear at the examination and treated as fail. But in a special case such students may be allowed to appear in the examination with the permission of Commandant and it must be approved by the Academic Council.

Calculation of CGPA

2.34 Grade Point Average (GPA) is the weighted average of the grade points obtained of all the courses passed/completed by a student. For example, if a student passes/completes *n* courses in a term having credits of C1, C2, ..., Cn and his grade points in these courses are G1, G2, ..., Gn, respectively, then

$$\text{GPA}=\frac{\text{Grade points earned in the semester}}{\text{Credits completed in the semester}}$$

$$= \frac{\text{Summation of (Credit hours in a course * Grade point earned in that course)}}{\text{Total number of credit hours completed}}$$

$$= \left(\sum_{i=1}^{n} Ci * Gi\right) \Big/ \sum_{i=1}^{n} Ci$$

2.35 The Cumulative Grade Point Average (CGPA) is the weighted average of the GPA obtained in all the terms passed/completed by a student. For example, if a student passes/ completes n terms having total credits of TC1, TC2, ... , TCn and his GPA in these terms are GPA1, GPA2,... , GPAn, respectively then

$$CGPA = \left(\sum_{i=1}^{n} TCi * GPAi\right) \Big/ \sum_{i=1}^{n} TCi$$

Numerical Example

Suppose a student has completed nine courses in a term and obtained the following grades:

Course	Credit Ci	Grade Points	Gi	Ci*Gi
EECE-163	3.00	A	3.75	11.25
EECE-164	0.75	A+	4.00	3.00
MATH-141	3.00	A-	3.50	10.50
PHY-103	3.00	B+	3.25	9.75
HUM-101	3.00	A	3.75	11.25
HUM-102	1.50	A	3.75	5.625
CSE-101	3.00	A	3.75	11.25
CSE-103	3.00	A-	3.50	10.50
CSE-104	1.5	B+	3.25	4.875
Total	**21.75**			**78.00**

$$GPA = \frac{78.00}{21.75} = 3.59$$

Suppose a student has completed four terms and obtained the following GPA:

Level	Term	Earned Credit Hours	Earned GPA	TCi*GPAi
		Tci	GPAi	
1	I	21.75	3.75	81.5625
1	II	20.75	3.61	74.9075
2	I	19.50	3.21	62.595
2	II	21.00	2.98	62.58
Total		**83.00**		**281.645**

$$CGPA = \frac{281.645}{83.00} = 3.39$$

Impacts of Grade Earned

2.36 The courses in which a student has earned a ‘D’ or a higher grade will be counted as credits earned by him/her. Any course in which a student has obtained an ‘F’ grade will not be counted towards his/her earned credits or GPA calculation. However, the ‘F’ grade will remain permanently on the Grade Sheet and the Transcript.

2.37 A student who obtains an ‘F’ grade in a core course will have to repeat that particular course. However, if a student gets an ‘F’ in an optional course, he/she may choose to repeat that course or take a substitute course if available. When a student will repeat a course in which he/she has previously obtained an ‘F’, he/she will not be eligible to get a grade better than ‘B+’ in that repeated course.

2.38 If a student obtains a grade lower than ‘B+’ in a particular course he/she will be allowed to repeat the course only **once** for the purpose of grade improvement. However, he/she will not be eligible to get a grade better than ‘B+’ for an improvement course.

2.39 A student will be permitted to repeat for grade improvement purposes a maximum of 6 courses in BSc. Engineering programs and a maximum of 7 courses in B. Arch. program.

2.40 If a student obtains a ‘B+’ or a better grade in any course he/she will not be allowed to repeat the course for the purpose of grade improvement.

Classification of Students

2.41 At MIST, regular students are classified according to the number of credit hours completed/ earned towards a degree. The following classification applies to all the students:

Level	Credit Hours Earned	
	Engineering/URP	Architecture
Level 1	0.0 to 36.0	0.0 to 34.0
Level 2	More than 36.0 to 72.0	More than 34.0 to 72.0
Level 3	More than 72.0 to 108.0	More than 72.0 to 110.0
Level 4	More than 108.0	More than 110.0 to 147.0
Level 5		More than 147.0

2.42 However, before the commencement of each term all students other than new batch are classified into three categories:

a. Category 1: This category consists of students who have passed all the courses described for the term. A student belonging to this category will be eligible to register for all courses prescribed for the upcoming term.

b. Category 2: This category consists of students who have earned a minimum of 15 credits but do not belong to category 1. A student belonging to this category is advised to take at least one course less since he might have to register for one or more backlog courses as prescribed by his/her adviser.

c. Category 3: This category consists of students who have failed to earn the minimum required 15 credits in the previous term. A student belonging to this category is advised to take at least two courses less than a category 1 student subject to the constraint of registering at least 15 credits. However, he will also be required to register for backlog courses as prescribed by the adviser.

2.43 **Definition of Graduating Student**. Graduating students are those students who will have ≤ 24 credit hours for completing the degree requirement.

Performance Evaluation

2.44 The performance of a student will be evaluated in terms of two indices, viz. Term Grade Point Average and Cumulative Grade Point Average which is the grade average for all the terms completed.

2.45 Students will be considered to be making normal progress toward a degree if their Cumulative Grade Point Average (CGPA) for all work attempted is 2.20 or higher. Students who regularly maintain a term GPA of 2.20 or better are making good progress toward the degrees and are in good standing with MIST. Students who fail to maintain this minimum rate of progress will not be in good standing. This can happen when any one of the following conditions exists.

a. The term GPA falls below 2.20.
b. The Cumulative Grade Point Average (CGPA) falls below 2.20.
c. The earned number of credits falls below 15 times the number of terms attended.

2.46 All such students can make up their deficiencies in GPA and credit requirements by completing courses in the subsequent term(s) and supplementary exams, if there are any, with better grades. When the minimum GPA and credit requirements are achieved, the student is again returned to good standing.

Minimum Earned Credit and GPA Requirement for Obtaining Degree

2.47 Minimum credit hour requirements for the award of bachelor’s degree in engineering (BSc

Engg) and architecture (B. Arch) will be decided by the respective department (BUGS). However, the syllabus of all BSc engineering program must be of minimum 157 credit hours or more, and for architecture program minimum 189 credit hours or more. A student must earn minimum credit hour set in the syllabus by the concerned department for qualifying Bachelor's Degree. The minimum CGPA requirement for obtaining a Bachelor's degree in engineering and architecture is 2.20.

2.48 A student may take additional courses with the consent of his/her Adviser in order to raise CGPA, but he/she may take a maximum of 15 such additional credits in engineering and 18 such additional credits in architecture beyond respective credit-hour requirements for Bachelor's degree during his/her entire period of study.

Application for Graduation and Award of Degree

2.49 A student who has fulfilled all the academic requirements for Bachelor's degree will have to apply to the Controller of Examinations through his/her Adviser for graduation. Provisional Degree will be awarded by BUP on completion of credit and GPA requirements.

Time Limits for Completion of Bachelor's Degree

2.50 A student must complete his studies within a maximum period of **six** years for engineering and **seven** years for architecture bachelor's degree.

Attendance, Conduct and Discipline

2.51 MIST has strict rules regarding the issues of attendance in class and discipline.

2.52 **Attendance**. All students are expected to attend classes regularly. The university believes that attendance is necessary for effective learning. The first responsibility of a student is to attend classes regularly and one is required to attend the classes as per MIST rules.

2.53 **Conduct and Discipline**. During their stay in MIST, all students are required to abide by the existing rules, regulations and code of conduct. Students are strictly forbidden to form or be members of student organization or political party, club, society etc., other than those set up by MIST authority in order to enhance student's physical, intellectual, moral and ethical development. Zero tolerance in regards of sexual abuse and harassment in any forms and drug abuse and addiction are strictly observed in the campus.

Teacher-Student Interaction

2.54 The academic system in MIST encourages students to come in close contact with the teachers. For promotion of high level of teacher-student's interaction, a course coordinator (CC) is assigned to each course. Students are free to discuss with CC about all academic matters. Students are also encouraged to meet other teachers any time for help and guidance for academic matters. Heads of the departments, Director of Administration, Director of Students Welfare (DSW), Dean and Commandant address the students at some intervals. More so, monthly Commandant's Parade is organized in MIST where all faculty members, staff and students are formed up, thereby increasing teacher-student interaction.

Absence during a Term

2.55 A student should not be absent from quizzes, tests, etc. during the term. Such absence will naturally lead to reduction in points/marks, which count towards the final grade. Absence in the Term Final Examination will result in an 'F' grade in the corresponding course. A student who has been absent for short periods, up to a maximum of three weeks due to illness, should approach the course teacher(s) or the course coordinator(s) for make-up quizzes or assignments immediately upon return to classes. Such request has to be supported by medical certificate from competent authority (e.g. CMH/MIST Medical Officer).

Recognition of Performance

2.56 As recognition of performance and ensure continued studies MIST awards medals, scholarships and stipends as per existing rules and practices.

Types of Different Examination

2.57 Following different types of final examinations will be conducted in MIST to evaluate the students of Undergraduate Programs:

a. Term Final Examination: At the end of each normal term (after 22week or so), Term Final Examination will be held. Students will appear in the Term Final Examination for all the theory courses they have taken in the Term.

b. Supplementary Examination: It will take place twice in a year. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun)/Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec)/ Spring Term (Jan-Jun) end break, respectively. Students will be allowed to register for a maximum of **two** theory courses (Failed/ Improvement) in Supplementary-I and maximum of **one** theory course (Failed/ Improvement) in Supplementary-II.

c. Improvement Examination: It will be taken during Supplementary-I and Supplementary-II Examination. Questions will be same as the question of the regular examination of that Supplementary Examination (if any). Student can take maximum two subjects at a time (two subjects in Supplementary-I and one subject in Supplementary-II) and maximum 6 subjects in the whole academic duration. If a student obtains a grade lower than 'B+' in a course, he/she will be allowed to repeat the course only once for grade improvement. However, he/she will not be eligible to get a grade better than 'B+' for an improvement course. Among the previous result and improvement examination result, best one will be considered as final result for an individual student. However, performance of all examination i.e. previous to improvement examination, shall be reflected in the transcript.

Rules of Different Examinations

2.58 Term Final Examination. Following rules to be followed:

a. Registration to be completed before commencement of the Term. A student has to register his desired courses paying registration, examination fee and other related fees.

b. Late registration will be allowed without penalty within first two weeks of the term.

c. Within 1st two weeks of a term a student can Add/Drop course/courses. To add a course, in the 3rd week, one has to register the course by paying additional fees. To drop a course, one has to apply within three weeks and paid fees will be adjusted/ refunded. If anyone wants to drop a course after three weeks and within 4 weeks, that will be permitted but paid fees will not be refunded in that case.

d. Registrar office will finalize registration of all courses within 7 (seven) weeks, issue registration slip and that will be followed by issuing Admit Card.

e. Term Final Examination to be conducted in the 18-20th week of the term as per approved Academic Calendar.

2.59 Supplementary Examination. Following rules to be followed:

a. Supplementary-I is defined as provision of giving exam in the first week of Spring Term (Jan-Jun) /Fall Term (Jul-Dec) end break and Supplementary-II in the first week of Fall Term (Jul-Dec) / Spring Term (Jan-Jun) end break, respectively.

b. Students will be allowed to register for a maximum of two theory courses (Failed/ Improvement) in Supplementary-I and maximum of one theory course (Failed/ Improvement) in Supplementary-II.

c. No class will be conducted.

d. 40% marks will be considered from the previous exams.

e. Maximum grading in Supplementary Exam will be 'B+'.

f. No Sessional Exam will be conducted.

g. Examination will be taken on 60% marks like Term Final Examination.

h. If a student fails in a course more than once in regular terms, then for calculating 40% marks, the best one of all continuous assessment marks will be counted.

j. If anyone fails in the Laboratory/ Sessional course, that course cannot be taken in the supplementary examination.

k. If any student fails in a course, he can clear the course retaking it second time or, he can clear the examination appearing at the Supplementary Examination as well. Anyone fails twice in a course, can only retake it in the regular term for appearing third time. But anyone fails even after appearing third time, he/she has to take approval of Academic Council of MIST for appearing 4th (last) time in a course and need to pay extra financial penalty. If any student fails even 4th time in a course, will not be allowed to appear anymore in this same course.

l. Registration of Supplementary-I Exam to be done within 5th week after completion of fall Term (Jul-Dec) and registration of Supplementary-II Exam to be done within the mid-term break of Spring Term (Jan-Jun), paying all the required fees.

m. There will be no provision for add/drop courses after registration.

n. **Thesis:** if a student cannot complete thesis in two consecutive terms, with the recommendation of the supervisor, he/she may continue for next one/two term within six academic years.

2.60 **Improvement Examination.** Following rules to be followed:

a. Improvement Examination is to be taken during the Supplementary-I and II examinations.

b. For Improvement Examination, registration is to be done during the registration of Supplementary-I and Supplementary-II Examinations by paying all the fees.

c. Question Setting, Moderation and Result Publication to be done with courses of Supplementary-I and Supplementary-II Examinations.

d. Any student gets a grading below ‘B+’ and desires to improve that course, he will be allowed to appear the Improvement Examination for that particular course.

e. Highest grade of Improvement Examination will be ‘B+’.

f. One student is allowed to appear at Improvement Exam in 6 (six) courses in his whole graduation period taking maximum two courses at a time (two courses at Supplementary-I and one course at Supplementary-II).

Irregular Graduation

2.61 If any graduating student clears his/her failed course in Spring Term /Fall Term/ Supplementary Examinations and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Spring Term /Fall Term / Supplementary Examinations and that student will be allowed to apply for provisional certificate.

Minimum Earned Credit and CGPA Requirement for Obtaining Degree

2.62 The requirements for award of engineering degree are as follows:

a. Completion of the courses for the minimum required credits of 157 (or as specified in a particular department) in a maximum period of six academic years.

b. Appearing at the final examination in all the required courses as per syllabus of the program.

c. Scoring a CGPA of 2.2 or above.

Consequences of Failing in Sessional Courses

2.63 Any student failing in any sessional course, must re-take that sessional course when offered by the department in any next Regular Term. No Supplementary exam is allowed for sessional course.

Withdrawal for Poor Performance

2.64 A student to remain in reasonable standing must maintain a minimum CGPA of 2.20. Failure to secure/achieve minimum CGPA of 2.20 in two consecutive levels will also lead to withdrawal of the student. A student who fails to maintain a CGPA of 2.20 at the end of a level, but obtains 2.00 or more, will be placed on probation. Failure by a student placed on probation to raise the CGPA to 2.20 in the next level will lead to his withdrawal from the Program. A student failing to maintain a CGPA of 2.20 at the end of the level-4 shall be allowed to repeat courses of the level-4 in which he earned 'C' grades or below. This opportunity will be given only once. Such a student failing to raise CGPA to 2.2 after repeating the courses will be withdrawn from the Program (For further detail 'MIST Withdrawal Policy' may be consulted).

2.65 **Voluntary withdrawal for Sickness.** In case of sickness which leads to missing of more than 40% class or miss term final examination (supported by requisite medical documents), students may be allowed to withdraw from that term subject to the approval of the Academic Council of MIST. Students may retain sessional courses of that term if applies and approved by Academic council. 'VW' as grading of each course to be reflected in concerned tabulation sheet, grade sheet and transcript.

2.66 **Class Tests.** Class test will be conducted by the subject teacher. Duration of class test should not be more than 30 minutes. Course teacher must announce results within 10 days of holding the examination. Checked script will be shown to the students. If a student misses the class test for acceptable reason the course teacher my take the test of the student.

2.67 MIST is committed in conferring degrees to the students in time which plays a very vital role in steering all the academic activities in any university/ institute. At the beginning MIST conducted all its examinations under the examination section of the University of Dhaka. In June 2008, MIST got affiliation with BUP. Since then MIST has been conducting all its examinations under the control and authority of BUP. For the need of time, former MIST examination policy was reviewed several times. Present review committee has made necessary amendment/ addition/ deletion to suit the proposed course system. This policy may be reviewed every after 05 (five) years or as and when felt necessary by the authority of MIST.

2.68 SUMMARY OF MIST EXAMINATION POLICY-2020

Serial	Examination Type	Session	Number of Theory Courses	Maximum Grading	Assessment Percentage	Examination Schedule	Courses	Registration Schedule
1	Regular	Spring Term (Jan-Jun) and Fall Term (Jul-Dec)	Maximum 6 Theory Courses	A+	Assessment on 100%	Regular Examination	Regular	Regular
2	Retake	Spring Term (Jan-Jun) and Fall Term (Jul-Dec)		B+				
3	Supplementary-I (Fail/Improvement)	Spring Term (Jan-Jun)	Maximum 2 Theory	B+	Assessment on 60%	1st week of Spring Term (Jan-Jun)/ Fall Term (Jul-Dec) End Break	Courses of immediate past terms included	5th week after completion of Fall Term (Previous Year)
4	Supplementary-II (Fail/Improvement)	Fall Term (Jul-Dec)	Maximum 1 Theory	B+	Assessment on 60%	1st week of Fall Term (Jul-Dec)/ Spring Term (Jan-Jun) End Break	Courses of immediate past terms not included	Mid-Term Break of Spring (Jan-Jun) Term (March)

a. Maximum 24 credit hour in one regular term (excluding Supplementary Exams).
b. Students may register maximum upto 7 (seven) theory courses in exceptional case, if department can accommodate within 24 credit hour.
c. Students can register maximum 6 (six) theory courses for improvement in his whole academic period.
d. Supplementary-I Exam to be considered as part of previous Academic Year.
e. Student appearing in Supplementary-I shall not be included in current graduation ceremony.

CHAPTER 3

DEPARTMENT OF ELECTRICAL, ELECTRONIC AND COMMUNICATION ENGINEERING (EECE)

3.1 Introduction to the program

Electricity, Electronics and Communication plays vital and in fact, indispensable role in all fields of modern human activities. Consequently, Electrical, Electronic and Communication Engineering (EECE) has established itself as one of the most important branches of engineering. The technical aspects of this branch of engineering are often categorized by terms such as power systems, power electronics, telecommunications, electronic circuits and devices, and computer engineering. Communication is one of the three battle winning factors in military. In the modern days, communication is one of the most exercised research arenas too. The students of Electrical, Electronics and Communication Engineering are required to have a balanced knowledge of digital electronics, computers, microprocessors and programming in addition to the knowledge on various subjects of electrical and electronics. The new generation of electrical engineers is encouraged to undertake research and development activities in the above areas and this department is committed to the study and analysis of fundamental as well as applied problems. Problems of military and national importance have consequently received great emphasis in the activities of this department. In addition to the above, presently this department is providing opportunity for postgraduate studies and research leading to higher degrees i.e. Ph.D. in EECE discipline.

3.2 Vision and Mission of the Program

Vision: To provide quality education in electrical, electronic and communication engineering and technology, and conduct research to meet the national and global challenges.

Mission: EECE department is working on the following missions:

a. To provide comprehensive education in electrical, electronic and communication engineering and conduct research.

b. To produce technologically advanced graduates and professionals with high moral and ethical values to meet the domestic and global needs in the field of electrical, electronic and communication engineering.

c. To provide consultancy, advisory and testing services to public and private organizations including personal in the areas of electrical, electronic and communication engineering.

d. To conduct collaboration and research activities with national and international academia and industry.

3.3 Program Educational Objectives (PEOs):

No	PEO Statement
PEO-1	Provide graduates mathematical, scientific and engineering fundamentals and advanced knowledge of understanding in the sector of electrical, electronic and communication engineering including analysis techniques, design, developments and implementation methodologies.
PEO-2	Integrate technical and communicative knowledge with professional and industry based education to build up successful professional careers in industry, government and academia.
PEO-3	Expose graduates problem solving skills and research based education for life-long learning to adapt the innovation and changes.
PEO-4	Make the graduates capable of working in the broader area of technology having the capability and responsibility of leadership and teamwork.

No	PEO Statement
PEO-5	Enable the graduates to establish and run sustainable business enterprises along diverse career paths by creating, selecting, applying appropriate and modern technologies and tools.
PEO-6	Contribute the educational, cultural, social, technological and economic development of society through the ethical application of their knowledge and skills.

3.4 Program Outcomes (PO)

Based on the suggestion of Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, the Bachelor in Electrical, Electronic and Communication Engineering (EECE) program will have the following Program Outcomes (POs):

1. **Engineering knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)
3. **Design/development of solutions:** Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)
4. **Investigation:** Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
5. **Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering problems, with an understanding of the limitations. (K6)
6. **The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)
7. **Environment and sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)
9. **Individual work and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

In addition to incorporating the above-listed POs, MIST also included the following Knowledge Profile (K1-K8) as an educational institution: may include additional outcomes in its learning programs. The ranges of Complex Problem Solving (P1 – P7) and Complex Engineering Activities (A1 – A5) that should be addressed in the program are given in Tables 3.2 and 3.3, respectively.

Table 3.1: Knowledge Profile (KP)

No	Attribute
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
K3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5	Knowledge that supports engineering design in a practice area
K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability
K8	Engagement with selected knowledge in the research literature of the discipline

Table 3.2: Range of Complex Engineering Problem Solving (CP)

Attribute	**Complex Engineering Problems** have characteristic P1 and some or all of P2 to P7:
Depth of knowledge required	P1: Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
Range of conflicting requirements	P2: Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	P3: Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	P4: Involve infrequently encountered issues
Extent of applicable codes	P5: Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder involvement and conflicting requirements	P6: Involve diverse groups of stakeholders with widely varying needs
Interdependence	P7: Are high level problems including many component parts or sub-problems

Table 3.3: Range of Complex Engineering Activities (CA)

Attribute	**Complex activities** means (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	A1: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	A2: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	A3: Involve creative use of engineering principles and research based knowledge in novel ways
Consequences for society and the environment	A4: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	A5: Can extend beyond previous experiences by applying principles-based approaches

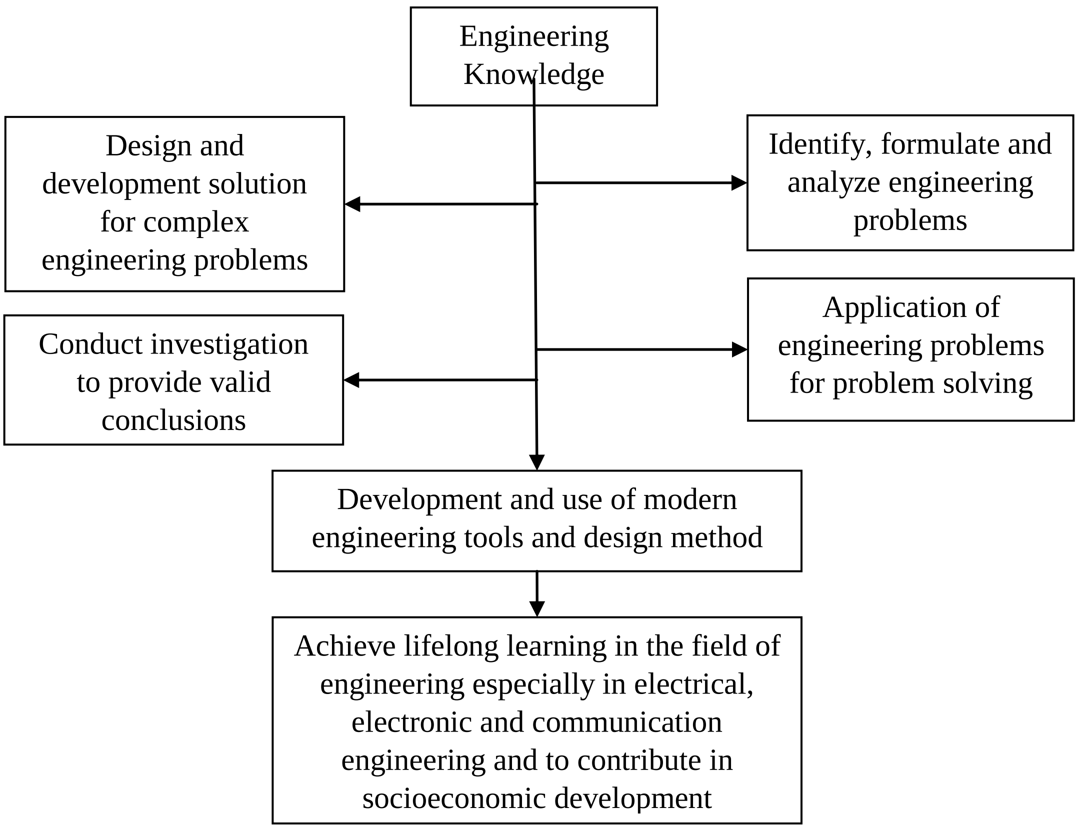
Table 3.4: Bloom's Taxonomy Domain

Cognitive Domain		Psychomotor Domain		Affective Domain	
C1	Remembering	**P1**	Perception	**A1**	Receive
C2	Understanding	**P2**	Set	**A2**	Respond
C3	Applying	**P3**	Guided Response	**A3**	Value
C4	Analyzing	**P4**	Mechanism	**A4**	Organize
C5	Evaluating/	**P5**	Complex Overt Response	**A5**	Internalize
C6	Creating/ Designing	**P6**	Adaptation		
		P7	Origination		

3.5 Generic Skills

a. Apply the principles and theory of electrical, electronic and communication engineering knowledge to the requirements, design and development of different electrical systems with appropriate understanding.
b. Define and use appropriate research methods and modern tools to conduct a specific project.
c. Learn independently, be self-aware and self-manage their time and workload.
d. Apply critical thinking to solve complex engineering problems.
e. Analyze real time problems and justify the appropriate use of technology.
f. Work effectively with others and exhibit social responsibility.

3.6 Curriculum/ Skill mapping:



CHAPTER 4

COURSE CURRICULUM FOR BACHELOR DEGREE IN EECE

4.1 Course Curriculum

Keeping the above mentioned program outcome, the Course Curriculum for the undergraduate students of the Department of Electrical, Electronic and Communication Engineering (EECE) is given below:

Level/ Term	Hum	Math	Basic Science	Engineering Courses		Elective Courses	Total
				Dept	Non-Dept		
L-1 T-I	2.0+0	3.0	6.0+3.0	3.0+1.5	-	-	18.5
L-1 T-II	2.0+1.5	3.0	3.0	3.0+1.5	3.0+1.5	-	18.5
L-2 T-I	2.0+1.5	3.0	-	6.0+3.0	3.0+1.5	-	20.0
L-2 T-II	2.0	3.0	-	9.0+5.0	-	-	19.0
L-3 T-I	2.0	-	-	15.0+4.5	-	-	21.5
L-3 T-II	0+2.0	-	-	9.0+5.5	3.0+1.5	-	21.0
L-4 T-I	0.0	-	-	9.0+6.0	-	6.0	21.0
L-4 T-II	4.0	-	-	3.0+3.0	-	9.0+1.5	20.5
% of Total Course	**11.88%**	**7.50%**	**7.50%**	**54.38%**	**8.43%**	**10.31%**	**100%**
Total Credit Hr	**19.0**	**12.0**	**12.0**	**87.0**	**13.5**	**16.5**	**160.0**

4.2 Contact Hours and Credit Hours Distribution in Eight Terms

Level/Term	Theory Contact Hours	Sessional Contact Hours	Theory Credit Hours	Sessional Credit Hours	Total Contact Hours	Total Credit Hours
L-1 T-I	14	9	14	4.5	23.0	18.5
L-1 T-II	14	9	14	4.5	23.0	18.5
L-2 T-I	14	12	14	6	26.0	20.0
L-2 T-II	14	10	14	5	24.0	19.0
L-3 T-I	17	9	17	4.5	26.0	21.5
L-3 T-II	12	17	12	9	29.0	21.0
L-4 T-I	15	12	15	6	27.0	21.0
L-4 T-II	16	9	16	4.5	25.0	20.5
Total	**116.0**	**87.0**	**116.0**	**44.0**	**203.0**	**160.0**

4.3 Final Year Design and Research Project

Final year design and research project will have to be undertaken by students under a supervisor in partial fulfillment of the requirement of his/her bachelor degree. Credits allotted to the final year design and research project will be 6.0 corresponding to 12.0 contact hours. Topic and supervisor selection of final year design and research project must be finalized within level-3, Term-II.

4.4 Term-wise Distribution of Courses

LEVEL 1, TERM-I

Course No	Course Name	Type of Course	Contact hours	Credits
EECE 101	Electrical Circuits I	Theory	3.0	3.0
PHY 101	Waves & Oscillation, Optics and Modern Physics	Theory	3.0	3.0
MATH 101	Differential and Integral Calculus	Theory	3.0	3.0
CHEM 101	Fundamentals of Chemistry	Theory	3.0	3.0
GEBS 101	Bangladesh Studies	Theory	2.0	2.0
		Subtotal (Theory)	**14.0**	**14.0**
EECE 102	Electrical Circuits and Simulation Laboratory I	Sessional	3.0	1.5
PHY 102	Physics Sessional	Sessional	3.0	1.5
CHEM 102	Chemistry Sessional	Sessional	3.0	1.5
		Subtotal (Sessional)	**9.0**	**4.5**
				Total = Contact hours: 23.0; Credits: 18.5

LEVEL 1, TERM-II

Course No	Course Name	Type of Course	Contact hours	Credits
EECE 105	Electrical Circuits II	Theory	3.0	3.0
PHY 103	Electricity & Magnetism, Thermal Physics, Quantum Mechanics & Photonics	Theory	3.0	3.0
MATH 105	Vector analysis, Matrices and Coordinate Geometry	Theory	3.0	3.0
CSE 109	Computer Programming	Theory	3.0	3.0
GES 101	Fundamentals of Sociology	Theory	2.0	2.0
		Subtotal (Theory)	**14.0**	**14.0**
EECE 106	Electrical Circuits and Simulation Laboratory II	Sessional	3.0	1.5
CSE 110	Computer Programming Laboratory	Sessional	3.0	1.5
LANG 102	Communicative English I	Sessional	3.0	1.5
		Subtotal (Sessional)	**9.0**	**4.5**
				Total = Contact hours: 23.0; Credits: 18.5

LEVEL 2, TERM-I

Course No	Course Name	Type of Course	Contact hours	Credits
EECE 201	Electronics-I	Theory	3.0	3.0
EECE 203	Electrical Machines-I/ Energy Conversion-I	Theory	3.0	3.0
ME 283	Fundamentals of Mechanical Engineering	Theory	3.0	3.0
MATH 205	Differential Equation, Laplace Transform and Fourier Transform	Theory	3.0	3.0
GEE 201	Fundamentals of Economics	Theory	2.0	2.0
		Subtotal (Theory)	**14.0**	**14.0**
EECE 202	Electronics Circuit and Simulation Laboratory I	Sessional	3.0	1.5
EECE 212	Numerical Technique Laboratory	Sessional	3.0	1.5
ME 284	Fundamentals of Mechanical Engineering Laboratory	Sessional	3.0	1.5
LANG 202	Communicative English II	Sessional	3.0	1.5
		Subtotal (Sessional)	**12.0**	**6.0**
				Total = Contact hours: 26.0; Credits: 20.0

LEVEL 2, TERM-II

Course No	Course Name	Type of course	Contact hours	Credits
EECE 205	Electrical Machines-II/ Energy Conversion-II	Theory	3.0	3.0
EECE 207	Electronics II	Theory	3.0	3.0
EECE 217	Engineering Electromagnetics	Theory	3.0	3.0
MATH 213	Complex Variable, Harmonic Function and Statistics	Theory	3.0	3.0
GELM 275	Leadership and Management	Theory	2.0	2.0
	Subtotal (Theory)		**14.0**	**14.0**
EECE 206	Electrical Machines Laboratory/ Energy Conversion Laboratory	Sessional	3.0	1.5
EECE 208	Electronics Circuit and Simulation Laboratory II	Sessional	3.0	1.5
EECE 222	Electrical Service Design and CAD Laboratory	Sessional	4.0	2.0
	Subtotal (Sessional)		**10.0**	**5.0**
	Total = Contact hours: 24.0; Credits: 19.0			

LEVEL 3, TERM-I

Course No	Course Name	Type of course	Contact hours	Credits
EECE 301	Continuous Signals and Linear Systems	Theory	3.0	3.0
EECE 303	Digital Electronics	Theory	3.0	3.0
EECE 305	Power System I	Theory	3.0	3.0
EECE 313	Electrical Measurement, Instrumentation and Sensors	Theory	3.0	3.0
EECE 315	Electrical Properties of Material	Theory	3.0	3.0
GESL 305	Environment, Sustainability and Law	Theory	2.0	2.0
	Subtotal (Theory)		**17.0**	**17.0**
EECE 304	Digital Electronics Laboratory	Sessional	3.0	1.5
EECE 306	Power System I Laboratory	Sessional	3.0	1.5
EECE 314	Electrical Measurement, Instrumentation and Sensors Laboratory	Sessional	3.0	1.5
	Subtotal (Sessional)		**9.0**	**4.5**
	Total = Contact hours : 26.0 ; Credits : 21.5			

LEVEL 3, TERM-II

Course No	Course Name	Type of course	Contact hours	Credits
EECE 309	Communication Theory I	Theory	3.0	3.0
EECE 311	Digital Signal Processing I	Theory	3.0	3.0
EECE 317	VLSI I	Theory	3.0	3.0
CSE 371	Microprocessors and Interfacing	Theory	3.0	3.0
	Subtotal (Theory)		**12.0**	**12.0**
GERM 352	Fundamentals of Research Methodology	Sessional	4.0	2.0
EECE 310	Communication Theory I Laboratory	Sessional	3.0	1.5
EECE 312	Digital Signal Processing I Laboratory	Sessional	3.0	1.5
EECE 318	VLSI I Laboratory	Sessional	3.0	1.5
CSE 372	Microprocessors and Interfacing Laboratory	Sessional	3.0	1.5
EECE 330	Industrial Training	Sessional	1.0	1.0
	Subtotal (Sessional)		**16.0+1.0 (6weeks)**	**9.0**
	Total = Contact hours : 29.0; Credits : 21.0			

EECE 330 (Industrial Training/attachment) will be conducted at any convenient time after the term end exam of Fall Term (Jul-Dec) for a duration of 6 weeks as applicable or decided by the department.

LEVEL 4, TERM-I

Course No	Course Name	Type of Course	Contact hours	Credits
EECE 401	Control System I	Theory	3.0	3.0
EECE 405	Solid State Devices	Theory	3.0	3.0
EECE 473	Power Electronics	Theory	3.0	3.0
EECE 4**	Elective I	Theory	3.0	3.0
EECE 4 **	Elective II	Theory	3.0	3.0
		Subtotal (Theory)	**15.0**	**15.0**
EECE 400	Final Year Design and Research Project		6.0	3.0
EECE 402	Control System I Laboratory	Sessional	3.0	1.5
EECE 474	Power Electronics Laboratory	Sessional	3.0	1.5
		Subtotal (Sessional)	**12.0**	**6.0**
				Total = Contact hours : 27.0; Credit hours : 21.0

LEVEL 4, TERM-II

Course No	Course Name	Type of course	Contact hours	Credits
EECE 409	Communication Theory II	Theory	3.0	3.0
GEEM 435	Engineering Ethics and Moral Philosophy	Theory	2.0	2.0
GEPM 465	Project Management and Finance	Theory	2.0	2.0
EECE 4 **	Elective III	Theory	3.0	3.0
EECE 4 **	Elective IV	Theory	3.0	3.0
EECE 4 **	Elective V	Theory	3.0	3.0
		Subtotal (Theory)	**16.0**	**16.0**
EECE 400	Final Year Design and Research Project		6.0	3.0
EECE 4 **	Elective III Laboratory	Sessional	3.0	1.5
		Subtotal (Sessional)	**9.0**	**4.5**
				Total = Contact hours : 25.0 ; Credits : 20.5

4.5 List of Elective Courses

Power

Ser. No.	Course Code	Course Name	Level	Contact Hour	Credit Hour
1	EECE 471	Power System II	4-I/ 4-II	3.0	3.0
2	EECE 475	Power Plant Engineering	4-I/ 4-II	3.0	3.0
3	EECE 477	Power System Protection	4-I/ 4-II	3.0	3.0
4	EECE 478	Power System Protection Laboratory	4-II	3.0	1.5
5	EECE 483	High Voltage Engineering	4-I/ 4-II	3.0	3.0
6	EECE 484	High Voltage Engineering Laboratory	4-II	3.0	1.5
7	EECE 479	Power System Reliability	4-I/ 4-II	3.0	3.0
8	EECE 481	Power System Operation and Control	4-I/ 4-II	3.0	3.0
9	EECE 485	Electrical Machines III / Energy Conversion III	4-I/ 4-II	3.0	3.0

Electronics

Ser.	Course Code	Course Name	Level	Contact Hour	Credit Hour
1	EECE 451	Processing and Fabrication Technology	4-I/ 4-II	3.0	3.0
2	EECE 453	Analog Integrated Circuits	4-I/ 4-II	3.0	3.0

3	EECE 455	Compound Semiconductor and Hetero-junction Devices	4-I/ 4-II	3.0	3.0
4	EECE 457	VLSI II	4-I/ 4-II	3.0	3.0
5	EECE 458	VLSI II Laboratory	4-II	3.0	1.5
6	EECE 459	Optoelectronics	4-I/ 4-II	3.0	3.0
7	EECE 461	Semiconductor Device Theory	4-I/ 4-II	3.0	3.0
8	EECE 463	Introduction to Nanotechnology	4-I/ 4-II	3.0	3.0
9	EECE 465	Semiconductor and Nano-scale Devices	4-I/ 4-II	3.0	3.0

Communication

Ser.	Course Code	Course Name	Level	Contact Hour	Credit Hour
1	EECE 403	Telecommunication Engineering	4-I/ 4-II	3.00	3.00
2	EECE 433	Microwave Engineering	4-I/ 4-II	3.00	3.00
3	EECE 434	Microwave Engineering Laboratory	4-II	3.00	1.50
4	EECE 435	Optical Fiber Communication	4-I/ 4-II	3.00	3.00
5	EECE 437	Digital Communication	4-I/ 4-II	3.00	3.00
6	EECE 438	Digital Communication Laboratory	4-II	3.00	1.50
7	EECE 439	Mobile Cellular Communication	4-I/ 4-II	3.00	3.00
8	EECE 441	Random Signals and Processes	4-I/ 4-II	3.00	3.00
9	EECE 443	Satellite Communication	4-I/ 4-II	3.00	3.00
10	EECE 444	Satellite Communication Laboratory	4-II	3.00	1.50
11	EECE 445	Communications Network	4-I/ 4-II	3.00	3.00
12	EECE 446	Communications Network Laboratory	4-II	3.00	1.50

Interdisciplinary

Ser.	Course Number	Course Name	Level	Contact Hour	Credit Hour
1	EECE 421	Control System II	4-I/ 4-II	3.00	3.00
2	EECE 422	Control System II Laboratory	4-II	3.00	1.50
3	EECE 423	Numerical Methods	4-I/ 4-II	3.00	3.00
4	EECE 424	Numerical Methods Laboratory	4-II	3.00	1.50
5	EECE 425	Biomedical Instrumentation	4-I/ 4-II	3.00	3.00
6	EECE 426	Biomedical Instrumentation Laboratory	4-II	3.00	1.50
7	EECE 429	Radar Engineering	4-I/ 4-II	3.00	3.00
8	EECE 430	Radar Engineering Laboratory	4-II	3.00	1.50
9	EECE 491	Sonar and Underwater Engineering	4-I/ 4-II	3.00	3.00
10	EECE 492	Sonar and Underwater Engineering Laboratory	4-II	3.00	1.50
11	EECE 493	Electronic Warfare	4-I/ 4-II	3.00	3.00
12	EECE 494	Electronic Warfare Laboratory	4-II	3.00	1.50
13	EECE 495	Avionics Engineering	4-I/ 4-II	3.00	3.00
14	EECE 496	Avionics Engineering Laboratory	4-II	3.00	1.50
15	EECE 497	Biomedical Signal Processing	4-I/ 4-II	3.00	3.00
16	EECE 498	Biomedical Signal Processing Laboratory	4-II	3.00	1.50
17	CSE 491	Introduction to Embedded Systems	4-I/ 4-II	3.00	3.00
18	CSE 492	Introduction to Embedded Systems Laboratory	4-II	3.00	1.50

CHAPTER 5

DESCRIPTION OF EECE DEPARTMENTAL COURSES

5.1 Core Courses Offered

5.1.1. EECE 101: Electrical Circuits I
Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code	: EECE 101	Lecture Contact Hours	: 3.00
Course Title	: Electrical Circuits I	Credit Hours	: 3.00

PRE-REQUISITE

N/A

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

It is necessary to develop a thorough understanding on fundamental concepts and principles of electrical circuits focused with a heavy laboratory component for the freshmen and sophomores of electrical engineering discipline. This understanding will in-turn enhance the students' skill that are important part of design process at a later stage. Therefore, this first course of electrical circuit is targeted to cover the laws, technics and theorems of dc electrical circuits those are essential for the students to develop appropriate problem solving strategy related to simplification of complex dc electrical circuits. In addition to linear circuits, a modest exposure to first and second order dc circuits along with their transient and steady state response has also been focused. This course is the foundation on which most other courses in the electrical engineering curriculum rest.

OBJECTIVE

1. To develop a strong foundation on characterization and operation of basic electrical components, linear circuits, first order and second order circuits.
2. To impart knowledge of basic circuit laws such as Ohm's Law and Kirchhoff's Laws and make students proficient in solving simplified linear circuits using circuit analysis techniques such as Nodal and Mesh analysis.
3. To develop students' skills of simplifying large scale linear networks into simplified circuits using basic circuit theorems such as Thevenin's Theorem and Norton's Theorem.
4. To make students adept in steady state and transient analysis of first-order circuits and provide them with a brief exposure to second-order series and parallel RLC circuits.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be proficient enough to apply basic circuit laws and **conclude** which is the most effective analysis technic to analyze and solve a simplified linear circuit	PO1	C5			1, 2	T, F
CO2	Be skilled enough to apply basic circuit theorems to **reorganize** a large-scale linear electrical network into a simplified circuit and evaluate the total power being consumed by any DC load	PO1	C6	1		2,3	T, F

	connected to the network.						
CO3	Be able to analyze first-order and second-order circuits both in presence and absence of DC sources and **evaluate** the transient and steady-state response of the circuits.	PO1	C5	1		2,3	T, Mid Term Exam, F
CO4	Be able to **design** and **create** application-specific linear/first-order/second-order circuits in order to **solve** a real life problem.	PO3	C6	1		5	ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Basic Concepts: Charge and Current, Voltage, Power and Energy, Circuit Elements, Real Life Applications of These Basic Concepts, Relevant Practice Problems

Basic Circuit Laws: Ohm's Law; Nodes, Branches and Loops; Kirchhoff's Laws, Series Resistors and Voltage Division, Parallel Resistors and Current Division, Wye-Delta Transformations, Real Life Applications based on Circuit Laws, Relevant Practice Problems

Methods of Circuit Analysis: Nodal Analysis, Nodal Analysis in Circuits with Supernodes, Mesh Analysis, Mesh Analysis in Circuits with Supermesh, Nodal and Mesh Analysis with Inspection, Real life Applications based on Circuit Analysis Technics, Practice Problems

Circuit Theorems: Linearity Property, Superposition Theorem, Source Transformation Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Real life Applications based on Circuit Theorems, Relevant Practice Problems

Capacitors and Inductors: Electrical Properties of Capacitors, Series and Parallel Capacitors, Electrical Properties of Inductors, Series and Parallel Inductors, Relevant Practice Problems

First-Order Circuits: Source-Free RC Circuits, Source-Free RL Circuits, Singularity Functions, Step Response of an RC Circuit, Step Response of an RL Circuit, Real life Applications based on First-Order Circuits, Relevant Practice Problems

Introduction to Second-Order Circuits: Source-Free Series RLC Circuits, Source-Free Parallel RLC Circuits, Step Response of a Series RLC Circuit, Step Response of a Parallel RLC Circuit, Real life Applications based on Second-Order Circuits.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient enough to apply basic circuit laws and **conclude** which is the most effective analysis technic to analyze and solve a simplified linear circuit	2											
CO2	Be skilled enough to apply basic circuit theorems to **reorganize** a large-scale linear electrical network into a simplified circuit and evaluate the total power being consumed by any DC load connected to the network.	2											

CO3	Be able to analyze first-order and second-order circuits both in presence and absence of DC sources and **evaluate** the transient and steady-state response of the circuits.	2											
CO4	Be able to **design** and **create** application-specific linear / first-order / second-order circuits in order to **solve** a real life problem.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	14
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	124

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Basic Concepts**	
Class 1	Charge and Current, Voltage, Power and Energy	
Class 2	Circuit Elements, Relevant Practice Problems	
Class 3	Real Life Applications of These Basic Concepts	
Week 2	**Basic Circuit Laws**	
Class 4	Ohm's Law; Nodes, Branches and Loops; Kirchhoff's Laws	
Class 5	Series Resistors and Voltage Division, Parallel Resistors and Current Division, Wye-Delta Transformations	CT-1
Class 6	Relevant Practice Problems and Real Life Applications based on Circuit Laws	
Week 3	**Methods of Circuit Analysis**	
Class 7	Nodal Analysis, Nodal Analysis in Circuits with Supernodes	
Class 8	Practice Problems Relevant to Nodal Analysis	
Class 9	Mesh Analysis, Mesh Analysis in Circuits with Supermesh	
Week 4	**Methods of Circuit Analysis**	
Class 10	Practice Problems Relevant to Mesh Analysis	
Class 11	Nodal and Mesh Analysis with Inspection	
Class 12	Real Life Applications based on Circuit Analysis Technics	CT-2
Week 5	**Circuit Theorems**	
Class 13	Linearity Property and Practice Problems Relevant to Linearity Property	
Class 14	Superposition Theorem	

Class 15	Practice Problems Relevant to Superposition Theorem	
Week 6	**Circuit Theorems**	
Class 16	Thevenin's Theorem	
Class 17	Practice Problems Relevant to Thevenin’s Theorem	
Class 18	Norton's Theorem	
Week 7	**Circuit Theorems**	MID
Class 19	Practice Problems Relevant to Norton’s Theorem	
Class 20	Maximum Power Transfer Theorem and Practice Problems Relevant to Norton’s Theorem	
Class 21	Real Life Applications based on Circuit Theorems	
Week 8	**Capacitors and Inductors**	
Class 22	Electrical Properties of Capacitors, Series and Parallel Capacitors	
Class 23	Electrical Properties of Inductors, Series and Parallel Inductors	
Class 24	Relevant Practice Problems	
Week 9	**First-Order Circuits**	
Class 25	Source Free RC Circuits	
Class 26	Practice Problems Relevant to Source Free RC Circuits	
Class 27	Source Free RL Circuits	
Week 10	**First-Order Circuits**	CT3
Class 28	Practice Problems Relevant to Source Free RL Circuits	
Class 29	Singularity Functions	
Class 30	Practice Problems Relevant to Singularity Functions	
Week 11	**First-Order Circuits**	
Class 31	Step Response of an RC Circuit	
Class 32	Practice Problems Relevant to Step Response of an RC Circuit	
Class 33	Real Life Applications of RC Circuits	
Week 12	**First-Order Circuits**	
Class 34	Step Response of an RL Circuit	
Class 35	Practice Problems Relevant to Step Response of an RL Circuit	
Class 36	Real Life Applications of RL Circuits	
Week 13	**Introduction to Second-Order Circuits**	
Class 37	Source Free Series RLC Circuits	
Class 38	Practice Problems Relevant to Source Free Series RLC Circuits	
Class 39	Source-Free Parallel RLC Circuits	
Week 14	**Introduction to Second-Order Circuits**	
Class 40	Practice Problems Relevant to Source Free Parallel RLC Circuits	
Class 41	Step Response of a Series RLC Circuit	
Class 42	Step Response of a Parallel RLC Circuit	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous Assessment (40%)	Class Test 1-3	20%	CO1	C5
			CO2	C6
			CO3	C5
	Assignment	5%	CO4	C6
	Attendance	5%	-	-
	Mid term	10%	CO3	C5
Final Exam		60%	CO1	C5
			CO2	C6
			CO3	C5

		CO4	C6
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. Fundamentals of Electrical Circuits -- Charles K. Alexander and Matthew N.O. Sadiku

Reference Books:

1. Introductory Circuit Analysis (10th Edition) - Robert Boylestad
2. Electric Circuits (9^{th} Edition) - James William Nilsson

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.2. EECE 102: Electrical Circuits and Simulation Laboratory -I
Level-1, Term-I (Spring)

COURSE INFORMATION

Course Code	: EECE 102	Contact Hours	: 3.00
Course Title	: Electrical Circuits and Simulation Laboratory -I	Credit Hours	: 1.50

PRE-REQUISITE

Course Code: EECE 101

Course Title: Electrical Circuits I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Engineering profession aims at implementing technology driven knowledge and applications to solve advanced problems at all aspects of human life. Therefore the first laboratory course of electrical engineering discipline aims to train students to employ basic understanding of electrical knowledge in solving real life engineering problems both at hardware and software domain. Designed for freshman students, experiments of this laboratory course will enable them to construct beginner-level circuits with understanding of established circuit laws, theorems and parametric applications along with introducing them to transient and steady state DC analysis. The basic understanding developed from these experiments will further enable them to analyse more complex electrical networks in future and design their own energy-efficient circuits adapting to specific optimized requirements.

OBJECTIVE

1. To enable the students to apply the basic circuit laws and techniques of electrical circuit analysis into real-life electrical problems.
2. To make students proficient in working with basic circuit simulation software (e.g. PSpice/Multisim) for analyzing electrical circuits and numerical software (e.g. MATLAB) for solving electrical circuits.
3. To develop student’s skill of applying basic circuit theorems to simplify complex electrical network and ensuring efficient operation.
4. To impart into students the quality of optimizing circuit characteristics by sweeping both independent and dependent circuit parameters using simulating tools.
5. To develop communication and project management skills among the students through presentation and mini projects.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **construct** electrical circuits using different types of active and passive components and follow safe electrical practices during experimentation.	PO9	P5	1			R,Q,T
CO2	Being adept in applying basic laws and techniques to design and solve real life electrical problems adapting to the specified requirements using both simulating tools and hardware.	PO5	C3,P7	1,2		6	R,Q,T
CO3	Being capable of applying basic circuit theorems to analyse large scale complex networks by simplifying them and design efficient circuit configuration adapting to the specified requirements using both simulating tools and hardware.	PO5	C4,P7	1,2		6	R,Q,T
CO4	Be able to practically design transient and steady state dc circuit parameters in order to achieve optimized circuit operation.	PO5	P7	1		6	R,Q,T

(CP- Complex Problems, CA-Complex Acti ities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to verify practically the theories and concepts learned in EECE 101 using different electrical equipment and simulation software like PSpice.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Be able to **construct** electrical circuits using different types of active and passive components and follow safe electrical practices during experimentation.									3			
CO2	Be able to **apply** basic laws and techniques to **design** and **solve** real life electrical problems adapting to the specified requirements using both simulating tools and hardware.					2							
CO3	Being capable of applying basic circuit theorems to **analyse** large scale complex networks by simplifying them and **design** efficient circuit configuration adapting to the specified requirements using both					2							

	simulating tools and hardware.												
CO4	Be able to practically **design** transient and steady state dc circuit parameters in order to achieve optimized circuit operation.					2							

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Experiment	14
Self-Directed Learning	
Preparation of Lab Reports	7
Preparation of Lab-test	6
Preparation of Quiz	7
Preparation of Presentation	6
Engagement in Group Projects	21
Formal Assessment	
Continuous Assessment	6
Final Quiz	1
Total	75

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Design Based Method

COURSE SCHEDULE

Week 1	Introduction to Safe Electrical Practices and Construction, Operation and Simulation of Simple Electrical Circuits using Hardware implementation and PSPICE/ Multisim (Remarks: Must Do)
Week 2	Application and Implication of Basic Circuit Laws and Techniques in Real Life Engineering Problems using Hardware implementation and PSPICE/ Multisim/ MATLAB (Remarks: Must Do)
Week 3	Application of Superposition Theorem in Real Life Electrical Problems using Hardware implementation and PSPICE/Multisim/ MATLAB (Remarks: Must Do)
Week 4	Application of Basic Circuit Theorems in Circuit Simplification and Achieving Efficient Operation using Hardware implementation and PSPICE/Multisim/MATLAB (Remarks: Must Do)
Week 5	Review
Week 6	Lab Test-1
Week 7	Analysing Circuits with Dependent Sources using PSPICE/Multisim (Remarks: Must Do)
Week 8	Application of Circuit Parameter Sweeping for Achieving Optimization (Remarks: Should Do)
Week 9	Application of Transient and steady state DC Systems for Solving Real Life Engineering Problems using PSPICE/Multisim/ MATLAB (Remarks: Should Do)
Week 10	Review
Week 11	Lab Test-2
Week 12	Lab Quiz
Week 13	Presentation on Assigned Problems
Week 14	Project Demonstration

ASSESSMENT STRATEGY				
Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	30%	CO1	P5
			CO2	C3,P7
			CO3	C4, P7
			CO4	P7
	Labtest-1 Labtest-2	40%	CO1	P5
			CO2	C3,P7
			CO3	C4, P7
			CO4	P7
Lab Quiz		30%	CO1	P5
			CO2	C3,P7
			CO3	C4, P7
			CO4	P7
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. Fundamentals of Electrical Circuits –Alexander & Sadiku (4^{th} Edition)

Reference Books:

1. Introductory Circuit Analysis(10th Edition)- Robert Boylestad

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.3. EECE 105: Electrical Circuits II
Level-1, Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 105	Lecture Contact Hours	: 3.00
Course Title	: Electrical Circuits II	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 101	Course Code: MATH 101	Course Code: MATH 105
Course Title: Electrical Circuits I	Course Title: Differential and Integral Calculus	Course Title: Vector analysis, Matrices and Cordinate Geometry

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Being one of the fundamental requirements for freshmen electrical engineering students, the course focuses on the analysis of alternating current circuits. It exploits areas like phasors, ac power, poly phase circuits, magnetically coupled circuits, frequency responses, passive filters etc. Although the course is designed particularly keeping in mind engineering students but in general it can also be used by practising engineers to somewhat understand the rudimentary notions behind certain realistic applications. The aim of the course is to make students skilled in handling ac circuits at a theoretical, and to some extent a practical level.

OBJECTIVE

1. **Impart** basic knowledge on steady-state response of circuits to sinusoidal inputs using phasor representation.

2. **Familiarize** students with basic Circuit laws (Ohm, Kirchhoff), techniques (Mesh, Nodal), concepts (Superposition, Source Transformation) and theorems (Thevenin, Norton). **3.** **Introduce** the definition and derivation of AC power (Average power, Instantaneous power) along with other power concepts (Power factor, Complex power, maximum average power transfer). 4. **Impart** knowledge of AC power conservation and measurements to be applied in practical field. 5. **Impart** in depth knowledge of balanced and unbalanced 3 phase circuits, their analysis and configurations (Y, Δ). 6. **Articulate** the concepts of magnetically coupled circuits (mutual inductance, dot convention) and introduce the idea of transformers. 7. **Familiarize** students with frequency response for a constant sinusoidal excitation and impart the knowledge of resonant circuits (Resonance, quality factor, bandwidth, cut-off frequency) 8. **Introduce** non-sinusoidal excitations in AC circuit and their analysis by Fourier series (Trigonometric and Exponential). 9. **Discuss** different types of filter and their characterization concepts (Fourier series, resonance, etc.)

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Manage to outline sinusoids and phasors in **explaining** circuit parameters like impedance and admittance.	PO1	C2			1	F, T
CO2	Capable to recall circuit laws and **apply** their corresponding technique to find AC quantities (Voltage and Current); also select particular circuit concept(s) and theorem(s) for simplifying complex circuits also be competent in comprehending AC power	PO1	C3			3	MT, T
CO3	Able to use the concept of mutual inductance and dot convention for solving inductively coupled circuits and **illustrate** the idea of isolating Transformer and impedance matching device.	PO1	C4	P1		3	MT
CO4	Be adept in **analyzing** various filters that uses passive elements basing on the knowledge of resonant circuits, bandwidth, and quality factor; and to interpret filter characteristics using exponential and trigonometric Fourier series.	PO3	C4	P1		5	F, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Sinusoidal functions: Instantaneous current, voltage, power, effective current and voltage, average power, phasors and complex quantities, impedance, real and reactive power, power factor.

Analysis of single-phase ac circuits: Series and parallel RL, RC and RLC circuits, nodal and mesh analysis, application of network theorems in ac circuits. Circuits with non-sinusoidal excitations, transients in ac circuits, passive filters, magnetically coupled circuits.

Resonance in ac circuits: Series and parallel resonance.

Analysis of three phase circuits: Three phase supply, balanced and unbalanced circuits, power calculation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Manage to outline sinusoids and phasors in **explaining** circuit parameters like impedance and admittance.	3											
CO2	Capable to recall circuit laws and **apply** their corresponding technique to find AC quantities (Voltage and Current); also select particular circuit concept(s) and theorem(s) for simplifying complex circuits also be competent in comprehending AC power	3											
CO3	Able to use the concept of mutual inductance and dot convention for solving inductively coupled circuits and **illustrate** the idea of isolating Transformer and impedance matching device.	3											
CO4	Be adept in **analyzing** various filters that uses passive elements basing on the knowledge of resonant circuits, bandwidth, and quality factor; and to interpret filter characteristics using exponential and trigonometric Fourier series.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of previous and (or) subsequent lecture at home	21
Preparation for final Exam	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	**Sinusoids and Circuit Variables**	CT-1
Class 1	Introduction time varying sinusoid excitations	
Class 2	Basic idea about ideal sources (independent and dependent)	
Class 3	Linear passive parameters R, L and C, Kirchoff's Laws.	
Week 2	**Phasor Algebra**	
Class 4	Introduction: Concept of phasor and complex impedance / admittance	
Class 5	Introduction: Concept of phasor and complex impedance / admittance	
Class 6	Solution of simple series and parallel circuits	
Week 3	**Circuit Analysis Concepts**	
Class 7	Math problems related to Source transformation	
Class 8	Theoretical derivation of star/delta transformation	
Class 9	Math Problems related to star/delta transformation	
Week 4	**Circuit Analysis Concepts**	CT-2
Class 10	Analysis of series and parallel circuits	
Class 11	Network reduction; voltage and current division	
Class 12	Basic idea about Source transformation	
Week 5	**Circuit Topology**	
Class 13	Tie-set and Cut- set schedules	
Class 14	Formulation of equilibrium equations in matrix form	
Class 15	Solution of resistive networks	
Week 6	**Variable Impedance Load**	
Class 16	Maximum power transfer theorems for variable resistance load	
Class 17	Variable impedance load– Statement and applications	
Class 18	Introduction: Graph of a network, Concept of tree and co-tree, incidence matrix	
Week 7	**Node and Mesh Analysis**	
Class 19	Problems on Node analysis	
Class 20	Problems on Mesh analysis	
Class 21	Assorted problems on node and mesh analysis	
Week 8	**Network Theorem**	Mid
Class 22	Reciprocity Theorem	
Class 23	Superposition Theorem	
Class 24	Thevenin and Norton's Theorem	
Week 9	**AC Power**	
Class 25	Introduction to Instantaneous power and Average power	
Class 26	Power factor, complex power, power triangle, maximum average power	
Class 27	AC power measurement and power conservation.	
Week 10	**Poly phase Circuits**	
Class 28	Balanced Poly phase Circuits, Voltage current relations and power measurement.	
Class 29	Unbalanced poly phase circuit, power measurement and faults analysis	
Class 30	Assorted problems on poly phase circuits	
Week 11	**Magnetically Coupled circuit and Frequency response**	
Class 31	Inductively coupled circuit, mutual inductance, dot-convention, coupling co-efficient and transformer design	
Class 32	Problems on Magnetically coupled circuits	
Class 33	Frequency Response of RL, RC and RLC circuits	

Week 12	Frequency Response	
Class 34	Resonance in series circuits and the behavior of series resonant circuit	CT-3
Class 35	Q factor, half-power frequencies and bandwidth of resonant circuits. And problem solving	
Class 36	Magnitude and frequency scaling and bode plot	
Week 13	**Non-Sinusoidal waves, Fourier series analysis and Transient Analysis**	
Class 37	Non-sinusoidal waves, Trigonometric and Exponential Fourier series	
Class 38	Damped Frequency, Damping Factor and Logarithmic Decrement	
Class 39	Transient response of RL,RC and RLC series and parallel circuits free response – step and sinusoidal responses	
Week 14	**Passive Filters**	
Class 40	Types of Filters, construction, gains, characteristics.	
Class 41	Filter design using harmonics and Fourier series.	
Class 42	Open Discussion	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C3
			CO4	C4
	Class Participation	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C3
			CO3	C4
Final Exam		60%	CO 1	C2
			CO 2	C3
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Alternating Current Circuits by G. S. Corcoran & R. F. Kerchner
2. Fundamentals of Electric Circuit by C. K. Alexander & M. N. Sadiku
3. Introductory Circuit Analysis by R. L. Boylsted
4. Electric Circuits by J. A. Edminister
5. Basic Engineering Circuit Analysis by J. D. Irwin & R. M. Nelms

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.4. EECE 106: Electrical Circuits and Simulation Laboratory-II
Level-1, Term-II (Fall)

COURSE INFORMATION			
Course Code	: EECE 106	Contact Hours	: 3.00
Course Title	: Electrical Circuits and Simulation Laboratory II	Credit Hours	: 1.50

PRE-REQUISITE

Course Code: EECE 105
Course Title: Electrical Circuits II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
Based on the practical aspects of EECE 105, the course essentially concentrates upon a hands-on approach in dealing with theories of AC circuits. The goal is designing and recreating circuits from EECE 105 in order to understand their behaviors in real life scenarios by use of hardware's, certain circuit simulation softwares and numerical computation softwares. Emphasis on designing small scale projects involving applications of AC circuit is given in the course, to give students the flavor of our several everyday engineering schemes.

OBJECTIVE

1. **Familiarize** students with hardware for the construction and operation of AC circuit and **acquaint** with circuit simulation softwares (PSpice, Proteus) for their simulations.
2. **Instill** the ability to determine AC quantities (Voltage, Current, Power) using basic circuit laws and corresponding techniques practically for various AC excitations.
3. **Develop** the quality of constructing and optimizing frequency responsive circuit that can be applied in real life engineering problems.
4. **Encourage** the capability of realizing Steady-state and transient analysis of ac circuits encountered real life situations through simulations.
5. **Impart** into students the ability to model 3 phase circuits and magnetically coupled circuits using circuit simulation softwares.
6. **Develop** team spirit, communication and managerial capabilities through designing small scaled projects and their presentations.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Construct** RLC circuits and shows expertise in using circuit laws and technique to detect AC parameters (voltage, current, power).	PO4	P4	1		8	R, Q, T, Pr, PR
CO2	Reproduce real world circuits building on the concepts of resonance, also describe and **manipulate** frequency responses of passive filter circuits via simulations.	PO4	P4	1,2		8	R, Q, T, Pr, PR
CO3	**Perform** steady-state and transient analysis for various constraints of ac circuits and conform the best case scenario of circuit operation.	PO5	A2	1		6	R, Q, T, Pr, PR
CO4	**Illustrate** 3 phase circuit and magnetically coupled circuit through simulation and **explain** their behaviours in actuality.	PO5	C4, A3	1		6	R, Q, T, Pr, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to verify practically the theories and concepts learned in EECE 105 using different electrical equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Construct** RLC circuits and shows expertise in using circuit laws and technique to detect AC parameters (voltage, current, power).				2								
CO2	Reproduce real world circuits building on the concepts of resonance, also describe and **manipulate** frequency responses of passive filter circuits via simulations.				2								
CO3	**Perform** steady-state and transient analysis for various constraints of ac circuits and conform the best case scenario of circuit operation.					3							
CO4	**Illustrate** 3 phase circuit and magnetically coupled circuit through simulation besides **explain** their behaviours in actuality.					3							

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Experiment	28
Self-Directed Learning	
Preparation of Lab Reports	30
Preparation of Lab-test	4
Preparation of Quiz	5
Preparation of Presentation	5
Engagement in Group Projects	24
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	121

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Familiarization with equipment (Oscilloscope, Function Generator) and simulation soft wares (PSpice and Proteus); along laboratory etiquettes and safety.
Week 2	Study the properties and values of Alternating Current waveforms (Sinusoids, saw tooth, triangular and square) using hard ware and their implementation using soft wares.

Week 3 **Week 4**	Study of series and parallel RLC circuit to verify circuit laws and techniques in real life applications, in addition observing the changes in AC quantities (Voltage, Current and Power) by means of Phasor and their verification using soft wares like PSpice and Proteus.
Week 5 **Week 6**	Construction of Tuning Circuit and Wave Traps using the concepts of series and parallel resonance using hard wares and exploring their characteristics using soft wares
Week 7 **Week 8**	Familiarization of various passive filter characteristics using hard wares and its frequency response and implementations using PSpice, Proteus
Week 9	Study of Steady-state analysis and transient analysis of AC circuits using PSpice.
Week 10	Implementation and application of 3 phase circuits and Magnetically coupled circuits by means of PSpice in solving real life engineering problems.
Week 11	Open discussion, Review and Practice Lab
Week 12	Lab Test
Week 13	Lab Quiz
Week 14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Participation and Report	20%	CO 1	P4
			CO 2	P4
			CO 3	A2
			CO4	C4, A3
	Lab Test	30%	CO 1	P4
			CO 2	P4
			CO 3	A2
			CO 4	C4, A3
	Project and Presentation	25%	CO 1	P4
			CO 2	P4
			CO 3	A2
			CO 4	C4, A3
Lab Quiz		25%	CO 1	P4
			CO 2	P4
			CO 3	A2
			CO 4	C4, A3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Fundamentals of Electrical Circuits –Alexander & Sadiku (4th Edition)
2. Introductory Circuit Analysis by R. L. Boylsted
3. Basic Engineering Circuit Analysis by J. D. Irwin & R. M. Nelms

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.5. EECE 201: Electronics-I
Level-2, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 201 : Electronics-I	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE 101 Course Title: Electrical Circuits I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To teach the students the concepts, principles and working of basic electronic circuits (Diodes, BJTs, JFETs and MOSFETs). It is targeted to provide a basic foundation for technology areas like electronics devices (rectifiers, voltage regulators and amplifiers), communication systems, industrial electronics as well as instrumentation, control systems and various electronic circuit design. Finally, this course is designed to develop a designing capability involving real life practical problems.			
OBJECTIVE			
1. Be able to impart basic knowledge on the physics of semiconductor along with the types, specification and standard values of passive and active components of electronic circuits. 2. Achieving ability to familiarize the students with the working principle of semiconductor devices (Diodes, BJTs, JFETs and MOSFETs) as electronic circuit elements and ICs. 3. Be proficient to familiarize with basic electronic circuits (rectifiers, voltage regulators and amplifiers), their working principles, design criteria and system components. 4. Be expert in imparting in depth knowledge on the hybrid parameters of electronic circuits and thereby enable students design complex electronic circuits.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **recall** and **infer** the physics of semiconductor devices and the operation of different electronic components for strengthening fundamental idea about basic electronics.	PO1	C2	1		1, 3	T, F
CO2	Be expert in comparing the input and output characteristics of different electronic components.	PO1	C4	1		3	T, Mid Term Exam, F
CO3	Be proficient to analyse basic electronic circuits considering existing system models to explore practical complex engineering problems.	PO1	C4	1, 3		3	Mid Term Exam, F, ASG
CO4	Be skilful to design various electronic circuits using both passive and active components to solve the real-life engineering problems.	PO3	C6	1		5	ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode, simplified dc and ac diode models, dynamic resistance and capacitance.

Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a zener diode, zener shunt regulator, clamping and clipping circuits.

Bipolar junction transistor (BJT) as a circuit element: Bipolar junction transistor current components, BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch. Single stage mid-band frequency

BJT amplifier circuits: Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits.

Metal-oxide-semiconductor field-effect-transistor (MOSFET) as circuit element: Structure and physical operation of an enhancement MOSFET, threshold voltage, Body effect, current-voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.

Junction field-effect-transistor (JFET): Structure and physical operation of JFET, transistor characteristics, and pinch-off voltage. Differential and multistage amplifiers: Description of differential amplifiers, small-signal operation, differential and common mode gains, RC coupled mid-band frequency amplifier.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **infer/illustrate** the physics of semiconductor devices and the operation of different electronic components for strengthening fundamental idea about basic electronics.	3											
CO2	Be able to **compare** the input and output characteristics of different electronic components.	3											
CO3	Be able to **analyse** basic electronic circuits considering existing system models to explore practical complex engineering problems.	3											
CO4	Be able to **design** various electronic circuits using both passive and active components to solve the real-life engineering problems.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	42

Non-face-to-face learning	21
Revision of the previous lecture at home	21
Preparation for final examination	
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Electronics (Must know)**	CT 1
Class 1	Basic idea about Electronics	
Class 2	Examples of electronic devices and comparison with electrical equipment.	
Class 3	Introduction to semiconductor devices and its classifications	
Week 2	**Semiconductor diodes (Must know)**	
Class 4	P-type and N-type materials and doping	
Class 5	Semiconductor diode and its band diagram	
Class 6	Biasing of semiconductor diodes	
Week 3	**Characteristics and application of diode (Must know)**	
Class 7	I-V characteristics of diode and equivalent circuit of diodes, Shockley's equation and related mathematical problems	
Class 8	Zener diode and related numerical problems of zener diode	
Class 9	Applications of diode	
Week 4	**Diode Rectifier (Must know)**	CT 2
Class 10	Diode rectifiers	
Class 11	Ripple factor and related mathematical problems.	
Class 12	Clipper circuit and related problems	
Week 5	**Application of diode circuits (Must know)**	
Class 13	Clamper circuit and related problems	
Class 14	Diodes in voltage multiplier circuit	
Class 15	Voltage doubler, tripler and quadrupler circuit	
Week 6	**Introduction to Bipolar Junction Transistor (Must know)**	
Class 16	Introduction to BJT and construction	
Class 17	Working principle and operating regions of BJT	
Class 18	CB, CE and CC configurations and characteristics curves	
Week 7	**Configurations and biasing of BJT (Must know)**	Mid Term
Class 19	Mathematical problems related to different configurations using BJT	
Class 20	BJT Biasing	
Class 21	Mathematical problems related to BJT biasing	
Week 8	**BJT as amplifier and switch (Must know)**	
Class 22	BJT as an amplifier, biasing the BJT for discrete circuits	
Class 23	small signal equivalent circuit models, BJT as a switch	
Class 24	Voltage and current gain, input and output impedance of a common	

	base, common emitter and common collector amplifier circuits	
Week 9	**Introduction to Field Effect Transistor (Must know)**	
Class 25	Introduction to FET and comparative studies between BJT and FET	
Class 26	Construction and operation of JFET	
Class 27	Drain characteristics and Transfer characteristics	
Week 10	**Basics and mathematical problems of JFET**	CT 4
Class 28	Pinch off and pinch off voltage	
Class 29	Mathematical problems related to JFET	
Class 30	Mathematical problems related to JFET (Cont.)	
Week 11	**Metal Oxide Semiconductor Field Effect Transistor (Must know)**	
Class 31	Introduction to MOSFET	
Class 32	Construction of MOSFET	
Class 33	Operating principle of MOSFET	
Week 12	**Types of MOSFET (Must know)**	
Class 34	Types of MOSFET	
Class 35	Construction and operating principle of depletion type MOSFET	
Class 36	Construction and operating principle of enhancement type MOSFET	
Week 13	**Biasing of MOSFET (Must know)**	
Class 37	Characteristic curves of MOSFET	
Class 38	Biasing of MOSFET and related problems	
Class 39	Biasing of MOSFET and related problems (Cont.)	
Week 14	**MOSFET as amplifier, switch and CMOS inverter (Must know)**	
Class 40	Threshold voltage, Body effect, current- voltage characteristics of an enhancement MOSFET	
Class 41	Single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter	
Class 42	Review Class.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C4
	Class Participation	5%	CO 4	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO 2	C4
			CO 3	C4
Final Exam		60%	CO 1	C2
			CO 2	C4
			CO 3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electronic Device and Circuit Theory by Robert L. Boylestad
2. Microelectronic circuit by Sedra Smith
3. Electronic Devices Circuits by Millman and Halkias

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.6. EECE 202: Electronics Circuits and Simulation Laboratory-I
Level-2, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 202 : Electronics Circuits and Simulation Laboratory -I	Lecture Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
Course Code: EECE 201 Course Title: Electronics I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Electronics Circuits and Simulation Laboratoty I is designed to teach the students about the concepts, principles and working of basic electronic devices and circuits by hand-held experiments as well as enabling them well acquainted with the computer aided simulation tool. With the completion of each experiments, student will gradually develop the ability to analyze and design electronic circuits. It is expected that, student will formulate the expertise obtained from this laboratory tasks not only for upcoming higher laboratory courses but also in their future professional engineering practice.			
OBJECTIVE			
1. To enable the students to be familiarized and implement different semiconductor diode circuits (e.g. rectifier, regulator, clipper, clamper), their output characteristics and their practical implication in real life. 2. To familiarize the students with input and output characteristics of different BJTs, FETs and also the operation of each device in terms of junction bias voltage and charge carrier movement. 3. To introduce the students with the use of circuit simulation software (e.g. OrCAD Capture/ PSpice Schematics/ Proteus) in analyzing electronic circuits and thereby enrich their skills in designing various complex electronic circuits. 4. To develop communication as well as project management skills among the students through presentation and group projects.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Achieving ability to **construct** simple electronic circuits using various types of passive and active components.	PO5	P5			6	R,Q,T
CO2	Developing capability to **compare** the input and output characteristics of different electronic component obtained by both simulations and hand-held experiments.	PO5	C5, P1	1		6	R,Q,T
CO3	Becoming proficient in **interpreting** the behaviour of FET with different configurations and **design** electronic circuits **adapting** to the specified requirements using both simulating tools and hardware.	PO5	C2, P7	1,2		6	R,Q,T

CO4	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	PO9	A4		A1		PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 201 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Achieving ability to **construct** simple electronic circuits using various types of passive and active components.					2							
CO2	Developing capability to **compare** the input and output characteristics of different electronic component obtained by both simulations and hand-held experiments.					2							
CO3	Becoming proficient in **interpreting** the behaviour of FET with different configurations and **design** electronic circuits **adapting** to the specified requirements using both simulating tools and hardware.					2							
CO4	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.									3			

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-directed learning	
Preparation for lab reports	24
Preparation for lab test	6
Preparation of quiz	6
Preparation of presentation	5
Engagement in group project	26
Formal Assessment	
Continuous assessment	10
Final Quiz	1
Total	120

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week 1	Introductory Session on familiarization of basic electronic components, laboratory norms and safety measures.
Week 2	Study of Diode Characteristics using Hardware implementation and OrCAD Capture/ PSpice Schematics/ Proteus for solving complex electronic network problem.
Week 3	Implementation of Diode Rectifier Circuits and study their rectification characteristics for real life engineering problem using Hardware implementation and OrCAD Capture/ PSpice Schematics/ Proteus.
Week 4	Construction of n-p-n CB (common base) and n-p-n CE (common emitter) transistor and determine their input and output characteristics using Hardware implementation and OrCAD Capture/ PSpice Schematic/ Proteus.
Week 5	Determine the Characteristics of Bipolar Junction Transistor (BJT) in terms of Biasing using Hardware implementation and OrCAD Capture/ PSpice Schematic/ Proteus.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Applications of Cascaded and Feedback Amplifier Circuits using BJT and Determine their Voltage and Current Gain.
Week 9	Study of Characteristics of Field Effect Transistor (FET) and its Application in CMOS Inverter
Week 10	Performance Analysis of Common Source (CS) and Common Drain (CD) JFET Small Signal Amplifier
Week 11	Determine the Frequency Response of an Integrated Circuit MOS amplifier.
Week 12	Review & Practice Lab-2
Week 13	Lab Test-2
Week 14	Lab Quiz, Project Presentation

<table>
<tr><th colspan="5">ASSESEMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="7">Continuous Assessment (40%)</td><td rowspan="3">Lab participation and Report</td><td rowspan="3">20%</td><td>CO1</td><td>P5</td></tr>
<tr><td>CO2</td><td>C5, P1</td></tr>
<tr><td>CO3</td><td>C2, P7</td></tr>
<tr><td rowspan="3">Labtest-1,Labtest-2</td><td rowspan="3">30%</td><td>CO1</td><td>P5</td></tr>
<tr><td>CO2</td><td>C5, P1</td></tr>
<tr><td>CO3</td><td>C2, P7</td></tr>
<tr><td>Project and Presentation</td><td>25%</td><td>CO4</td><td>A4</td></tr>
<tr><td colspan="2" rowspan="3">Lab Quiz</td><td rowspan="3">25%</td><td>CO1</td><td>P5</td></tr>
<tr><td>CO2</td><td>C5, P1</td></tr>
<tr><td>CO3</td><td>C2, P7</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

TEXT AND REFERENCE BOOKS
1) Electronic Device and Circuit Theory by Robert L. Boylestad 2) Introduction to PSpice Using OrCAD by Muhammad. H. Rashid

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.7. EECE 203: Energy Conversion I
Level-2, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 203 : Energy Conversion I	Contact Hours Credit Hours	:3.00 :3.00
PRE-REQUISITE			
Course Code: EECE 101, EECE 105 Course Title: Electrical Circuits I, Electrical Circuits II			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Energy Conversion I is a basic course to acquire knowledge on electro mechanical energy conversion by electrical machines, their constructions, operating principles, characteristics and applications. Students will be able to exemplify the concepts on energy conversion by renewable energy sources and their impact on our environment as an alternative to the nonrenewable sources and supplementary sources in smart grid.			
OBJECTIVE			
1. To convey basic knowledge of electromagnetic induction in different electrical machineries. 2. To appraise the operating principle and constructional details of electrical machines like transformer, motor, generator. 3. To demonstrate the performance indicating parameters of electrical machines and develop understanding on practical use of electrical machines at social and economic context.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Attaining proficiency in **describing** the physics of electromagnetic induction and constructions and operating principles of different Electrical Machines to **infer** the fundamental ideas about common energy conversion devices.	PO1	C2			3	T, Midterm, F
CO2	Gaining ability to **develop** equivalent circuits**, compare** vector diagrams and torque speed characteristics of different electrical machineries.	PO3	C4		1	5	T, Midterm, F
CO3	Be able to **demonstrate** the concepts of renewable energy, their environmental impacts, advantages and conversion to electrical energy to solve the real life engineering problems.	PO1	C2		1	3	F,ASG
CO4	Developing potential in **analysing** the uses of starter circuits and control circuits of different electrical machines.	PO1	C4	2,3	1	3	F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Energy Conversion: Review of law of energy conversions, electro-mechanical energy conversions.

DC generator: Construction, winding, types of losses, no-load voltage characteristics, build-up of a self excited shunt generator, critical field resistance, load-voltage characteristic, effect of speed on no-load and load characteristics, voltage regulation, armature reaction and commutation.

DC motor: Torque, counter emf, rotational speed, torque-speed characteristics, starting and speed control, regulation, braking, bio gas systems.

Transformer: Principle, construction of ideal transformer, practical transformer, transformation ratio, no-load and load vector diagrams; actual transformer's equivalent circuit, regulation, short circuit and open circuit tests, parallel operation of transformers, auto transformer, instrument transformers, 3- phase transformers, different connection and their applications.

Renewable energy: Introduction to wind turbine generators and solar cells.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Attaining proficiency in **describing** the physics of electromagnetic induction and constructions and operating principles of different Electrical Machines to **infer** the fundamental ideas about common energy conversion devices.	3											
CO2	Gaining ability to **develop** equivalent circuits**, compare** vector diagrams and torque speed characteristics of different electrical machineries.			2									
CO3	Be able to **demonstrate** the concepts of renewable energy, their environmental impacts, advantages and conversion to electrical energy to solve the real life engineering problems.	3											
CO4	Developing potential in **analysing** the uses of starter circuits and control circuits of different electrical machines.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	
Self-Directed Learning	-
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method		
COURSE SCHEDULE		
Week 1	**DC Generator**	**CT 1**
Class 1	Basic idea about energy conversion, conversion by electrical machines	
Class 2	Introduction to DC generator and its principle of operation	
Class 3	Commutation principle and slip rings	
Week 2	**DC Generator (Cont.)**	
Class 4	Types, construction of DC generator and its different parts	
Class 5	Lap winding and wave winding and its comparison	
Class 6	Emf equation of DC generator and related mathematical problems.	
Week 3	**DC Generator (Cont.)**	**CT 2**
Class 7	Mathematical problems of series-shunt configurations	
Class 8	Losses in DC generator and efficiency calculation	
Class 9	Power stages, maximum efficiency	
Week 4	**DC Generator (Cont.)**	
Class 10	Armature reaction of DC generator	
Class 11	Commutations	
Class 12	Critical field resistance, load-voltage characteristic	
Week 5	**DC Generator (Cont.)**	
Class 13	Effect of speed on no-load and load characteristics and voltage regulation	
Class 14	O.C.C and S.C.C basics and related mathematical problems	
Class 15	Mathematical problems(Cont.)	
Week 6	**DC Motor**	
Class 16	Introduction to DC motor	
Class 17	Construction and operating principle	
Class 18	Flemings right hand rule, left hand rule, lentz's law, conversion of energy	
Week 7	**DC Motor (Cont.)**	**Mid Term**
Class 19	Differences between energy conversion in DC generator and DC motor	
Class 20	Equivalent circuits of DC motor	
Class 21	Back emf and related equations for DC motor	
Week 8	**DC Motor (Cont.)**	
Class 22	Torque –speed characteristics of DC motor	
Class 23	Different types of motor and their operating principles	
Class 24	Different types of motors' characteristics	
Week 9	**DC Motor (Cont.)**	
Class 25	Losses in DC motor	
Class 26	Loss related mathematical problems	
Class 27	Loss related mathematical problems (Cont.)	
Week 10	**DC Motor (Cont.)**	**CT-3**
Class 28	DC Motor Starter Circuit Analysis	
	Transformer	
Class 29	Introduction to Transformer and its principle of operations, types of transformer and ideal characteristics	
Class 30	Equivalent circuit of Transformer	

Week 11	**Transformer (Cont.)**	
Class 31	Vector diagrams of transformer under different conditions	
Class 32	Mathematical problems of Transformer	
Class 33	Losses in transformer and their explanations	
Week 12	**Transformer (Cont.)**	
Class 34	Efficiency calculation and condition for maximum efficiency and mathematical problems	
Class 35	Short circuit test and open circuit test of transformer	
Class 36	Regulation of transformer and related problems	
Week 13	**Transformer (Cont.)**	
Class 37	Parallel operation of transformer	
Class 38	Auto transformer , Instrument transformers	
	Renewable Energy	
Class 39	Introduction to Renewable energy	
Week 14		
Class 40	Solar cell, solar PV system	

ASSESMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C4
	Class Participation	5%	CO3	C2
	Class Attendance	5%	-	-
	Mid term	10%	CO1	C2
			CO2	C4
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C2,
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electrical Machinery Fundamentals- Stephen J Chapman
2. A Textbook of Electrical Technology - B.L Theraja
3. Electrical machines- Samarjit Ghosh.
4. Electrical machinery and Transformer – Irving L. Kosow.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.8. EECE 205: Energy Conversion II

Level-2, Term-II (Fall)

COURSE INFORMATION			
Course Code	: EECE-205	Contact Hours	: 3.00
Course Title	: Electrical Conversion II	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 203
Course Title: Electrical Machines-I

CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To develop a strong foundation in the basic operating principle, constructions, characteristic features, applications etc. of AC electrical machinery like synchronous generator, synchronous motor and three phase and single-phase induction motors and special motors. The emphasis has been given on both physical insight and analytical techniques. The subject material covered here will provide the basis for understanding many real-world electric machinery applications as well as the foundation for advanced courses in electric machinery design and control.
OBJECTIVE
1. To develop a strong foundation on AC electrical machines (synchronous machines, induction machines, universal machines etc) with a special focus on operating principle, identification of parts and accessories, constructional features, types etc. 2. Be able to investigate and analyse characteristic features of such machines like modelling of equivalent circuit, estimations of regulations and efficiency, input and output relationships and other design features. 3. To have a concept on special operations of AC machines like synchronizing of generators, induction motor as generator, synchronous motor as synchronous condenser, reverse rotation of 1-phase induction motor etc. 4. To develop a broad idea on application of machines in practical industrial and domestic field.
COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the principle of operation, explain the construction, classify as per construction or operation of the ac machines like synchronous machines, induction motors and special type motors.	PO1	C2			1	T, F
CO2	Be capable to **interpret** and **analyse** the design features and **evaluate** the characteristics of such machines.	PO1	C5	1		3	T, Mid Term Exam, F
CO3	Be able to **explain** behaviours during special operations of ac machines and **justify** their performance.	PO1	C5	1, 2	2	3	Mid Term Exam, F, ASG
CO4	Be able to **discover** appropriate applications and **select** proper ac machines in practical situation.	PO3	C3	2		5	ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)
COURSE CONTENT
Synchronous generator: Excitation System, Equivalent Circuit, Vector diagram at different loads, factor affecting voltage regulation, synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations, parallel operation, necessary conditions, synchronizing of alternators, circulating current and vector diagram. **Parallel operation:** Synchronizing of alternator, Necessary conditions, circulating current, synchronizing power and vector diagram, alternator connected to infinite bus, synchronizing torque, effect of change in excitation, mechanical input upon synchronizing, effect of load on synchronizing power, effect of unequal voltages. **Synchronous motor**: Operation, Effect of loading under different excitation condition, effect of changing excitation, V-curves, synchronous capacitors, starting, applications

3-Phase Induction Motor: construction, Rotating Magnetic Field, Rotor Rotation, slip, frequency of rotor current, Starting and running torque, Torque-speed characteristics, equivalent circuit, induction motor as induction generator, motor starters, speed control
1-Phase Induction Motor: Construction, double field revolving theory, starting method, torque-speed characteristics, equivalent circuit, capacitor start and run motors, reverse rotation, applications. special types of motors. split phase motors and universal motor.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the principle of operation, explain the construction, classify as per construction or operation of the ac machines like synchronous machines, induction motors and special type motors.	3											
CO2	Be capable to **interpret** and **analyse** the design features and **evaluate** the characteristics of such machines.	3											
CO3	Be able to **explain** behaviours during special operations of ac machines and **justify** their performance.	3											
CO4	Be able to **discover** appropriate applications and **select** proper ac machines in practical situation.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Synchronous Generator**
Class 1	Operating principle, construction, types of rotor, damper winding, speed and frequency
Class 2	Armature windings, pitch factor, distribution or breadth factor.
Class 3	Equation of induced emf, equivalent circuit of synchronous generator, factors affecting alternator size.

Week 2	**Synchronous Generator (Cont'd)**	CT-1
Class 4	Alternator on load, types of load	
Class 5	Synchronous reactance, vector diagram of a loaded alternator.	
Class 6	Voltage regulation, factors affecting voltage regulation, determination of voltage regulation.	
Week 3	**Synchronous Generator (Cont'd)**	
Class 7	Synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations.	
Class 8	Losses in alternator, power developed by a synchronous generator.	
Class 9	Mathematical problems	
Week 4	**Parallel operation of Synchronous Generator**	CT-2
Class 10	Synchronizing of alternator, necessary conditions for parallel operation, circulating current.	
Class 11	Synchronizing power and vector diagram. alternator connected to infinite bus, synchronizing torque.	
Class 12	Effect of change in excitation, mechanical input upon synchronizing, effect of load on synchronizing power, effect of unequal voltages.	
Week 5	**Synchronous motor**	
Class 13	Principle of operation, construction, method of starting	
Class 14	Motor on load with constant excitation, load angle	
Class 15	Power flow within a synchronous motor, motor losses.	
Week 6	**Synchronous motor (Cont'd)**	
Class 16	Equivalent circuit and vector diagrams of synchronous motor, power developed by a synchronous motor and related problems.	
Class 17	Synchronous motor with different excitations and vector diagrams.	
Class 18	Effect of increased load with constant excitation and related problems.	
Week 7	**Synchronous motor (Cont'd)**	MID
Class 19	Effect of changing excitation on constant load, different torques of a synchronous motor	
Class 20	Mechanical power developed by a synchronous motor, alternative expression for power developed, Various conditions of maxima.	
Class 21	Effect of excitation on armature current and power factor	
Week 8	**Synchronous motor (Cont'd)**	
Class 22	Construction of V curves, inverted V curves and compound curves.	
Class 23	Power factor adjustment, synchronous capacitor and power factor correction.	
Class 24	Hunting, application of synchronous motor, comparison with other motor, quick review	
Week 9	**Three Phase Induction Motor**	
Class 25	General principle, advantage, disadvantage	
Class 26	Construction, types of rotor, squirrel cage rotor and phase wound rotor	
Class 27	Rotating magnetic field, slip, slip frequency and related problems	
Week 10	**Three Phase Induction Motor (Cont'd)**	
Class 28	Relation between torque and rotor power factor, starting torque and condition for maximum starting torque.	
Class 29	Starting torque of a squirrel cage motor, effect of change in supply voltage on starting torque, rotor emf and reactance under running	

	condition.	CT-3
Class 30	Torque under running conditions, condition for maximum torque under running conditions.	
Week 11	**Three Phase Induction Motor (Cont'd)**	
Class 31	Relation between torque and slip, starting torque, full load torque and maximum torque.	
Class 32	Torque-speed curve, current-speed curve, torque-speed characteristics under load.	
Class 33	Starting and braking, plugging of an induction motor, induction motor operating as a generator.	
Week 12	**Three Phase Induction Motor (Cont'd)**	CT-4
Class 34	Power stages in an induction motor, losses, torque developed by an induction motor	
Class 35	Induction motor torque equation, synchronous watt and variation in rotor current	
Class 36	Speed control of three phase induction motor and quick review on all topics	
Week 13	**Single Phase Induction Motor**	
Class 37	Principle of operation, construction, why not self-starting, how to make self-starting.	
Class 38	Split phase, capacitor type and shaded stator pole induction motor.	
Class 39	Torque vs speed curve of single-phase induction motors, speed control of single-phase induction motor, equivalent circuit and related problems	
Week 14	**Single Phase Induction Motor (Cont'd)**	
Class 40	Capacitor run motor, benefits, single value capacitor run and two value capacitor run motor.	
Class 41	Universal motor construction, operating principle and advantages.	
Class 42	Review Class	

ASSESMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3, CO4	C2, C3, C5
	Class Participation	5%	CO1, CO2, CO3, CO4	C2, C3, C5
	Class Attendance	5%	-	-
	Mid Term	10%	CO2, CO3	C5
Final Exam		60%	CO 1	C2
			CO 2	C5
			CO 3	C5
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electric Machinery Fundamentals by Stephen J.Chapman
2. A Textbook of Electrical Technology, Vol II, by B.L Theraja

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.9. EECE 206: Electrical Machine Laboratory
Level-2, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE-206 : Electrical Machine Laboratory	Lecture Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 205
Course Title: Electrical machines II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To help the students to explore various DC and AC machines and put theory in practice. Our mission is to expose students to the constructions of electrical machines and analyze their performance. This course is targeted to verify the properties of generator, motor etc. and relate them with their theoretical knowledge. Our aim is to give the students the basic idea of how these machines fit in large context. This course is also designed to examine the construction of some induction machines like squirrel cage motor, wound rotor motor, capacitor start & run motor and observe their characteristics.

OBJECTIVE

1. Be able to familiarize the students with the basic electrical machines like transformer, dc generator, dc motor, synchronous machines, induction machines etc.

2. Be able to calculate various parameters of machines like voltage regulation, efficiency etc., observe their behavior under various load conditions and compare them.

3. To develop skills of handling basic machinery equipment by engaging students in experiences with experimental processes and by growing the capability to give connection.

4. Be able to impart practical knowledge on electrical machine crafting and develop collaborative learning skill.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **compute** the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and **justify** these characteristics under various loading condition.	PO9	P3		1	6	R, Q, LT
CO2	Be able to **identify** the characteristics of electrical machines like dc generator, dc motor, alternator, synchronous motor etc.	PO5	P4	1	1	6	R, Q, LT
CO3	Be able to **compare** the starting and operating characteristics of various induction machines.	PO9	P4	1	1	6	R, Q, LT
CO4	Be able to **perform** project-task and **design** electrical-machine **adapting** to requirement.	PO10	P6	1	1,3	6	LT, PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 205 using different hardware equipment and simulation software.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **compute** the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and **justify** these characteristics under various loading condition.									3			
CO2	Be able to **identify** the characteristics of electrical machines like dc generator, dc motor, alternator, synchronous motor etc.					2							
CO3	Be able to **compare** the starting and operating characteristics of various induction machines.									3			
CO4	Be able to **perform** project-task and **design** electrical machine **adapting** to requirement.										2		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Practical	28
Total	42
Self-Directed Learning	
Preparation of Lab Reports	10
Preparation of Lab Test	10
Preparation of presentation	5
Preparation of Quiz	10
Engagement in Group Projects	20
Formal Assessment	
Continuous Assessment	14
Final Examination	1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week1	Introduction to the lab equipment, rules and norms of the laboratory and safety guidelines.
Week2	Expt-01: Computing the regulation of the Transformer in Various Loads.
Week3	Expt-02: Conducting open circuit and short circuit test of a single phase transformer.

Week4	Expt-03: Study the properties of DC self and separately excited shunt generator.
Week5	Expt-04: Identifying the characteristics of DC shunt motor and calculating the efficiency.
Week6	Expt-05: Study the properties of Three-Phase Alternator in various loads.
Week7	Expt-06: Three-phase alternator synchronizing process in power utility system.
Week8	Expt-07: Study the properties of synchronous motor.
Week9	Expt-08: Study the properties of Squirrel-Cage Induction Motor.
Week10	Expt-09: Study the properties of Wound-Rotor Induction Motor.
Week11	Expt-10: Study the properties of Capacitor-Start & Run Motor.
Week12	Practice
Week13	Lab Test +Quiz
Week14	Project Presentation +viva

ASSESMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Participation and Report	20%	CO1	P3
			CO2	P4
			CO 3	P4
	Labtest-1, Labtest-2	30%	CO1	P3
			CO2	P4
			CO 3	P4
	Project and Presentation	25%	CO4	P6
Lab Quiz		25%	CO 1	P3
			CO 2	P4
			CO 3	P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electrical Machinery Fundamentals- Stephen J Chapman.
2. Electrical machinery and Transformer – Irving L. Kosow.
3. Electrical machines- Samarjit Ghosh.
4. A Textbook of Electrical Technology - B.L Theraja.
5. Direct and Alternating Current Machinery – Jack Rosenblatt & Friedman

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.10. EECE 207: Electronics-II
Level-2, Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 207	Lecture Contact Hours	: 3.00
Course Title	: Electronics-II	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 101, EECE 201
Course Title: Electrical Circuits I, Electronics-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the students with the advanced concepts of Electronics. The main motive is to make them understand the working principle of the advanced electronic circuits such as operational amplifiers, feedback amplifiers, oscillator circuits along with frequency response of diverse electronic circuits and implement the knowledge gathered to solve various practical problems.

OBJECTIVE

1. Be able to impart rudimentary knowledge on basic integrated circuit components, its designing & packaging.
2. Achieving ability to familiarize the students with the ideal characteristics of op-amp and its deviations in practical conditions along with its different modes of operation in linear and non-linear applications.
3. Be proficient to acquaint the students with the composite electronic circuits (filters, oscillators and amplifiers), their working principles, design criteria and system components.
4. Be expert in imparting in depth knowledge on the predominant features (frequency response, stability) of these advanced electronic circuits and thereby enable students to design complex electronic circuits.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **recall** and **infer** the genesis of basic integrated circuits and the operation, designing and packaging of different advanced electronic circuits.	PO1	C2	1		3	T, F
CO2	Be expert in **comparing** the ideal and pragmatic behaviors of the op-amp and thereby **identifying** the differences between various modes of operation of the circuit for miscellaneous purposes.	PO1	C4	1		3	T, Mid Term Exam, F
CO3	Be proficient to **analyse** advanced electronic circuits considering existing system models to explore practical complex engineering problems.	PO1	C4	1, 3		3	Mid Term Exam, F, ASG
CO4	Be skillful in **designing** various electronic circuits incorporating the paramount features to solve the real-life engineering problems.	PO3	C6	1, 3		5	PR/ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Operational amplifiers (Op-Amp): properties of ideal Op-Amps, non-inverting and inverting amplifiers, inverting integrators, differentiator, weighted summer and other applications of Op-Amp circuits, effects of finite open loop gain and bandwidth on circuit performance, logic signal operation of Op-Amp, dc imperfections.

General purpose Op-Amp: DC analysis, small-signal analysis of different stages, gain and frequency response of 741 Op-Amp. Negative feedback: properties, basic topologies, feedback amplifiers with different topologies, stability, frequency compensation.

Active filters: Different types of filters and specifications, transfer functions, realization of first and second order low, high and band pass filters using Op-Amps.

Signal generators: Basic principle of sinusoidal oscillation, Op-Amp RC oscillators, and LC and crystal oscillators.

Power Amplifiers: Classification of output stages, class A, B and AB output stages.

Frequency response of amplifiers: Amplifier transfer function, Poles, zeros and Bode plots, techniques of determining 3 dB frequencies of amplifier circuits, frequency response of single-stage and cascade amplifiers, and frequency response of differential amplifiers.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **recall** and **infer** the genesis of basic integrated circuits and the operation, designing and packaging of different advanced electronic circuits.	3											
CO2	Be expert in **comparing** the ideal and pragmatic behaviors of the op-amp and thereby **identifying** the differences between various modes of operation of the circuit for miscellaneous purposes.	3											
CO3	Be proficient to **analyse** advanced electronic circuits considering existing system models to explore practical complex engineering problems.	3											
CO4	Be skillful in **designing** various electronic circuits incorporating the paramount features to solve the real-life engineering problems.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio	 42 -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	42 21 21
Formal Assessment Continuous Assessment Final Examination	2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Operational amplifier**	
Class 1	Introduction to Electronics II	
Class 2	Basics of Operational Amplifier.	
Class 3	Inverting and Non-inverting amplifier	
Week 2	**Applications of Operational amplifier**	

Class 4	Inverting Integrators and Summer	CT 1
Class 5	Differentiator and Weighted summer	
Class 6	Other applications of Op-Amp circuits	
Week 3	**Mathematical problems on Operational amplifier**	
Class 7	Mathematical Problems based on different applications of Op-Amp.	
Class 8	Effects of finite open loop gain and bandwidth on circuit performance,	
Class 9	Logic signal operation of Op-Amp, dc imperfections	
Week 4	**Mathematical problems on Operational amplifier**	
Class 10	General purpose Op-Amp: DC analysis, of different stages, gain and frequency response of 741 Op-Amp	
Class 11	Mathematical Problem based on DC analysis	
Class 12	Small-signal analysis of stages, gain, frequency response of Op-Amp.	
Week 5	**Filters**	
Class 13	Mathematical Problem based on small-signal analysis	
Class 14	Different types of Active filters and specifications	
Class 15	Transfer functions and realization of four orders of low, high, band pass and band reject filters using Op-Amps.	
Week 6	**Feedback amplifier**	CT-2
Class 16	Transfer functions and realization of first and second order high filters using Op-Amps	
Class 17	Properties of negative feedback	
Class 18	Basic topologies of negative feedback	
Week 7	**Feedback amplifier**	
Class 19	Feedback amplifiers with different topologies	
Class 20	Feedback amplifiers with stability and frequency compensation.	
Class 21	Design Problem on feedback amplifiers.	
Week 8	**Oscillators**	
Class 22	Basic Principle of oscillation	
Class 23	Different type of oscillators	
Class 24	Mathematical problems related to oscillator	
Week 9	**Power Amplifier**	CT-3
Class 25	Introduction to power amplifier	
Class 26	Classification and output stages of class A, B, C, AB power amplifiers	
Class 27	Application of power amplifiers	
Week 10	**Power Amplifier**	
Class 28	Application of power amplifiers (contd)	
Class 29	Mathematical problems related to power amplifier	
Class 30	Mathematical problems related to power amplifier	
Week 11	**Frequency Response**	
Class 31	Basic concepts of frequency response	
Class 32	Miller's theorem : Miller's capacitance and Miller's effect	
Class 33	Mathematical equations of frequency response	
Week 12	**Bode Plot**	
Class 34	Introduction to Bode plot	
Class 35	Bode plot preliminaries	

Class 36	Transfer function with multiple simple poles and zeroes	CT-4
Week 13	**Bode Plot**	
Class 37	Decibel scale and log function	
Class 38	Drawing Bode Plots (Magnitude)	
Class 39	Bode phase plots	
Week 14	**Stability**	
Class 40	Stability effect of feedback on amplifier	
Class 41	Gain margin & Phase margin	
Class 42	Review class	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C4
	Class Participation	5%	CO 4	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO 2	C4
			CO 3	C4
Final Exam		60%	CO 1	C2
			CO 2	C4
			CO 3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Operational Amplifiers and Linear Integrated Circuit –Robert Coughlin and Frederic Driscoll.
2. Integrated Electronics - by Jacob Millman and Halkias.
3. Op amps and linear integrated circuits by Ramakant A Gayakwad

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.11. EECE 208: Electronic Circuits & Simulation Laboratory II
Level-2, Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 208	Contact Hours	: 3.00
Course Title	: Electronic Circuits & Simulation Laboratory II	Credit Hours	: 1.50

PRE-REQUISITE

Course Code: EECE 207

Course Title: Electronic Circuit II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Electronics Circuits and Simulation Laboratory-II is designed to teach the students about the notions, postulates and working of advanced electronic devices and circuits by hand-held experiments as well as make them well acquainted with the computer aided simulation tools. With the completion of each experiments, student will gradually develop the ability to analyze and design advanced electronic circuits. It is expected that, student will formulate the expertise obtained from this laboratory tasks not only for upcoming higher laboratory courses but also in their future professional engineering practice.

OBJECTIVE

1. Be able to impart basic knowledge about analog electrical devices, particularly operational amplifiers and their applications.

2. Achieving ability to familiarize the students with the implementation of the op-amps in producing more complex circuits (Filters and oscillators).

3. Be proficient to introduce the students with the use of circuit simulation software (e.g. OrCAD Capture/ PSpice Schematics/ Proteus) in analyzing advanced electronic circuits and thereby enrich their skills in designing various complex electronic circuits.

4. To assist the students in demonstrating appropriate communication skills through group projects and presentations and make them able to work as part of a technical team.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be expert in **analyzing** the operating postulates of the op-amps to produce various complex circuits like adder, subtractor, differentiator, filters, oscillators and **interpreting** the difference between the data achieved by hardware and software approach.	PO5	C4	1		6	R,Q,T
CO2	Be skillful to **design** various electronic circuits using predetermined requirements and also to **appraise** unprecedented situations implementing theoretical ideas.	PO5	P7	1, 2, 3, 4		6	R,Q,T
CO3	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	PO9	A4				PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 207 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be expert in **analyzing** the operating postulates of the op-amps to produce various complex circuits like adder, subtractor, differentiator, filters, oscillators and **interpreting** the difference between the data achieved by hardware and software approach.					3							
CO2	Be skillful to **design** various electronic circuits using predetermined requirements and also					2							

	to **appraise** unprecedented situations implementing theoretical ideas.												
CO3	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.									2			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	06
Preparation of Quiz	06
Preparation of Presentation	05
Engagement in Group Projects	26
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Weeks	Intended topics to be covered	Remarks
1.	Familiarization with the basic op-amp circuit 741 IC.	
2.	Mathematical operations using OPAMP (Adder, subtractor)	
4.	Study of high pass and low pass filter using Op-amp.	
5.	Study of an R-C Phase Shift Oscillator.	
6.	Study of Wien Bridge Oscillator.	
7.	Lab Test-01	
8.	Determination of operational amplifier characteristics.	
9.	Linear application of operational amplifiers.	
10.	Digital Simulation of Decoders.	
11.	Practice	
12.	Lab test-02 and viva	
13.	Quiz test	
14.	Project Presentation	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	P3
			CO 2	P7
	Lab test- 1, Lab test- 2	30%	CO 1	P3
			CO 2	P7

	Project and Presentation	25%	CO 3	A4
Lab Quiz		25%	CO 1	P3
			CO 2	P7
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Spices for Circuits and Electronics Using PSPICE - MD. H. Rashid; Prentice Hall of India Private Ltd.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.12. EECE 212: Numerical Technic Laboratory
Level-2, Term-I (Spring)

COURSE INFORMATION

Course Code	: EECE 212	Contact Hours	: 3.00
Course Title	: Numerical Technic Laboratory	Credit Hours	: 1.50

PRE-REQUISITES

Course Code: MATH 101; MATH 105

Course Title: Differential and Integral Calculus; Vector Analysis, Matrices and Coordinate Geometry

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

A professional engineer or a researcher has to often deal with large scale complex computational problems in his/her everyday life. In order to make these computations simpler, faster, more efficient and most accurate; application of well-known numerical techniques are indispensable. This laboratory coursework is primarily focused on revisiting some these numerical concepts and using them for diverse purposes like data derivation, curve fitting, numerical calculus, solving linear and non-linear equations as well as ordinary and partial differential equations. Another cardinal goal of this coursework is to make a comparative analysis between different numerical techniques applied for the same purpose and verify the numerically derived results by comparing them with actual mathematical results.

OBJECTIVE

1. To develop students' skill of applying different numerical techniques in an industrially used numerical analysis tool (MATLAB/Python/Wolfram Mathematica/Octave) and comparing the numerically derived results with the analytical results.
2. To make students proficient in deriving new data points using interpolation formulae and creating curve that converges through scattered data points using curve fitting techniques.
3. To familiarize students with different techniques of numerical calculus, growing their skills in implementing these techniques in numerical software and demonstrate to them various applications of numerical calculus. (e.g. deriving co-efficients of a Fourier series or determining Fourier transform of a given time signal numerically)
4. To enable students to solve single non-linear equation or a system of multiple linear or non-linear equations numerically by implementing elimination methods like Gauss-Jordan or iterative methods like Gauss-Siedel, Newton Raphson etc.
5. To introduce students to numerical solution techniques of linear and non-linear ordinary differential equation and linear partial differential equation.

COURSE OUTCOMES & GENERIC SKILLS`

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Being able to **compare** between different numerical techniques and **conclude** which technique is the most efficient and accurate to solve a given mathematical problem	PO9	C5	1,2			R,Q,T
CO2	Being proficient in **originating** new data points by interpolating any given set of equidistant or arbitrary data and constructing a generalized curve that fits within a given set of scattered data with highest accuracy by applying different curve fitting techniques.	PO5	P7	1,2		6	R,Q,T
CO3	Being skillful in **measuring** derivative at any given data point of a non-linear curve and **measuring** the total area under any linear or non-linear curve by applying different techniques of numerical calculus.	PO5	P5	1,2		6	R,Q,T
CO4	Be able to solve a single non-linear equation or a system of multiple linear or multiple non-linear equations by applying widely used iterative methods, **fixing** initial points in close proximity to the actual solutions and **organizing** the given system into a unit matrix or any other convenient form to reach solution with lowest possible number of iterations.	PO5	P5	1,2		6	R,Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 207 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Being able to **compare** between different numerical techniques and **conclude** which technique is the most efficient and accurate to solve a given mathematical problem									2			
CO2	Being proficient in **originating** new data points by interpolating any given set of					2							

	equidistant or arbitrary data and constructing a generalized curve that fits within a given set of scattered data with highest accuracy by applying different curve fitting techniques.												
CO3	Being skillful in **measuring** derivative at any given data point of a non-linear curve and **measuring** the total area under any linear or non-linear curve by applying different techniques of numerical calculus.					2							
CO4	Be able to solve a single non-linear equation or a system of multiple linear or multiple non-linear equations by applying widely used iterative methods, **fixing** initial points in close proximity to the actual solutions and **organizing** the given system into a unit matrix or any other convenient form to reach solution with lowest possible number of iterations.					2							

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 11 22
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz	 33 11 11
Formal Assessment Continuous Assessment Final Quiz	 17 1
Total	106

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, individual effort and performance evaluation

COURSE SCHEDULE

Week 1	Introduction to Numerical Analysis Tools (MATLAB /Python/ Wolfram Mathematica / Octave) (Remarks: Must Do)
Week 2	Interpolating a Set of Equidistant Data Using Newton's Forward and Backward Difference Formula and a Set of Arbitrary Data Using Lagrange's Interpolation formula and Inverse Lagrange's Interpolation Formula. (Remarks: Must Do)
Week 3	Curve Fitting using Linear Regression, Polynomial Regression and Linearization of Non-linear Relations (Remarks: Must Do)
Week 4	Numerical Differentiation Using Forward Difference, Backward Difference, Richardson's Extrapolation and Stirling's Interpolation Formula (Remarks: Must Do)
Week 5	Numerical Integration using Trapezoidal Rule, Simpson's (1/3) Rule, Simpson's (3/8) Rule and Implementation of Fourier Series using Numerical Integration (Remarks: Must Do)
Week 6	Lab Test-I
Week 7	Solution to a System of Linear Equations using Gauss-Jordan Elimination

	through Pivoting and Gauss-Siedel Iterative Method (Must Do)
Week 8	Solution to a Single Non-linear Equation using Bisection Method, False Position Method, Newton-Raphson Method, Secant Method (Remarks: Must Do)
Week 9	Solution to a System of Non-linear Equations using Newton-Raphson Method (Remarks: Must Do)
Week 10	Solutions to Linear Ordinary Differential Equation Using Euler's Method and Improved Euler's Method (Remarks: Must Do)
Week 11	Solution to Non-linear Ordinary Differential Equation Using Modified Taylor's Series and Runge Kutta Method (Remarks: Should Do)
Week 12	Solution to Linear Partial Differential Equation Using Finite Difference Method and Finite Element Method (Remarks: Nice to Do)
Week 13	Lab Test-II
Week 14	Lab Quiz

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	30%	CO1	C5
			CO2	P7
			CO3	P5
			CO4	P5
	Labtest-1,Labtest-2	40%	CO1	C5
			CO2	P7
			CO3	P5
			CO4	P5
Lab Quiz		30%	CO1	C5
			CO2	P7
			CO3	P5
			CO4	P5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. An Introduction to Numerical Analysis---E.Suli, D.F.Mayers
2. Essential MATLAB for Scientists and Engineers----Brian D.Hahn

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.13. EECE 217: Engineering Electromagnetics
Level-2, Term-II (Fall)

COURSE INFORMATION			
Course Code	: EECE 217	Contact Hours	: 3.00
Course Title	: Engineering Electromagnetics	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: MATH 101, MATH 105, PHY 103

Course Title: Differential and Integral Calculus, Vector analysis, Matrices and Coordinate Geometry, Electricity & Magnetism, Thermal Physics, Quantum Mechanics & Photonics)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This course provides the foundations of electromagnetic theory, with applications in electrical and electronic engineering. Along with static electric and magnetic fields, time-varying electric and magnetic fields the course covers basics of antenna theory, that are used in the designs and implementations of electrical power systems and modern wireless communication systems. Characterization of electrostatics, magnetostatics and dynamic fields and their associated laws and principles are discussed, and the electric and magnetic boundary conditions are also explained in details. It may also be useful for the practicing engineers who want to refresh their understanding in Electromagnetics.
OBJECTIVE
1. To **impart** knowledge on basic concepts of vector calculus that provide a convenient language for expressing fundamental ideas in engineering electromagnetics. 2. To **expose** the physical laws (Coulomb's law, Gauss's law, Biot-Savart law, Ampere's law, Faraday's law etc.) that govern the electromagnetic phenomena commonly encountered in electrical engineering systems. 3. To **introduce** the students with the electrical properties of materials in general and of dielectric materials in particular leading to the concept of boundary conditions for electric and magnetic fields existing in two different media. 4. To **familiarize** students with the major parameters and electromagnetic quantities involved in EM wave propagation, transmission line theory and also with the principles of guided waves.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **recognize** different co ordinate systems to describe the spatial variations of the physical quantities dealt in electromagnetic field theory as they are functions of space and time and **apply** vector calculus to understand different concepts of electromagnetic field theory.	PO1	C3			1	T, ASG
CO2	Be able to **explain** fundamental laws governing electromagnetic fields to determine different properties (Field intensity, Flux density etc.) and **analyse** the boundary value problems by interpreting electric and magnetic fields in different material media.	PO1	C4	1		3	T,Mid Term Exam, F
CO3	Be able to **generalize** the coupling (or interaction) among time-varying electric and magnetic fields and the resulting Maxwell equations, and use them to **solve** complex problems.	PO2	C3	1		4	Mid Term Exam, F,
CO4	Be able to **describe** the basic concepts of antenna engineering by using all the applications of electromagnetic wave transmission.	PO3	C5	2		5	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
Coordinate Systems and Transformation: Cartesian coordinates, circular cylindrical coordinates, spherical coordinates, Vector calculus: Differential length, area and volume, line surface and volume integrals, del operator, gradient of a vector, divergence of a vector and divergence theorem, curl and Stoke's theorem, Laplacian of a scalar. **Electrostatic field and basic theorems:** Electrostatic fields, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses's Law – Maxwell's equation, Electric dipole and flux lines, energy density in electrostatic fields. Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, dielectric constants, continuity equation and relaxation time, boundary condition. Electrostatic boundary value problems: Poission's and Laplace's equations, general procedures for soling Poission's or Laplace's equations, resistance and capacitance, method of images. **Magnetic forces, materials and Maxwell's equation:** Magnetostatics: Postulates of magnetostatics, Biot-Savart's law, Ampere's law and applications, vector magnetic potential, magnetic dipole, magnetization, magnetic field intensity and relative permeability, boundary conditions for magnetic field, magnetic energy, magnetic forces, torque and inductance of different geometries. Time varying fields and Maxwell's equations: Faraday's law of electromagnetic induction, Maxwell's equations - differential and integral forms, boundary conditions, potential functions, time harmonic fields. **Plane electromagnetic wave:** Poynting theorem and EM lower flow, Plane wave in loss less media - Doppler effect, transverse electromagnetic wave, polarization of plane wave, plane wave in lossy media – low-loss dielectrics, good conductors, group velocity, instantaneous and average power densities, normal and oblique incidence of plane waves at plane boundaries for different polarization. **Transmission Lines:** Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power, The Smith chart, Some applications of transmission lines. **Waveguides and Antennas:** Introduction to waveguides, Rectangular waveguide, Elemental electric dipole, Antenna patterns and directivity, Antenna arrays, introduction to communication systems.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **recognize** different co- ordinate systems to describe the spatial variations of the physical quantities dealt in electromagnetic field theory as they are functions of space and time and **apply** vector calculus to understand different concepts of electromagnetic field heory.	3											
CO2	Be able to explain fundamental laws governing electromagnetic fields to determine different properties (Field intensity, Flux density etc.) and analyse the boundary value problems by	3											

	interpreting electric and magnetic fields in different material media.												
CO3	Be able to generalize the coupling (or interaction) among time-varying electric and magnetic fields and the resulting Maxwell equations, and use them to solve complex problems.		2										
CO4	Be able to describe the basic concepts of antenna engineering by using all the applications of electromagnetic wave transmission.			1									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	84
Formal Assessment	05
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Electromagnetic Model and Vector Analysis**	**CT 1**
Class 1	Introduction to electromagnets and universal constants	
Class 2	Overview on vector algebra	
Class 3	Orthogonal coordinate systems	
Week 2	**Vector Analysis**	
Class 4	Gradient of scalar field, Divergence of vector field	
Class 5	Curl of vector field, Divergence theorem	
Class 6	Stokes's theorem, Two null identity	
Week 3	**Static Electric fields**	**CT 2**
Class 7	Fundamental postulates	
Class 8	Coulomb's law	
Class 9	Gauss's law and application	
Week 4	**Static Electric fields**	
Class 10	Electric Potential	
Class 11	Conductors, Dielectrics	
Class 12	Electric flux density and Dielectric constant	
Week 5	**Static Electric Fields**	
Class 13	Conductors in static electric field-Capacitance and capacitors	
Class 14	Electrostatic energy and forces	
Class 15	Poisson's and Laplace's equation	
Week 6	**Steady Electric Currents**	

Class 16	Boundary- value problems	
Class 17	Methods of images	
Class 18	Current density and ohm's law	
Week 7	**Steady Electric Currents**	**Mid Term**
Class 19	Equation of continuity	
Class 20	Power dissipation and Joule's law	
Class 21	Resistance Calculation	
Week 8	**Static Magnetic Fields**	
Class 22	Fundamental Postulates	
Class 23	Vector magnetic potential	
Class 24	Biot-Savart Law, Magnetic dipole, Magnetization	
Week 9	**Static Magnetic Fields**	
Class 25	Boundary conditions, Inductances and Inductors	
Class 26	Magnetic field intensity, Relative permeability, Magnetic energy	
Class 27	Magnetic forces and Torques	
Week 10	**Time-Varying Fields**	**CT-3**
Class 28	Faraday's law of electromagnetic induction	
Class 29	Maxwell's equation	
Class 30	Potential functions, Time-harmonic fields	
Week 11	**Plane Electromagnetic Waves**	
Class 31	Plane waves in lossless media with application	
Class 32	Plane waves in lossy media with application	
Class 33	Group Velocity, Poynting vector	
Week 12	**Transmission Lines**	
Class 34	Transmission-line equation and parameters	
Class 35	Wave characteristics on finite and infinite transmission line	
Class 36	Impedance matching	
Week 13	**Waveguides And Antennas**	
Class 37	Wave behaviors along uniform guiding structures	
Class 38	Rectangular waveguides, Elemental electric dipole	
Class 39	Antenna patterns and directivity	
Week 14	**Waveguides and Antenna arrays**	
Class 40	Thin linear antennas	
Class 41	Antenna Arrays	
Class 42 and Extra Hours	Showing radiation and directivity manipulation by basic exposer to modern engineering tools (Ansoft HFSS, CST microwave studio, Altair FEKO) on antenna design and numerical methods of electromagnetic wave simulation.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO4	C3, C4, C5
	Class Participation	5%	CO1	C3
	Class Attendance	5%	-	-

	Mid term	10%	CO2, CO3	C3, C4
Final Exam		60%	CO 2	C4
			CO 3	C3
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. D.K. Cheng, Fundamentals of Engineering Electromagnetics, Pearson.
2. M. N. O. Sadiku, “Elements of Electromagnetics”, 5th Edition, Oxford University Press 2010.
3. W. H. Hayt and J. A. Buck, “Electromagnetic field theory”, 7th Edition.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.14. EECE 301: Continuous Signals and Linear System
Level-3 Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 301 : Continuous Signals and Linear System	Contact Hours Credit Hours	:3.00 :3.00

PRE-REQUISITE

Course Code: MATH 105 Course Name: Vector Analysis, Matrices and Coordinate Geometry	Course Code: MATH 205 Course Name: Differential Equation, Laplace Transform and Fourier Transform	Course Code: MATH 213 Course Name: Complex Variable, harmonic Function and Statistics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To give the students a comprehensive knowledge on signal, system, their classification and characterization and different techniques to evaluate a signal in different domain. Additionally, to make the students capable of selecting appropriate practice to evaluate a signal and system to meet design specifications in communication system design for real life application. The course also focuses on developing an interrelation between a mechanical system and electrical system.

OBJECTIVE

1. To impart basic knowledge on signals and system, their classification, modeling techniques, basic operations and mathematical problems related to it.
2. To familiarize the students with system characterization and analysis in time and frequency domain, system specification (linearity, causality, time invariance, memory, stability, invertibility, order of system), convolution, correlation, sampling, system response and determination of properties.
3. To familiarize with Fourier series and Fourier transform, their properties, determination of system transfer function and response and its application in system analysis.
4. To familiarize with Laplace transform, its properties and its application in determining system transfer function and response to design a system.
5. To impart in depth knowledge on interdisciplinary application of signals and system and thereby enable students to design solution of analog electrical and mechanical system.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom’s Taxonomy	CP	CA	KP	Assessment Methods

CO1	Be able to **define** and **describe** signal, system according to different classification and hence **explain** the properties of these classified signal and system in terms of elemental system operation.	PO1	C2, A1			2, 3	T, F
CO2	Be able to **analyze** signal and system in terms of both time domain and frequency domain and then **compare** the advantages of the complementary insights and tools that these different perspectives provide.	PO1	C5	1		2, 3	T, Mid Term Exam, F
CO3	Be able to **apply** appropriate analyzing technique of system to **design** solution of electrical system, control system and communication system.	PO3	C6	1, 3		5	T, Mid Term Exam, F
CO4	Be able to **design** an analogy between electrical and mechanical system and then **justify** the use of this analogy in finding response of mechanical system.	PO3	C6, A3	1		5	ASG,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Classification of signals and systems: Signals classification, basic operation on signals, elementary signals, representation of signals using impulse function, systems classification.
Properties of Linear Time Invariant (LTI) systems: Linearity, causality, time invariance, memory, stability, invertibility.
Time domain analysis of LTI systems: Differential equations – system representation, order of the system, solution techniques, zero state and zero input response, system properties, impulse response – convolution integral, determination of system properties, state variable – basic concept, state equation and time domain solution.
Frequency domain analysis of LTI systems: Fourier series- properties, harmonic representation, system response, frequency response of LTI systems, Fourier transformation- properties, system transfer function, system response and distortion-less systems.
Applications of time and frequency domain analyses: Amplitude modulation and demodulation, time-division and frequency-division multiplexing.
Laplace transformation: Properties, inverse transform, solution of system equations, system transfer function, system stability and frequency response and application.
Solution of analog electrical and mechanical systems

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **define** and **describe** signal, system according to different classification and hence **explain** the properties of these classified signal and system in terms of elemental system operation.	3											

CO2	Be able to **analyze** signal and system in terms of both time domain and frequency domain and then **compare** the advantages of the complementary insights and tools that these different perspectives provide.	3											
CO3	Be able to **apply** appropriate analyzing technique of system to **design** solution of electrical system, control system and communication system.			2									
CO4	Be able to **design** an analogy between electrical and mechanical system and then **justify** the use of this analogy in finding response of mechanical system.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	**Introduction and Classification of signals and systems**	CT 1
Class 1	Introduction to Signals and Systems, Continuous time and discrete time signal	
Class 2	Periodic and aperiodic signal, Energy signal and power signal	
Class 3	Introduction to Impulse function, unit step function, rectangular function, ramp function, complex envelope function	
Week 2	**Different Elementary Signal operation and Signal Properties**	
Class 4	Properties of Impulse function, unit step function, rectangular function and ramp function.	
Class 5	Signal Operation: Shifting, scaling and time reversal operation on different signal	
Class 6	Properties of System: Linearity, causality, time invariance, memory, stability	
Week 3	**LTI system and Convolution Integral**	
Class 7	Properties of Linear Time Invariant (LTI) systems	
Class 8	Convolution Integral	
Class 9	Properties of Convolution Integral	
Week 4	**LCCDE and State variable Representation**	CT 2
Class 10	System described by Linear Constant coefficient differential	

	equation(LCCDE)	
Class 11	Finding Solution of LCCDE	
Class 12	State Variable Representation of System	
Week 5	**State Variable Representation and Fourier Series**	
Class 13	State Variable Representation of System Cont.	
Class 14	State Variable Representation of System Cont	
Class 15	Fourier Series: Orthogonal , Orthonormal representation	
Week 6	**Fourier Series Cont.**	
Class 16	Exponential Fourier Series	
Class 17	Coefficient calculation of Fourier series	
Class 18	Properties of Fourier series Coefficient	
Week 7	**Fourier Series Cont.**	MT
Class 19	The Gibbs Phenomenon	
Class 20	Mathematical problem to find Fourier series	
Class 21	Mathematical problem to find Fourier series Cont.	
Week 8	**Fourier Transform**	
Class 22	Introduction to Fourier Transform	
Class 23	Properties of Fourier Transform: Linearity, symmetry, time shift, time scaling, differentiation	
Class 24	Properties of Fourier transform: Integration, Parseval’s theorem, Duality, Convolution	
Week 9	**Application of Fourier Transform**	
Class 25	Nyquist Sampling Theorem	
Class 26	Sampling And Reconstruction	
Class 27	Amplitude Modulation and demodulation	
Week 10	**Multiplexing and Laplace Transform**	CT 3
Class 28	Time-Division and Frequency-Division Multiplexing	
Class 29	Introduction to laplace transformation	
Class 30	Properties of laplace transformation	
Week 11	**Laplace Transform Cont.**	
Class 31	Inverse laplace transformation	
Class 32	Solution of systems of equations using Laplace Transform	
Class 33	Solution of systems of equations using Laplace Transform Cont.	
Week 12	**Laplace Transform Cont.**	
Class 34	System transfer function using laplace	
Class 35	Problems related to system transfer function	
Class 36	System stability using laplace transform	
Week 13	**Laplace Transform Cont.**	
Class 37	Frequency response of the system using laplace	
Class 38	State Equation and Laplace Transform	
Class 39	Overall Mathematical problems resolve session	
Week 14	**Analogous Electrical And Mechanical System**	
Class 40	Interdisciplinary application of signals and systems	
Class 41	Solution to Analogous Electrical and Mechanical System.	
Class 42	Solution to Analogous Electrical and Mechanical System.	

ASSESSMENT STRATEGY

Components	Grading	CO	Bloom’s Taxonomy

Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2, A1
			CO2	C5
			CO3	C6
	Class Participation	5%	CO1	C2, A1
			CO2	C5
			CO3	C6
			CO4	C6, A2
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C5
			CO3	C6
Final Exam		60%	CO1	C2, A1
			CO2	C5
			CO3	C6
			CO4	C6, A2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Continues and Discrete Signals & Systems - S.S. Soliman& M. D. Srinath
2. Signal and System (Continuous & Discrete) - R.E. Ziemer; Pearson Education Asia.
3. Principle of Linear Systems and Signals – B.P. Lathi; Oxford University Press.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.15. EECE 303: Digital Electronics
Level-3 Term-I (Spring)

COURSE INFORMATION

Course Code Course Title	: EECE 303 : Digital Electronics	Lecture Contact Hours Credit Hours	: 3.0 : 3.0

PRE-REQUISITE

EECE 201 (Electronics)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed for the engineering students which focuses on building the concepts of digital logic design. The aim of this course is to make the students proficient in designing various digital combinational and sequential circuits which can be used in designing day-to-day life digital technology. Although the course is designed for electrical engineering students, it can also be used as a study tool for any engineers working in the field of designing digital systems.

OBJECTIVE

1. To familiarize the students with number systems and basic operations of logic gates to understand digital electronic circuits.
2. To make the student proficient in designing the combinational circuit and be able to simplify in its minimal form.
3. To familiarize the students about the applications of the combinational circuits such as multiplexers / demultiplexers, ALU, PLA etc.
4. To acquaint the students with the memory elements (flipflop, latches etc.) and make them capable of designing different sequential circuits.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding	Bloom's	CP	CA	KP	Assessment

		PO	Taxonomy				Methods
CO1	To **interpret** and **demonstrate** the structure of various number systems and its application in digital design.	PO2	C3			2	T
CO2	To **adhere** to the design constraints to **construct** efficient and simplified combinational circuits.	PO3	A4 C3 P4	1		5	T, F, ASG
CO3	To be able to **construct** multiplexers/demultiplexers, ALU, PLA as the applications of combinational circuits.	PO3	C3 P5	2		5	Mid Term Exam
CO4	Be able to **comprehend** different memory elements and **use** the concepts in **designing** and **evaluating** the sequential circuits such as counters, shift registers etc.	PO3	C6	2		5	Mid Term Exam, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T –Test; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to number systems and codes.
Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, combinational logic design, minimization of combinational logic.
Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin and power dissipation. Power optimization of basic gates and combinational logic circuits.
Modular combinational circuit design: Pass transistor, pass gates, multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements and ALU design.
Programmable logic devices: Logic arrays, field programmable logic arrays and programmable read only memory.
Sequential circuits: Different types of latches, flip-flops and their design using ASM approach, timing analysis, design procedure and analysis of sequential circuits.
Modular sequential logic circuit design: shift registers, counters and their applications.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO 1	To **interpret** and **demonstrate** the structure of various number systems and its application in digital design.		3										
CO 2	To **adhere** to the design constraints to **construct** efficient and simplified combinational circuits.			3									
CO 3	To be able to **construct** multiplexers/demultiplexers, ALU, PLA as the applications of combinational circuits.			3									
CO 4	Be able to **comprehend** different memory elements and **use** the			3									

	concepts in **designing** and **evaluating** the sequential circuits such as counters, shift registers etc.												

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching).

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous and (or) subsequent lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Lecture Plan		
Week 1	**Various Number Systems**	**CT-1**
Class 1	Number based conversion.	
Class 2	Complements and related problems.	
Class 3	Binary codes.	
Week 2	**Boolean Algebra**	
Class 4	Basic theories and properties of Boolean Algebra.	
Class 5	Canonical and standard forms.	
Class 6	Mathematical problems on Boolean Algebra.	
Week 3	**Simplification of Boolean Function, Universal Gate Introduction**	
Class 7	Simplification of Boolean functions through Map method.	
Class 8	Product of Sums simplification.	
Class 9	NAND and NOR implementation.	
Week 4	**Analysis and synthesis of digital logic circuits**	**CT-2**
Class 10	Simplification with Don’t Care conditions.	
Class 11	The Tabulation method of simplification.	
Class 12	Related mathematical problem solving.	
Week 5	**Combinational Circuit Design**	
Class 13	Introduction to Combinational Logic.	
Class 14	Discussion on Design procedure.	
Class 15	Adders and subtractors.	
Week 6	**Modular combinational circuit design**	
Class 16	Implementation of multiplexer and demultiplexer in CMOS.	
Class 17	Decoder and encoder.	
Class 18	Exclusive-OR AND equivalence functions. Pass transistor, Pass gates.	
Week 7	**Combinational Circuit Design**	
Class 19	Parity generation and checking.	
Class 20	Combinational logic with MSI and LSI.	
Class 21	Coder/decoder and multiplexer/demultiplexer design.	

Week 8	**Modular combinational circuit design**	**MID TERM**
Class 22	Operations of comparators.	
Class 23	Binary arithmetic elements and ALU design.	
Class 24	Programmable read-only memory, Field programmable logic arrays.	
Week 9	**Introduction to Sequential Circuit**	
Class 25	Introduction to memory elements. Difference between latches and flipflops.	
Class 26	Construction and operation of SR, JK, D and T flipflop.	
Class 27	Conversion of flipflops. Types of triggering methods.	
Week 10	**State Table and State diagram**	
Class 28	Race Around condition. Construction and operation of master slave flipflops	
Class 29	Introduction to state table, state diagram and state equation. State assignment and state reduction method.	
Class 30	Design procedure of a clocked sequential circuit.	
Week 11	**Analysis of sequential circuits**	
Class 31	Analysis of a sequential circuit and derive state diagram from the clocked sequential circuit.	
Class 32	Operation of Mealy and Moore state machine.	
Class 33	Operation of sequence or pattern detector.	
Week 12	**Registers**	**CT-4**
Class 34	Registers: Introduction, Types. Types of data. Difference between shift registers and storage registers.	
Class 35	Design and operation of SISO, SIPO, PISO and PIPO registers.	
Class 36	Operation of universal and bidirectional shift registers.	
Week 13	**Counters**	
Class 37	Counters: Introduction, Types. Difference between synchronous and asynchronous counter	
Class 38	Asynchronous counters: up, down and up-down, modulus of a counter	
Class 39	Synchronous counters: up, down and up-down	
Week 14	**Counters, Registers**	
Class 40	BCD counters and other modulo counters.	
Class 41	Ring counter, Johnson counter	
Class 42	Applications of registers and counters	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C3, A4, P4
	Class Participation	5%	CO2, CO4	C6, A4, P4
	Class Attendance	5%	-	-
	Mid term	10%	CO3, CO4	C6, P5
Final Exam		60%	CO2, CO4	C6, A4, P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Digital Logic and Computer Design- M Morris Mano; Prentice Hall of India Private Ltd.
2. Digital Fundamentals –Thomas L Floyd; Prentice Hall International, Inc.
3. Pulse, Digital and Switching waveforms - Jacob Millman & Herbert Taub.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.16. EECE 304: Digital Electronics Laboratory
Level-3 Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 304 : Digital Electronics Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 303
Course Title: Digital Electronics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Being one of the fundamental requirements for electrical engineering students of Level-3, the course emphasizes on a good understanding of basic concepts about digital logic circuits. Besides, it helps to form a firm grasp of the modern design approach that relies on computer-aided design (CAD) tools. It exploits areas like Boolean algebra, combinational circuits, sequential circuits and memory elements. The students are first taught about the number system and logic gates before introduction to digital IC technology. This paves the way of exposure to CAD tools like Schematic Capture and Verilog constructs which are useful for the design of logic circuits. It will be followed by implementation of Verilog code in FPGA board. The aim of the course is to familiarize students with modern design methodology to illustrate how digital design is carried out in practice today.

OBJECTIVE

1. To acquaint the students with the fundamental concepts in classical manual digital design.
2. To familiarize the students clearly with the way in which digital circuits are designed today using CAD tools like Schematic Capture and Verilog HDL.
3. To develop students' analytical skills to build complex digital circuit and impart the knowledge about 'Green Technology' to integrate it in their projects.
4. To enhance the skill set of students in designing various memory devices such as flip flops, registers and counters followed by implementation in FPGA boards.
5. To develop communication and project management skills in the students through presentation and project.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **follow** instructions on building combinational and sequential circuits using basic logic gates and compute simulation using CAD tools.	PO9	P3			3	R,Q,T
CO2	Be adept to apply basic Boolean laws and K-map to **reproduce** a simplified and efficient version of large scale complex circuits meeting the specified requirements using minimum hardware.	PO10	P3	1,3		6	R,Q,T
CO3	Be proficient to deconstruct a device and **demonstrate** skills to troubleshoot a digital circuit.	PO5	A3			6	R,Q,T

CO4	Be capable to **construct** different types of digital electronic circuits with or without memory elements for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.	PO10	P7	1,4		7	PR, Pr, Q

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to verify practically the theories and concepts learned in EECE 303 using electrical equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **follow** instructions on building combinational and sequential circuits using basic logic gates and compute simulation using CAD tools.									3			
CO2	Be adept to apply basic Boolean laws and K-map to **reproduce** a simplified and efficient version of large scale complex circuits meeting the specified requirements using minimum hardware.										1		
CO3	Be proficient to deconstruct a device and **demonstrate** skills to troubleshoot a digital circuit.					3							
CO4	Be capable to **construct** different types of digital electronic circuits with or without memory elements for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.										2		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	27
Lecture	9
Experiment	18
Self-Directed Learning	54
Preparation of Lab Reports	9
Preparation of Lab-test	12
Preparation of Quiz	10
Preparation of Presentation	5
Engagement in Group Projects	18
Formal Assessment	
Continuous Assessment	3
Final Quiz	1
Total	73

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introductory session on IC(s) of logic gates, FPGA board and safety measures followed by hands on experiment to compute the truth tables of the logic gates. Introduction to Schematic Capture and Verilog and simulation on simple digital circuits along with verification of De Morgan's laws both on hardware and software levels.
Week 2	Brief follow up on Boolean Algebra and K-map and gray code-binary code conversion. Followed by experiments using hardware and simulation using Schematic Capture and Verilog.
Week 3	Design and simulation of arithmetic circuits such as half adder, full adder, ripple adder, half subtractor, full subtractor and multiplier circuit using basic logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 4	Design and simulation of 4-2-1 multiplexer, 16-2-1 multiplexer, 4-2-1 multiplexer using two 2-to-1 multiplexer, crossbar switch and demultiplexers using basic logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 5	Design and simulation of 4-to-2 encoder, priority encoder, 2-to-4 decoder, 3-to-8 decoder using two 2-to-4 decoders, 4-to-16 decoder built using a decoder tree, 4-to-1 multiplexer built using a decoder using logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 6	Design of BCD to seven-segment decoder circuit using logic gates and simulation of BCD to seven-segment decoder and multilevel modules (using adder, 7 segment display) using Schematic Capture and Verilog.
Week 7	Lab Test-1
Week 8	Design and simulation of Latch, S-R FF, J-K FF, D FF, T FF, Master Slave FF using logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 9	Design and simulation of Up Counter, Down Counter (Synchronous and Asynchronous with and without Enable and Clear pins), Ring Counter, BCD Counter using logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 10	Design and simulation of Shift Register and Parallel Access Shift Register using logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 11	Lab Test-2
Week 12	Lab Quiz
Week 13	Project Presentation
Week 14	Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment	Lab participation and Report	20%	CO 1	P3
			CO 2	P3
			CO 3	A3
			CO4	P7
	Labtest-1,Labtest-2	30%	CO 1	P3
			CO 2	P3
			CO 3	A3
			CO4	P7
	Project and Presentation	25%	CO 4	P7
Project and Presentation		25%	CO 1	P3

		CO 2	P3
		CO 3	A3
		CO 4	P7
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design.
2. Ronald J Tocci, Digital Systems, Pearson Education, 10th edition 2009.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.17. EECE 305: Power System-I
Level-3 Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 305 : Power System-I	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE 205
Course Title: Energy Conversion-II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To familiarize the students with the basics of power system including the functions of its different subsystems like Generation, Transmission, Distribution and Loads etc. It is targeted to provide a strong foundation to the students on modelling of power system components for different analysis like fault study, load flow study etc.

OBJECTIVE

1. To familiarize the students with the components of an interconnected power system starting from generation to the load and enable them to represent the components in per unit quantities under steady state condition for power system analysis.
2. To develop student's skill to manipulate different parameters of power system network for performance evaluation using appropriate developed models under steady state conditions.
3. To make them understand about the formulation of the power flow problem and grow the ability in them to cast any given system in this framework.
4. To impart in depth knowledge to the students on modelling of synchronous machines and other components under fault condition to understand the system response and fault level.
5. To introduce the students with the operating principle and appropriate applications of different types of circuit breaker and relay for power system fault protection.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **know** the role of different subsystems of an interconnected power system and convert given network parameters into per unit values for steady-state analysis.	PO1	C2			1, 3	T, F

CO2	Attaining knowledge to **compare** different developed models for transmission lines and **manipulate** different performance indicating parameters of transmission lines applying the knowledge of basic mathematical and electrical principles.	PO1	C4			1, 3	T, Mid Term Exam, F
CO3	Achieving ability to **analyze** problems on load flow study and **propose** best solution algorithm using any load flow methods considering technical constraints.	PO3	C4, A3	3		5	F, ASG
CO4	Developing capability to **analyze** a power system network under short circuit faulted condition to **identify** the behaviour of synchronous machines and fault current and hence **design** a network to **adapt** with specific requirements.	PO3	C6	1		5	T, Mid Term Exam, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Network representation: Single line and reactance diagram of power system, Per unit system of calculation.
Line representation: Equivalent circuit of short, medium and long lines.
Load flow: Gauss-Seidal and Newton Raphson Methods.
Power flow control: Tap changing transformer, phase shifting, booster and regulating transformer and shunt capacitor.
Fault analysis: Short circuit current and reactance of a synchronous machine.
Symmetrical fault calculation methods: Symmetrical components, sequence networks and unsymmetrical fault calculation.
Protection: Introduction to relays, differential protection and distance protection, Introduction to circuit breakers.
Load curves: Demand factor, diversity factor, load duration curves, energy load curve, load factor, capacity factor and plant factor.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO 1	Be able to **know** the role of different subsystems of an interconnected power system and **convert** any given network parameters into per unit values for steady state analysis.	3											
CO 2	Attaining knowledge to **compare** different developed models for transmission lines and **manipulate** different performance indicating parameters of transmission lines applying the knowledge of basic mathematical and electrical principles.	2											

CO 3	Achieving ability to **analyze** problems on load flow study and **propose** best solution algorithm using any load flow methods considering technical constraints.			2									
CO 4	Developing capability to **analyze** a power system network under short circuit faulted condition to **identify** the behaviour of synchronous machines and fault current and hence **design** a network to **adapt** with specific requirements.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Power System and Per Unit Representation**	CT-1
Class 1	Brief history and development of Power System of Bangladesh	
Class 2	Per unit quantities and per unit representation of Power System Components	
Class 3	Mathematical problems based on per unit representation	
Week 2	**Sequence Networks and Transmission Lines Representation**	
Class 4	Sequence components and sequence network representation	
Class 5	Mathematical problems based on sequence network representation.	
Class 6	Introduction to transmission line parameters (Lumped and Distributed) and Classification	
Week 3	**Transmission Line Representation**	
Class 7	Theory and mathematical problems based on Short transmission lines.	
Class 8	Theory and mathematical problems based on medium transmission lines (End Condenser, Nominal T and Nominal π)	
Class 9	Theory and mathematical problems based on medium transmission lines (End Condenser, Nominal T and Nominal π	
Week 4	**Transmission Line Representation**	CT-2
Class 10	Theoretical analysis of long transmission lines (Rigorous method), Reflected and Transmitted wave (practical and lossless transmission lines).	
Class 11	Mathematical Problems bas d on long transmission lines and Introduction to A, B, C and D parameters for all types of transmission lines.	

Class 12	Mathematical problems on A, B, C and D parameters, Equivalent T and π model of long transmission lines, Surge Impedance and SIL.	
Week 5	**Load Flow Study**	
Class 13	Introduction to Load Flow Analysis, Behavior of interconnected power system, Parameters affecting real and reactive power flow, lassification of Buses.	
Class 14	Properties and formulation of Y_{BUS} matrix, Mathematical problems on Y_{BUS}	
Class 15	Theoretical analysis of bus voltage, Injected Power, Transmission Line losses	
Week 6	**Load Flow Study**	
Class 16	Power Flow Methods: Theory and mathematical problems on Gauss-Seidal Iterative Methods (PQ buses only).	
Class 17	Power Flow Methods: Theory and mathematical problems on Gauss-Seidal Iterative Methods (Both PQ and PV buses).	
Class 18	Power Flow Methods: Theoretical analysis of Newton Raphson Method for load flow study.	
Week 7	**Load Flow Study**	
Class 19	Power Flow Methods: Mathematical Problems on Newton Raphson Method.	
Class 20	Power Flow Methods: Mathematical Problems on Newton Raphson Method.	
Class 21	Brief introduction to Decoupled Load Flow (DLF) and Fast Decoupled Load Flow (FDLF) methods for power flow analysis, Comparative study among all power flow methods.	Mid-term
Week 8	**Symmetrical Components and Symmetrical Short Circuit Fault Analysis**	
Class 22	Introduction to symmetrical components and related mathematical problems.	
Class 23	Introduction to symmetrical short circuit faults, Short circuit model of synchronous machines, Introduction to Fault impedance, Fault MVA, Fault current etc.	
Class 24	Fault analysis using internal voltage method and Thevenin equivalent method.	
Week 9	**Symmetrical Short Circuit Fault Analysis**	
Class 25	Mathematical problems based on fault analysis.	
Class 26	Mathematical problems based on fault analysis.	
Class 27	Step by step formulation of Z_{BUS} matrix.	
Week 10	**Symmetrical Short Circuit Fault Analysis**	
Class 28	Mathematical problems on Z_{BUS} formulation.	
Class 29	Fault analysis using Z_{BUS} matrix and mathematical problems.	
Class 30	Mathematical Problems and Review class.	CT-3
Week 11	**Unsymmetrical Short Circuit Fault Analysis**	
Class 31	Introduction to unsymmetrical short circuit fault.	
Class 32	Theoretical analysis and mathematical problems based on L-G fault.	
Class 33	Theoretical analysis and mathematical problems based on L-L fault.	
Week 12	**Unsymmetrical Short Circuit Fault Analysis and Power Flow Control**	
Class 34	Theoretical analysis and mathematical problems based on L-L-G fault.	
Class 35	Introduction to Tap Changing Transformer (ON load and OFF load), Regulating Transformer, Booster Transformer for power flow control.	
Class 36	Introduction to Phase shifting transformer and Shunt capacitor for power flow control.	CT-4
Week 13	**Variable Loads on Power Station**	
Class 37	Introduction to Load Curves, Load Duration Curves, Maximum Demand, Connected Load, Load Factor, Demand Factor, Diversity Factor, Plant Capacity Factor, Plant Utilization Factor etc.	
Class 38	Mathematical Problems.	
Class 39	Mathematical Problems.	
Week 14	**Protection: Introduction to Circuit Breaker and Relay**	
Class 40	Introduction to Circuit Breaker operating principle, Classification and	

	applications, TRV, RRRV, Restriking Voltage, Recovery voltage, CB Ratings and mathematical problems on RRRV calculation.	
Class 41	Introduction to Relay operating principle, Classification, Relay ratings, Pick-up current, PSM, TSM, Relay applications, Block diagram of Numerical relay.	
Class 42	Operating principle of Distance relay and Differential relay, Primary and Back-up protection.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C4
			CO3	C4, A3
			CO4	C6
	Class Participation	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C4
			CO4	C6
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C4, A3
			CO4	C6
Total Marks		100%		

(CO = Course Outcome, C= Cognitive, P= Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:
1. Power System Analysis- John Grainger & Stevenson
2. Principles of Power System- V. K. Mehta

Reference Books:
1. Elements of Power System Analysis- Stevenson
2. Modern Power System Analysis- Nagrath & Kothari
3. Power System Analysis- Hadi Saadat

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.18. EECE 306: Power System-I Laboratory
Level-3 Term-I (Spring)

COURSE INFORMATION

Course Code Course Title	: EECE 306 : Power System I Laboratory	Lecture Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 305
Course Title: Power System I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Power System Laboratory is the introductory step of practical knowledge of power system for the impartment of basic power system concepts in the students. This laboratory work starts with the practical implementation of synchronizing a new component to the existing system followed by the physical impersonation of power flow in a specific network, power drop and voltage regulation in different situation with different component. Towards the end, the transmission line basics will be offered to the students. And at the end, the students will be told to design a power system with some required outputs with which students will be helped in the long run.

OBJECTIVE

1. To introduce the students to synchronization, parallel operation and phase angle.
2. To impart into the students, the real and reactive power for different types of loads along with synchronous motors, parameters that affect it for different conditions.
3. To give in depth knowledge about power flow, power drops and mathematical formulations for voltage regulations for different types of loads and machines
4. To infix to the students about different types of connections of power transmission line and power handling capacity as well as maximum power transmission condition.
5. To introduce a primary knowledge on power system designing software

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Acquiring the competency to **describe** the characteristics of real and reactive power flowing in a power system and to **illustrate** the societal and safety issue of power flow.	PO6	P1			7	R
CO2	Attaining the proficiency to **compute** the power flow, power drop and voltage regulation for different situation for different types of machines and loads and to **respond** as per the given conditions	PO9	P3			3	R, Q, T
CO3	Earning the potential to **perform** in a group and be able to **demonstrate** different types of transmission line connection along with their uses and power handling capacity of transmission line	PO10	A5			5	R, Q, T
CO4	Developing hands-on knowledge to **create** designs using different simulation software (PSAF, ETAP) to **present** own-designed systems and **defend** the usage of the components	PO12	A4	1	A1	6	PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to verify practically the theories and concepts learned in EECE 305 using electrical equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO) 1	2	3	4	5	6	7	8	9	10	11	12
CO1	Acquiring the competency to **describe** the characteristics of real and reactive power flowing in a power system and to **illustrate** the societal and safety issue of power flow.						2						
CO2	Attaining the proficiency to **compute** the power flow, power drop and voltage regulation for different situation for different types of machines and loads and to **respond** as per the given									2			

	conditions												
CO3	Earning the potential to **perform** in a group and be able to **demonstrate** different types of transmission line connection along with their uses and power handling capacity of transmission line									2			
CO4	Developing hands-on knowledge to **create** designs using different simulation software (PSAF, ETAP) to **present** own-designed systems and **defend** the usage of the components												1

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 14 28
Self-Directed learning Preparation of lab reports Preparation of Lab-test Preparation of Lab Quiz Preparation of presentation Engagement in group projects	 18 5 9 5 20
Formal Assessment Continuous assessment Final examination	 10 1
Total	110

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Weeks	**Intended topics to be covered**	**Remarks**
1	Safety and the power supply	
2	**Expt-01:** Determination of phase sequence	
3	**Expt-02:** Observation of real and reactive power flow in three phase circuits using simulation software.	
4	**Expt-03:** Measurement of power flow and voltage regulation of three phase transmission line	
5	**Expt-04:** Determination of phase angle and voltage drop between sender and receiver	
6	**Expt-05:** Study of real and reactive power flow for different sending and receiving end voltage condition	
7	**Expt-06:** Observation of power handling capacity of transmission line using transformer	
8	**Expt-07:** Measurement of the synchronous reactance and voltage regulation of alternator	
9	**Expt-08:** Study of real and reactive power flow of Synchronous Motor	

10	**Expt-09:** Study of the regulation of receiver voltage using synchronous capacitor	
11	Practice Lab	
12	Lab Test	
13	Quiz test	
14	Project submission	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Participation and Report	15%	CO1	P1
			CO2	P3
			CO3	A5
	Lab test	25%	CO2	P3
			CO3	A5
	Project and presentation	20%	CO4	A4
Lab Quiz		40%	CO2	P3
			CO3	A5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Principle of Power System – V. K. Mehta &Rohit Mehta
2. Elements of Power System Analysis – William d Stevenson

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.19. EECE 309: Communication Theory I
Level-3 Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 309	Lecture Contact Hours	: 3.00
Course Title	: Communication Theory I	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 301
Course Title: Continuous signals and Linear System

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To familiarize the students with the basics of communication system including the functions of its different components, transmission fundamentals, modulation schemes, multiplexing methods, multiple access techniques etc. It is targeted to provide a strong foundation to the students for analysing the performance of different communication system with respect to corresponding design parameters.

OBJECTIVE

1. To familiarize the students with the basic principles and fundamentals components of a communication system starting from message source to receiver and enable them to outline the characteristics of various types of noises, channel capacity.
2. To develop student's skill to analyze different performance characteristics of communication systems by comparing different analog and digital modulation and transmission schemes.
3. To make them understand about different multiplexing and multiple access techniques to have a better idea about modern communication system.

4. To develop the ability to design a communication system with predefined design parameters by analyzing proper channel selection criteria and evaluating the performance of that system through simulation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **know** the basic architecture and role of different components of a communication system and **outline** the characteristics of various types of noises by **estimating** the channel capacity of different system using information theory.	PO1	C2			1, 2	T, F
CO2	Attaining knowledge to **compare** different analog and digital modulation methods and transmission schemes lines and **analyze** different performance indicating parameters of that system by **applying** the knowledge of mathematical and electrical principles.	PO1	C4			2, 3	T, Mid Term Exam, F
CO3	Achieving ability to **identify** and **explain** different methods of multiplexing for communication systems and **contrast** between different multiple access schemes for communication networks.	PO2	C5			3, 4	T, Mid Term Exam, F
CO4	Developing capability to **design** a communication system with defined design parameters and **justify** the selection of channel by generating the performance characteristics of the system through simulation	PO3	C6	1		5	F, ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Overview of communication systems: Basic principles, fundamental elements, system limitations, message source, bandwidth requirements, transmission media types, bandwidth and transmission capacity.
Noise: Source, characteristics of various types of noise and signal to noise ratio.
Information theory: Measure of information, source encoding, error free communication over a noisy channel, channel capacity of a continuous system and channel capacity of a discrete memory less system.
Communication systems: Analog and digital. Continuous wave modulation: Transmission types, base-band transmission, carrier transmission.
Amplitude modulation: Introduction, double side band, single side band, vestigial side band, quadrature, spectral analysis of each type, envelope and synchronous detection.
Angle modulation: Instantaneous frequency, frequency modulation (FM) and phase modulation (PM), spectral analysis, demodulation of FM and PM.
Pulse modulation: Sampling theorem, Nyquist criterion, aliasing, instantaneous and natural sampling.
Pulse amplitude modulation: Principle, bandwidth requirements.
Pulse code modulation (PCM): Quantization principle, quantization noise, non-uniform

quantization, signal to quantization error ratio, Companded PCM, PSK, FSK, QPSK, BPSK, differential PCM, demodulation of PCM.

Delta modulation (DM): Principle, adaptive DM, line coding – formats and bandwidths.

Digital modulation: Amplitude-shift keying - principle, ON-OFF keying, bandwidth requirements, detection, noise performance.

Phase-shift keying (PSK): Principle, bandwidth requirements, detection. Coherent and Non-coherent Demodulation techniques.

Multiplexing: Frequency division multiplexing (FDM), Time division multiplexing (TDM) - principle, receiver synchronization, frame synchronization, PHD, SONET/SDH, wavelength division multiplexing, multiple-access network – time division multiple access, frequency-division multiple access, code-division multiple access (CDMA), spread spectrum techniques, coding techniques and constraints of CDMA.

Communication system design: Design parameters, channel selection criteria and performance simulation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **know** the basic architecture and role of different components of a communication system and **outline** the characteristics of various types of noises by **estimating** the channel capacity of different system using information theory.	3											
CO2	Attaining knowledge to **compare** different analog and digital modulation methods and transmission schemes lines and **analyze** different performance indicating parameters of that system by **applying** the knowledge of mathematical and electrical principles.	3											
CO3	Achieving ability to **identify** and **explain** different methods of multiplexing for communication systems and **contrast** between different multiple access schemes for communication networks.		3										
CO4	Developing capability to **design** a communication system with defined design parameters and **justify** the selection of channel by generating the performance characteristics of the system through simulation			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42

Practical / Tutorial / Studio Student-Centred Learning	- -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Basics**	CT 1
Class 1	Overview of communication systems: Basic principles	
Class 2	Fundamental elements, system limitations	
Class 3	Message source, bandwidth requirements	
Week 2	**Noise and Information theory**	
Class 4	Transmission media types, bandwidth and transmission capacity	
Class 5	Noise: Source, characteristics of various types of noise and signal to noise ratio	
Class 6	Information theory: Measure of information	
Week 3	**Information theory**	CT 2
Class 7	Source encoding, error free communication over a noisy channel	
Class 8	Channel capacity of a continuous system	
Class 9	Channel capacity of a discrete memory less system	
Week 4	**Communication systems**	
Class 10	Communication systems: Analog and digital	
Class 11	Continuous wave modulation: Transmission types	
Class 12	Base-band transmission, carrier transmission	
Week 5	**Amplitude modulation**	
Class 13	Amplitude modulation: Introduction, double side band	
Class 14	Single side band	
Class 15	vestigial side band details	
Week 6	**Angle modulation**	
Class 16	Envelope and synchronous detection	
Class 17	Angle modulation: Instantaneous frequency, frequency modulation (FM)	
Class 18	Phase modulation (PM), spectral analysis	
Week 7	**Pulse modulation**	Mid Term
Class 19	Demodulation of FM and PM	
Class 20	Pulse modulation: Sampling theorem, Nyquist criterion	
Class 21	Aliasing, instantaneous and natural sampling. Principle, bandwidth requirements	
Week 8	**Pulse code modulation (PCM)**	
Class 22	Pulse code modulation (PCM):Quantization principle, quantization noise	
Class 23	Non-uniform quantization, signal to quantization error ratio	
Class 24	Companded PCM, PSK, FSK, QPSK,BPSK, differential PCM	
Week 9	**Delta modulation (DM) and Amplitude-shift keying**	
Class 25	Demodulation of PCM. Delta modulation (DM)	
Class 26	Pulse amplitude modulation Principle	
Class 27	Digital modulation: Amplitude-shift keying– principle	

Week 10	**Amplitude-shift keying and Phase-shift keying (PSK)**	CT 3
Class 28	Amplitude-shift keying:ON-OFF keying, bandwidth requirements, detection, noise performance	
Class 29	Phase-shift keying (PSK): Principle, bandwidth requirements, detection	
Class 30	Coherent and Non-coherent Demodulation techniques	
Week 11	**Multiplexing**	
Class 31	Multiplexing: Frequency division multiplexing (FDM)	
Class 32	Time division multiplexing (TDM) -principle	
Class 33	TDM - receiver synchronization, frame synchronization	
Week 12	**Multiple-access network**	
Class 34	PHD, SONET/SDH, wavelength-division multiplexing	
Class 35	Multiple-access network – time-division multiple access	
Class 36	Frequency-division multiple access	
Week 13	**Multiple-access network**	
Class 37	Code-division multiple access (CDMA)	
Class 38	Spread spectrum techniques	
Class 39	Coding techniques and constraints of CDMA.	
Week 14	**Communication system design**	
Class 40	Communication system design: Design parameters	
Class 41	Channel selection criteria	
Class 42	Performance simulation.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C4
			CO3	C5
	Class Participation	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C4
			CO3	C6
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C5
			CO4	C6
Total Marks		100%		

(CO= Course Outcome, C= Cognitive Domain, P= Psychomotor Domain, A= Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. S. Haykin and M. Moher, Communication Systems, 5th ed.
2. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th ed.,
3. S. Haykin and M. Moher, Introduction to Analog and Digital Communications, 2nd ed.

Reference Books:

1. M. P. Fitz, Fundamentals of Communications Systems.
2. J.G. Proakis, M. Salehi, Fundamentals of Communication Systems, 2nd ed.
3. L. W. Couch, II, Digital and Analog Communication Systems, 8th ed.,

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.20. EECE 310: Communication Laboratory
Level-3 Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 310 : Communication Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE
Course Code: EECE 309 Course Title: Communication Theory I
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To teach the students to analyze the modulation and demodulation techniques implementing the circuit physically. The students are expected to be able to distinguish between the different multiplexing techniques. With necessary modules and equipment required, the target is to enable the students to demonstrate the characteristic waveforms of sampled and reconstructed signals.
OBJECTIVE
1. To introduce the students with the basic concepts of modulation and demodulation. 2. To familiarize the students with the analogue modulation techniques and enable them to implement the circuits using necessary modules and oscilloscopes. 3. To impart knowledge on the multiplexing and demultiplexing techniques and teach them to implement the circuits for these for their better understanding 4. To acquaint the students with the digital modulation techniques with the help of the required modules and oscilloscopes.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **construct** the circuits to understand the analogue modulation techniques.	PO5	P2,C3			6	R,Q,T
CO2	Be able to **analyze** the characteristics of sampled and reconstructed signals and evaluate international IEEE standards.	PO8	C4	1		7	R,Q,T
CO3	Be able to **compare** different multiplexing techniques by physically implementing the circuits.	PO10	P1	2			R, Q, T, Pr
CO4	Be able to **explain** the circuit diagrams of digital modulation techniques and **design** a project of communication network.	PO11	P3, A2	1	1		R,Q,T,PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 309 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	Be able to **construct** the circuits to understand the analogue modulation techniques.					2							
CO2	Be able to **analyze** the characteristics of sampled and reconstructed signals and evaluate international IEEE standards.								2				
CO3	Be able to **compare** different multiplexing techniques by physically implementing the circuits.										2		
CO4	Be able to **explain** the circuit diagrams of digital modulation techniques and **design** a project of communication network.											2	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiments	42 14 28
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	89
Formal Assessment Continuous Assessment Final Examination	2 3
Total	136

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	Amplitude Modulation and Demodulation.
Week 2	DSB-SC and SSB Modulation and Demodulation.
Week 3	Frequency Modulation and Demodulation.
Week 4	Sampling Signal and Reconstruction.
Week 5	PCM Modulation and Demodulation.
Week 6	Time Division Multiplexing and Demultiplexing
Week 7	Lab Test-1
Week 8	Delta Modulation and Demodulation
Week 9	ASK Modulation and Demodulation
Week 10	FSK Modulation and Demodulation
Week 11	PSK Modulation and Demodulation
Week 12	Lab Test-2

Week 13	Lab Quiz
Week 14	Project Presentation and Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO1	P2,C3
			CO2	C4
			CO3	P1
			CO4	P3, A2
	Labtest-1, Labtest-2	30%	CO1	P2,C3
			CO2	C4
			CO3	P1
			CO4	P3, A2
	Project and Presentation	25%	CO4	P3, A2
Lab Quiz			CO1	P2,C3
			CO2	C4
			CO3	P1
			CO4	P3, A2
Total Marks		100%		

(CO= Course Outcome, C= Cognitive Domain, P= Psychomotor Domain, A= Affective Domain)

TEXT AND REFERENCE BOOKS

1. Modern Digital & Analog Communication System - B. P. Lathi; Oxford University Press.
2. Communication System – Simon Haykin; John Wiley & Sons, Inc.

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.1.21. EECE 311: Digital Signal Processing-I
Level-3 Term-II (Fall)

COURSE INFORMATION

Course Code Course Title	: EECE 311 : Digital Signal Processing-I	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE-301
Course title: Continuous Signals and Linear System

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To familiarize the students with the basics of digital signal processing like analog to digital conversion and vice-versa, sampling, quantization, aliasing etc. Understanding and analyzing capacity development of LTI systems with difference equation in time domain. Being conversant with Z transform and its applications and learn to analyze DT signal and systems in frequency domain. Utilizing the knowledge in solving complex analytical practical problems related to digital signals processing like digital filter design. In this course, therefore, the students will learn the necessity and scope of DSP in various systems and how to use the relevant tools and techniques for processing of digital signals and implementing digital systems.

OBJECTIVE

1. Be able to deliver fundamental knowledge on discrete time signals and systems, their classification, core properties, representation and conversion of analog signal to digital signal with discussion on problem of aliasing.

2. Be able to apprise the students with characteristics, response and state of LTI systems for varying conditions.
3. Be able to familiarize the students with Z-transform, inverse Z-transform and analysis of LTI systems.
4. Be able to apprise the students with frequency domain analysis of discrete time signals and systems to explore engineering problems.
5. Be able to impart in depth knowledge to enable students to design digital filters.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** different signals and systems, their basic properties, representation and conversion.	PO1	C2			2,3	T, F
CO2	Be able to **determine/compute** convolution sum and FIR and IIR systems solving from difference equation.	PO1	C3, P3			2,3	T, Mid Term Exam
CO3	Be able to **analyze** discrete time signals and systems with Z-transforms,DTFS, DTFT, DFT and FFT.	PO3	C4, P3	1		5	Mid Term Exam, F, ASG
CO4	To be able to **design** FIR and IIR filters adopting various techniques to solve real life engineering problems.	PO2	C6, A2, P4	1,2,7	2	6	F, PR/ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to digital signal processing (DSP): Discrete-time signals and systems, analog to digital conversion, impulse response, finite impulse response (FIR) and infinite impulse response (IIR) of discrete-time systems, difference equation, convolution, transient and steady state response.
Discrete transformations: Discrete Fourier series, discrete-time Fourier series, discrete Fourier transform (DFT) and properties, fast Fourier transform (FFT), inverse fast Fourier transform.
Z transformation: Properties, transfer function, poles and zeros and inverse Z transform.
Correlation: Circular convolution, auto-correlation and cross correlation.
Digital Filters: FIR filters-linear phase filters, specifications, design using window, optimal and frequency sampling methods, IIR filters – specifications, design using impulse invariant, bi-linear Z transformation, least-square methods and finite precision effects.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **understand** different signals and systems, their basic properties, representation and conversion.	3											
CO2	Be able to **determine/compute** convolution sum and solution of FIR and IIR systems from solving difference equation.	3											
CO3	Be able to **analyze** discrete time			3									

	signals and systems with Z-transforms,DTFS, DTFT, DFT and FFT.												
CO4	To be able to **design** FIR and IIR filters adopting various techniques to solve real life engineering problems.		2										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Discrete Time Signals and Systems**	CT 1
Class 1	Basic elements of a digital signal processing system	
Class 2	Advantages and (Application) of digital signals and classification of signals.	
Class 3	Continuous and discrete time sinusoidal signals	
Week 2	**Discrete Time Signals & Systems**	
Class 4	Sampling of analog signals and sampling theorem	
Class 5	Quantization of continuous amplitude and sinusoidal signals	
Class 6	Coding of quantized samples and digital to analog conversion	
Week 3	**Discrete Time Signals & Systems (Contd.)**	
Class 7	Elementary discrete time signals, classification and manipulation of discrete time signals	
Class 8	Input-output description of systems and block diagram representations of discrete time systems	
Class 9	Resolution of a discrete time signal into impulses	
Week 4	**Discrete Time Signals & Systems and Correlation (Contd.)**	CT 2
Class 10	Response of LTI systems to arbitrary inputs: the convolution sum	
Class 11	Solution of linear constant coefficient difference equations	
Class 12	Cross-correlation sequences	
Week 5	**Correlation and Z-transformation (Contd.)**	
Class 13	Autocorrelation sequences	
Class 14	Z-transform: direct and inverse	
Class 15	Properties of Z-transform	
Week 6	**Z-transformation (Contd.)**	
Class 16	Rational Z-transforms: Poles and zeros	
Class 17	Pole location and time domain behavior for causal signals	

Class 18	The system function of a linear time-invariant system	
Week 7	**Z-transformation (Contd.)**	Mid Term
Class 19	Inversion of Z-transform by power series expansion	
Class 20	Inversion of Z-transform by partial fraction expansion	
Class 21	Solving of mathematical problems regarding inversion of Z-transform	
Week 8	**Discrete Transformations**	
Class 22	Frequency analysis of continuous time signals	
Class 23	Frequency analysis of discrete time signals	
Class 24	Fourier series and power density spectrum of periodic signals	
Week 9	**Discrete Transformations (Contd.)**	
Class 25	Fourier transform and energy density spectrum of aperiodic signals	
Class 26	Properties of the Fourier transform for discrete time signals	
Class 27	Ideal sampling of continuous time signals	
Week 10	**Discrete Transformations (Contd.)**	CT 4
Class 28	Ideal reconstruction of continuous time signals	
Class 29	Discrete time processing of continuous time signals	
Class 30	The Discrete Fourier Transform (DFT)	
Week 11	**Discrete Transformations (Contd.)**	
Class 31	Periodicity, linearity and symmetry properties of DFT	
Class 32	Circular convolution	
Class 33	Efficient computation of the DFT: FFT algorithm, Inverse FFT	
Week 12	**Digital Filters**	
Class 34	Implementations of FFT algorithm	
Class 35	Introduction of digital filters: FIR and IIR filters	
Class 36	Characteristics of digital filters	
Week 13	**Digital Filters (Contd.)**	
Class 37	Designing of FIR filters with window method	
Class 38	Designing of FIR filters with optimal method	
Class 39	Designing of FIR filters with Frequency Sampling method	
Week 14	**Digital Filters (Contd.)**	
Class 40	Designing of IIR filters with bi-linear Z-transform method	
Class 41	Designing of IIR filters with Least Square method	
Class 42	Review Class.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C2, C3, P3
			CO3	C4, P3
	Class Participation	5%	CO3	C4, P3
	Class Attendance	5%	-	-
	Mid term	10%	CO 2, CO3	C3, C4, P3
Final Exam		60%	CO 1, CO 3	C2, C4, P3
			CO 4	C6,A2,P4
Total Marks		100%		

(CO =Course Outcome, C= Cognitive Domain, P= Psychomotor Domain, A= Affective Domain)

TEXT AND REFERENCE BOOKS

1. Digital Signal Processing: Principles, Algorithms and Applications-John G. Proakis, Dimitris K Manolakis; Pearson Education.
2. Digital Signal Processing – Emmanuel C. Ifeachor & Barrie w. Jervis; Addision,

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.1.22. EECE 312: Digital Signal Processing-I Laboratory
Level-3 Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 312 : Digital Signal Processing-I Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
Course Code: EECE 311 Course Title: Digital Signal Processing I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To teach the students the analyze the fundamental properties of different types of signals and signals for real life application using MATLAB simulation tool. It is targeted to provide a basic foundation for designing communication systems using hardware and computer aided tools.			
OBJECTIVE			
1. To impart the students in-depth knowledge about the basic concepts of signals and systems and their interconnections in a simple and easy-to-understand manner through different mathematical operations like folding, shifting, scaling, convolutions, etc. using MATLAB 2. To familiarize the students to determine the transfer function and predict frequency response of discrete-time systems by applying various techniques like Z-transform, DFT and FFT using MATLAB 3. To impart the basic knowledge of design and compose digital IIR and FIR filters using filter approximation theory, for optimal cost. 4. Be familiarize the students to develop engineering design and report writing skills with the help of project work.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	To acquire basic knowledge of generation of different signals and convert analog signal into digital signals and vice-versa for real life applications.	PO1	P1	1	1	1, 2	R, Q, LT
CO2	To explain frequency response of the systems using frequency transformation technique, DFT, DIF-FFT or DIT-FFT algorithm, window techniques and visualization using MATLAB;	PO5	P2		1	6	R, Q, LT
CO3	To follow the design procedures of FIR and IIR filters for evaluating its performance along with noise reduction technique of complex communication channel in real life application.	PO12	P3	3	2,4	6	R, Q, LT
CO4	To perform as a group member and assist others during group projects and presentations.	PO10	A4				PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 311 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To acquire basic knowledge of generation of different signals and convert analog signal into digital signals and vice-versa for real life applications.	3											
CO2	To explain frequency response of the systems using frequency transformation technique, DFT, DIF-FFT or DIT-FFT algorithm, window techniques and visualization using MATLAB;					3							
CO3	To follow the design procedures of FIR and IIR filters for evaluating its performance along with noise reduction technique of complex communication channel in real life application.												3
CO4	To perform as a group member and assist others during group projects and presentations.										3		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	27
Lecture:	9
Experiment:	18
Self-Directed Learning	51
Preparation of Lab Reports	9
Preparation of Lab-test	10
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	18
Formal Assessment:	4
Continuous Assessment	3
Final Quiz	1
Total	82

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	To represent basic signal like: Unit Impulse, Ramp, Unit Step and Exponential and generation of discrete sine and cosine signals with given sampling frequency by MATLAB.
Week 2	To covert an analog signal into digital signal and vice-versa to calculate the quantization error using MATLAB.

Week 3	To develop a MATLAB program to perform cross-correlation, auto-correlation and circular convolution of two sequence.
Week 4	To write an MATLAB program to find discrete Fourier transform and Inverse discrete Fourier transform.
Week 5	To compute DFT and IDFT by DIT-FFT and DIF-FFT methods of a given sequence using MATLAB.
Week 6	To determine z-transform from a given transfer function and its ROC using MATLAB.
Week 7	Lab Quiz-1
Week 8	To write a MATLAB program for low pass, high pass and band pass filter using Butterworth approximation.
Week 9	To design analog filters (Low pass, high pass, band pass and band stop), IIR (Low pass, high pass, band pass and band stop) and FIR filters (Window Technique) using MATLAB
Week 10	To write a program to remove Salt & paper type noise from a given image 2. To change the colour of specific part of given image.
Week 11	Practice
Week 12	Lab Test
Week 13	Lab Quiz-2
Week 14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (70%)	Lab participation and Report	25%	CO 1	P1
			CO 2	P2
			CO 3	P3
	Lab Test	30%	CO 1	P1
			CO 2	P2
			CO 3	P3
	Project and Presentation	15%	CO4	A4
Lab Quiz		30%	CO 1	P1
			CO 2	P2
			CO 3	P3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Digital Signal Processing: Principles, Algorithms and Applications – Proakis & Manolakis.
2. Digital Signal Processing using MATLAB – Ingle & Proakis.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.23. EECE 313: Electrical Measurement, Instrumentation and Sensors
Level-3 Term-I (Spring)

COURSE INFORMATION

Course Code	: EECE 313	Contact Hours	: 3.00
Course Title	: Electrical Measurement, Instrumentation and Sensors	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 101, EECE 105, EECE 201 and EECE 207
Course Title: Electrical Circuits I, Electrical Circuits II, Electronics I and Electronics II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
To familiarize with a general measurement system; from the study of measurement execution with the help of various tools and sensory devices, conditioning/ converting the data obtained to a suitable format and finally making use of that suitable data for real life applications and relate to the recent measurement techniques used in industry and researches.

OBJECTIVE
1. To impart the knowledge of the basics of electrical and electronic measurement system components along with different methods of measurement. **2.** To develop the ability to analyze typical measurement data obtained and determine performance metrics. **3.** To divulge about prevailing measurement tools and techniques in order to develop the ability to improvise and handle measurements in a relatively new experimental scenario. **4.** To familiarize with the measurement methods and tools used in the industry and top-notch research facilities around the world.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** the basics of electrical and electronic measurement equipment and **explain** their characteristics along with different types of methods of measurement.	PO1	C2			1,3	T, F
CO2	Be adept in **analysing** measurement data and information with the help of study, design, and implementation and performance analysis of measurement systems.	PO4	C4	1		3	T, Mid Term Exam, F
CO3	Be competent in **evaluating**, debugging and improving the operation of a measurement system to **apply** to new, unexpected situations.	PO3	C5	2	2	5	Mid Term Exam, F
CO4	Be able to **estimate** the crucial part that measurement plays in industrial and scientific activities and to be familiar with criteria for sensors and transducers selection and **select** appropriate measurement methods for engineering tasks and scientific researches.	PO1	C2			2,3	Pr /ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Applications, functional elements of a measurement system and classification of instruments.

Measurement of electrical quantities: Current and voltage, power and energy measurement. Current and potential transformer.

Transducers: Mechanical, electrical and optical. Measurement of non-electrical quantities: Temperature, pressure, flow, level, strain, force and torque.

Basic elements of dc and ac signal conditioning: Instrumentation amplifier, noise and source of noise, noise elimination compensation, function generation and linearization, A/D and D/A converters, sample and hold circuits.

Data Transmission and Telemetry: Methods of data transmission, dc/ac telemetry system and digital data transmission. Recording and display devices. Data acquisition system and microprocessor applications in instrumentation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO 1	Be able to **define** the basics of electrical and electronic measurement equipment and **explain** their characteristics along with different types of methods of measurement.	3											
CO 2	Be adept in **analysing** measurement data and information with the help of study, design, and implementation and performance analysis of measurement systems.				2								
CO 3	Be competent in **evaluating**, debugging and improving the operation of a measurement system to **apply** new unexpected situations.			3									
CO 4	Be able to **estimate** the crucial part that measurement plays in industrial and scientific activities to be familiar with criteria for sensors transducers selection, **select** appropriate measurement method for engineering tasks and scientific researches.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Measurement System and Instrumentation**	CT 1
Class 1	Introduction on Measurement System.	
Class 2	Basic requirements, significance and methods of measurement.	
Class 3	Functional elements of a generalized measurement system and classification of instruments.	
Week 2	**Measurement Tools : Analog Meters**	
Class 4	Galvanometer: D'Arsonval type, Its construction and operating principle.	
Class 5	Galvanometer: Torque equation, Dynamic behaviour and equation of motion in various damping conditions.	
Class 6	Performance metrics: Sensitivities and damping conditions.	

Week 3	**Measurement Tools : Analog Meters**	
Class 7	Analog meters: PMMC meter, Its construction and operating principle.	
Class 8	Voltage and Current measurements: Rectifier based AC meter, multi-range meters. Instrument transformers: Introduction, uses, advantages, design considerations etc.	
Class 9	Power measurement: Electrodynamometer type meter movement; Energy measurement: Induction type meters. A brief overview on Smart Energy Meter.	
Week 4	**Measurement Tools: Electronic Devices Integration**	CT 2
Class 10	Power Factor meters: Familiarization with the DSP chip for electrical quantity measurement.	
Class 11	Electronic Analog meters: Use of electronic components (transistor, op-amp etc.) for better measurement systems, Energy metering ICs (brief overview)	
Class 12	Chronological development of measurement tools (meters) and gradual development in measurement methods.	
Week 5	**Electrical Transducers : Basics and Working Principle**	
Class 13	Transducers: Introduction, advantage of using Electrical Transducers.	
Class 14	Resistance, Inductance and Capacitive transducer.	
Class 15	Hall effect transducer and Optical transducer.	
Week 6	**Transducers : Spatial Variable Measurement**	
Class 16	Distance and Level measurement- Time of Flight method.	
Class 17	Anemometer, Ultrasonic and Turbine Flowmeter, Electromagnetic Flowmeter.	
Class 18	Tilt and Proximity sensing application in Robotics.	
Week 7	**Transducers : Thermal and Mechanical Variable Measurement**	Mid Term
Class 19	Thermocouple, Resistance Temperature Detector and Thermistor.	
Class 20	Thermal Imaging- Applications in heat signature detection, night vision and warfare.	
Class 21	Measurement of Strain, Force (piezoelectric sensors) and Torque.	
Week 8	**Transducers : Radiation and Wireless Instrumentation**	
Class 22	Radioactivity and Dosimetry measurement.	
Class 23	Wireless Sensing Node hardware and Technology.	
Class 24	Remotely located Autonomous sensors and transducers- Power issues	
Week 9	**Error Analysis**	
Class 25	Typical errors in measurement methods and data obtained from transducers and meters.	
Class 26	Practical design issues in electrical quantity measurement: Loading effect and linearity between input and output of measurement system, accuracy and precision.	
Class 27	Statistical analysis of errors and deviations, performance metrics of the measurement tools.	
Week 10	**Noise Performance Analysis**	CT 3
Class 28	Noise in a measurement system: Typical source of noise in a measurement system.	
Class 29	Types of noise in measurement system- Electromagnetic Interference, Inductive and Capacitive coupling.	
Class 30	Techniques for compensation of noise: Shielding, Filtering and Ground isolation.	
Week 11	**Measurement Data/Signal Conditioning**	
Class 31	Overview of data/signal conditioning: Noise elimination and	

	compensation, Amplification, Linearization.	
Class 32	Isolation of the output from the input: Buffering and Impedance matching.	
Class 33	Protection of the measurement devices from high current/voltage signal: Zener regulator, Opto-isolator, Fuse etc.	
Week 12	**Measurement Data/Signal Conditioning**	
Class 34	Different methods in use: A\D and D\A conversion for suitable output devices and data acquisition.	
Class 35	A\D converters: Basics, techniques- parallel/flash, single slope (ramp), successive approximation, sample and hold circuit implementations.	
Class 36	D\A converters: Basics, Practical Circuits- weighted resistor and ladder type. Performance characteristics of A\D and D\A systems.	
Week 13	**Data Transmission, Telemetry and Data Presentation**	
Class 37	Data Acquisition and Distribution system: Microprocessor and embedded system applications.	
Class 38	Telemetry: Current, Voltage and Frequency telemetry. Telemetry in use: Application in biomedical and space applications.	
Class 39	Various types of user-end display devices and their interfacing with sensors and signal conditioning elements.	
Week 14	**Practical Measurement System Familiarization**	
Class 40	Different practical measurement system network analysis (1):Elementary systems	
Class 41	Different practical measurement system analysis (2):Elaborate systems	
Class 42	Review Class	

ASSESSMENT STRATEGY

Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C4
			CO4	C2
	Class Participation	5%	CO4	C2
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C4
			CO3	C5
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. ‘A Course in Electrical and Electronic Measurements and Instrumentation’ by A. K. Sawhney, 19th Revised Edition, Publisher: Dhanpat Rai and Sons, Delhi

2. ‘Electronic Instruments and Instrumentation Technology’, by M. M. S. Anand, @2004 by Prentice-Hall of India

3. ‘Modern Electronic Instrumentation and Measurement Techniques’ by A. D. Helfrick and W. D. Cooper, @1990 by Prentice-Hall Inc.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.24. EECE 314: Electrical Measurement, Instrumentation and Sensors Laboratory
Level-3 Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 314 : Electrical Measurement, Instrumentation and Sensors Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE
Course Code: EECE 313. Course Title: Electrical Measurement, Instrumentation and Sensors
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To familiarize the students with practical approach of measuring electrical and natural parameters. It is also targeted to perform some of the signal conditioning techniques (e.g. ADC/DAC). It is designed to teach the students how to adapt measurement devices with environmental variation and change of range of the measured. Finally, this course contains a project that may have real life applications, and students will develop communication skill engaging in different group activities.
OBJECTIVE
1. To provide the students hand on experience on measurement techniques and signal conditioning that are taught in theory. 2. To enable the students to adapt the measurement processes with variation of range and environment. 3. To develop communication skill of the students by engaging them with various group activities. 4. To introduce the students with a modern engineering tool (Proteus) that has wide application in industrial fields, and keep them in touch of MATLAB practice. 5. To enhance project and finance management skill of the students.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **measure** different electrical and nonelectrical parameters by **assembling** measurement circuits.	PO9	P4	1		3	T, Mid Term, ASG, F
CO2	Achieve ability to **calibrate** measurement equipment and **explain** their accuracy and precision.	PO5	P5	1		6	T, Mid Term, F, ASG
CO3	Be adept to **change** experimental setups in order to vary its range and **adapt** with environmental variation.	PO9	P6	1,2		5	T, Mid Term, ASG, F
CO4	Be able to construct real life project independently and verify for real world application to achieve life-long learning.	PO12	A5, P7	2,3	2,3	8	T, Mid Term, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 313 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	Be able to **measure** different electrical and nonelectrical parameters by **assembling** measurement circuits.									3			
CO2	Achieve ability to **calibrate** measurement equipment and **explain** their accuracy and precision.					3							
CO3	Be adept to **change** experimental setups in order to vary its range and **adapt** with environmental variation.									3			
CO4	Be able to construct real life project independently and verify for real world application to achieve life-long learning.												3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 10 20
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 20 4 5 5 20
Formal Assessment Continuous Assessment Final Quiz	 5 1
Total	90

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	Measurement of Medium Resistance Using Wheatstone Bridge, Low Resistance Using Kelvin Double Bridge and Simulation in Proteus.
Week 2	Range Extension of Ammeter and Voltmeter and Demonstration of Loading Effect.
Week 3	Measurement of Power by 2 Wattmeter Method and Energy Metering IC and Simulation in Proteus.
Week 4	Active Low-pass Butterworth Filter Design and Simulation in Proteus and MATLAB.
Week 5	Lab Test-01
Week 6	Measurement of Capacitance Using 555 Timer IC and Simulation in Proteus.
Week 7	Measurement of Self-inductance by Maxwell’s Capacitance Bridge and Simulation in Proteus.
Week 8	Inductive Displacement Sensor (LVDT) and Ultrasonic Displacement Sensor Interfaced with Arduino: Simulation in Proteus and Implementation.
Week 9	Touch and Position Sensor Using Capacitive Transducer: Simulation in Proteus and Implementation.
Week 10	Implementation of Resistance Temperature Detector (RTD) to Measure Temperature and Simulation in Proteus.
Week 11	Implementation of an 8-bit Analog to Digital (A/D) Converter and Simulation in Proteus.
Week 12	Lab Test-2
Week 13	Project Submission and Presentation

Week 14	Lab Quiz

ASSESSMENT STRATEGY				
Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	P4
			CO 2	P5
			CO 3	P6
	Lab test-1, Lab test-2	30%	CO 1	P4
			CO 2	P5
			CO 3	P6
	Project and Presentation	25%	CO4	A5, P7
Lab Quiz		25%	CO 1	P4
			CO 2	P5
			CO 3	P6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. A Course in Electrical and Electronic Measurements and Instrumentation - A. K. Sawhney
2. Measurement and Instrumentation Principle – Alan Morris (3rd Ed.)

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.25. EECE 315: Electrical Properties of Material
Level-3 Term-I (Spring)

COURSE INFORMATION

Course Code Course Title	: EECE 315 : Electrical Properties of Material	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To provide the student an excellent opportunity to prepare themselves for advanced study in a variety of different areas of solidstate engineering and material science: metals, semiconductors, superconductors, optical, magnetic and amorphous materials. This course is meant to create the background needed to understand the physics of device operations and also prepare students for advanced courses in solid state and quantum electronics.

OBJECTIVE

1. Be able to familiarize with atomic structure-property relationships and engineering of materials to perform well in a specific electrical application.
2. Be able to introduce basic concepts of quantum physics to analyze dynamics of particle like electron and photon.
3. Be able to stress the importance of magnetic materials, their properties and applications in electrical engineering.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Acquiring ability to **infer** the physics of electron theory, atomic structure, atomic bonds, crystal structure, crystal geometry and crystal defects	PO1	C2	1		3	ASG, T, Mid Term Exam, F

	and its application to a broad range of materials.						
CO2	Achieving capability to **analyze** the modern physical principles underlying electrical conduction and magnetism in a range of materials.	PO1	C4			2	T, Mid Term Exam, F
CO3	Becoming adept in **solving** Schrödinger's equation for for one/two-dimensional potential barrier problem and applying the concept to design semiconductor devices.	PO3	C3	3		2	ASG, PR, F
CO4	Getting in-depth knowledge to **interpret** the physics of magnetic phase transitions and superconductivity.	PO1	C5			3	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

1. Crystal structures: Types of crystals, lattice and basis, Bravais lattice and Miller indices.
2. Classical theory of electrical and thermal conduction: Scattering, mobility and resistivity, temperature dependence of metal resistivity, Mathiessen's rule, Hall effect and thermal conductivity.
3. Introduction to quantum mechanics: Wave nature of electrons, Schrodinger's equation, one-dimensional quantum problems - infinite quantum well, potential step and potential barrier; Heisenbergs's uncertainty principle and quantum box.
4. Band theory of solids: Band theory from molecular orbital, Bloch theorem, Kronig-Penny model, effective mass, density-of-states.
5. Carrier statistics: Maxwell-Boltzmann and Fermi-Dirac distributions, Fermi energy.
6. Modern theory of metals: Determination of Fermi energy and average energy of electrons, classical and quantum mechanical calculation of specific heat.
7. Dielectric properties of materials: Dielectric constant, polarization - Electronic, ionic and orientational; internal field, Clausius-Mosotti equation, spontaneous polarization, frequency dependence of dielectric constant, dielectric loss and piezoelectricity.
8. Magnetic properties of materials: Magnetic moment, magnetization and relative permittivity, different types of magnetic materials, origin of ferromagnetism and magnetic domains.
9. Introduction to superconductivity: Zero resistance and Meissner effect, Type I and Type II superconductors and critical current density.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Acquiring ability to **infer** the physics of electron theory, atomic structure, atomic bonds, crystal structure, crystal geometry and crystal defects and its application to a broad range of materials.	3											
CO2	Achieving capability to **analyze** the modern physical principles underlying electrical conduction and magnetism in a range of materials.	3											
CO3	Becoming adept in **solving**			2									

	Schrödinger's equation for for one/two-dimensional potential barrier problem and applying the concept to design semiconductor devices.												
CO4	Getting in-depth knowledge to **interpret** the physics of magnetic phase transitions and superconductivity.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Crystal structures**	CT 1
Class 1	Types of crystals, lattice and basis	
Class 2	Types of crystals, lattice and basis	
Class 3	Types of crystals, lattice and basis,	
Week 2	**Crystal structures**	
Class 4	Bravais lattice and Miller indices	
Class 5	Bravais lattice and Miller indices	
Class 6	Bravais lattice and Miller indices	
Week 3	**Classical theory of electrical and thermal conduction**	
Class 7	Scattering	
Class 8	Mobility and resistivity	
Class 9	Mobility and resistivity	
Week 4	**Classical theory of electrical and thermal conduction**	Mid-term
Class 10	Temperature dependence of metal resistivity,Mathiessen's rule	
Class 11	Temperature dependence of metal resistivity,Mathiessen's rule	
Class 12	Hall effect and thermal conductivity.	
Week 5	**Introduction to quantum mechanics**	
Class 13	Wave nature of electrons	
Class 14	Wave nature of electrons	
Class 15	Heisenbergs's uncertainty principle	
Week 6	**Introduction to quantum mechanics**	
Class 16	Schrodinger's equation	
Class 17	Schrodinger's equation	
Class 18	Potential step and potential barrier, One-dimensional quantum problems	

	- infinite quantum well	
Week 7	**Introduction to quantum mechanics**	CT 3
Class 19	One-dimensional quantum problems - infinite quantum well	
Class 20	Quantum box	
Class 21	Quantum box	
Week 8	**Band theory of solids**	
Class 22	Band theory from molecular orbital	
Class 23	Band theory from molecular orbital	
Class 24	Density-of-states	
Week 9	**Band theory of solids**	
Class 25	Bloch Theorem	
Class 26	Kronig-Penny model	
Class 27	Kronig-Penny model, effective mass	
Week 10	**Carrier statistics**	
Class 28	Maxwell-Boltzmann and Fermi-Dirac distributions, Fermi energy	
Class 29	Determination of Fermi energy and average energy of electrons	
Class 30	Classical and quantum mechanical calculation of specific heat	
Week 11	**Dielectric properties of materials**	CT 4
Class 31	Dielectric constant, polarization - Electronics	
Class 32	Ionic and orientational, internal field	
Class 33	Clausius-Mosotti equation	
Week 12	**Dielectric properties of materials**	
Class 34	Spontaneous polarization	
Class 35	Frequency dependence of dielectric constant	
Class 36	Dielectric loss and piezoelectricity	
Week 13	**Magnetic properties of materials**	
Class 37	Magnetic moment, magnetization and relative permittivity	
Class 38	Different types of magnetic materials, origin of ferromagnetism and magnetic domains.	
Class 39	**Introduction to superconductivity**	
Class 39	Zero resistance and Meissner effect	
Week 14	**Introduction to superconductivity**	
Class 40	Zero resistance and Meissner effect	
Class 41	Type I and Type II superconductors and critical current density.	
Class 42	Students' Presentation on selected topics.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO-1	C2
			CO-2	C4
			CO-4	C5
	Class Participation	5%	CO-1, CO-3	A2
	Class Attendance	5%	-	-
	Mid term	10%	CO 1, CO2	C2, C4
Final Exam		60%	CO-1, CO-2	C2, C4
			CO-3 , CO-4	C3, C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Principles of Electrical Engineering Materials and Devices - S. O. Kasap; Irwin McGrawHill.
2. Electrical Engineering Material – A. J. Dekker; Prentice Hall of India Private Ltd.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.26. EECE 317: VLSI I
Level-3 Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 317 : VLSI I	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

EECE-201- Electronics I, EECE-303-Digital Electronics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To familiarize the students with the steps of fabrication, techniques to implement any arbitrary logic function in different circuit families. This course is also designed to teach the students how to calculate edge times, delay and power of MOS circuits, how to draw stick diagram and layouts maintaining the well-established design rules. Principles of Subsystems, Memory Cells, ALU and Adders and Amplifiers are taught that are widely required in electronics industry.

OBJECTIVE

1. To teach the elementary Fabrication steps and working principle of different circuit families to implement logic functions.
2. To familiarize students with edge times, delay and power calculation of MOS circuits.
3. To impart the knowledge of Layout, Design Rules of Layout to the students.
4. To develop Subsystems and Memory Cell design skills of the students and engage them in using modern engineering tools, e.g. Cadence, Proteus and Quartus.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **interpret** the steps of Fabrication, **implement** any logic function using NMOS, CMOS and other circuit families.	PO1	C3			1,3	T, Mid Term, ASG, F
CO2	Be able to **comprehend** non ideal characteristics of MOS devices and **apply** this knowledge in analysing performances of amplifiers and logic gates.	PO1	C3	1		1,2	T, Mid Term, F, ASG
CO3	Be adept to **compute** power and delay of MOS circuits and **design** MOS circuits for desired power delay performance.	PO1	C6	1		2	T, Mid Term, ASG, F
CO4	Be adroit to **draw** Stick Diagram and Layout maintaining the lambda-based Design Rules, **design** Subsystems, Memory Cells.	PO3	C3, P7	1,2	1	5	T, F, ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

VLSI technology: Top down design approach, technology trends and design styles. **Review of MOS transistor theory:** Threshold voltage, body effect, I-V equations and characteristics, latch-up problems, NMOS inverter, CMOS inverter, pass-transistor and transmission gates.
CMOS circuit characteristics and performance estimation: Resistance, capacitance, rise and fall times, delay, gate transistor sizing and power consumption.
CMOS circuit and logic design: Layout design rules and physical design of simple logic gates.

CMOS subsystem design: Adders, multiplier and memory system, arithmetic logic unit. Programmable logic arrays. I/O systems. VLSI testing.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **interpret** the steps of Fabrication, **implement** any logic function using NMOS, CMOS and other circuit families.	3											
CO2	Be able to **comprehend** non ideal characteristics of MOS devices and **apply** this knowledge in analysing performances of amplifiers and logic gates.	3											
CO3	Be adept to **compute** power and delay of MOS circuits and **design** MOS circuits for desired power delay performance.	3											
CO4	Be adroit to **draw** Stick Diagram and Layout maintaining the lambda-based Design Rules, **design** Subsystems and Memory Cells.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1		CT 1
Class 1	Brief History	
Class 2	Integrated Circuits Trends, Choice of Technology and Various Design Approaches	
Class 3	nMOS Fabrication & CMOS Fabrication	
Week 2		
Class 4	Thermal Aspects of Processing	
Class 5	BiCMOS technology	
Class 6	Production of E-beam Masks	

Week 3		
Class 7	MOS Capacitor	
Class 8	MOS Device Design Equations	
Class 9	MOS Transconductance	
Week 4		CT 2
Class 10	Nonlinear Behavior of MOS Device, Mobility Degradation,Velocity Saturation	
Class 11	Channel Length Modulation, Threshold Voltage Effect	
Class 12	Leakage, Pass Transistor and Pass Gate	
Week 5		
Class 13	MOS Layers	
Class 14	Stick Diagrams	
Class 15	Design Rules and Layout, Examples & Summary	
Week 6		
Class 16	Lambda-Based Design and Other Rules	
Class 17	Layout Diagrams	
Class 18	Basic Physical Design of Simple Logic Gates	
Week 7		Mid Term
Class 19	MOS Biasing	
Class 20	CS Stage with Diode Connected Load	
Class 21	MOS Device as Current Source	
Week 8		
Class 22	CS Stage with Current-Source Load	
Class 23	CS Stage with Degeneration	
Class 24	Source Follower (Common-Drain), Common-Gate Stage	
Week 9		
Class 25	Architectural Issues	
Class 26	Switch Logic, Pull up and Pull down Network	
Class 27	Gate Logic, Compound Logic	
Week 10		CT3
Class 28	Clocked Circuits	
Class 29	ALU Subsystem, Adders, Multipliers, Memory Arrays	
Class 30	Examples & Summary	
Week 11		
Class 31	DC Response for Resistive load, Saturated Load, and Linear Load Inverter	
Class 32	DC Response of CMOS Inverter, NAND, NOR	
Class 33	Noise Margin and Beta Ratio Effects	
Week 12		
Class 34	Transient Response and Delay Estimation	
Class 35	Elmore Delay and Delay Estimation Using Elmore Delay	
Class 36	Examples & Summary	
Week 13		
Class 37	Power in Circuit Elements	
Class 38	Switching Power	
Class 39	Power Dissipation Sources	
Week 14		
Class 40	Dynamic Power and Dynamic Power Reduction	
Class 41	Activity Factor Estimation	
Class 42	Stack Effect and Power Gating, Examples & Summary	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1	C3

Assessment (40%)			CO 2	C3
			CO 3	C6
			CO 4	C3, P7
	Class Participation	5%	CO 4	C3, P7
	Class Attendance	5%	-	-
	Mid term	10%	CO1	C3
			CO 2	C3
			CO 3	C6
			CO 4	C3, P7
Final Exam		60%	CO1	C3
			CO 2	C3
			CO 3	C6
			CO 4	C3, P7
			CO 5	C6, P7
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Basic VLSI Design by Douglas A. Pucknell; Prentice Hall of India private Ltd.
2. CMOS VLSI Design - A Circuits and System Perspective by N. H. E. Weste and D. Harris.
3. Fundamentals of Microelectronics by Behzad Razavi, MacGraw Hill International

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.27. EECE 318: VLSI I Laboratory
Level-3 Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 318 : VLSI I Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE	
Course Code: EECE 317 Course Title: VLSI I	Course Code: EECE 303 Course Title: Digital Electronics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is an introduction to concepts associated with the analysis and design of integrated circuits (IC) in the state of the art CMOS technologies. Continuous advances in microelectronics and Very Large Scale of Integration (VLSI) made an entire electronic system on a single chip (SoC) possible. Design and manufacturing of semiconductor devices present unique challenges, especially at the conceptual and design levels, therefore computer-assisted design (CAD) methods are sought to help manage these complex design. The major aim of this course is to give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon. This paves the way of exposure to CAD tools like Microwind, DSCH2 and Quartus II, which are essential for the VLSI design process. After completion of this course students will be prepared for leading edge positions in industry of VLSI with a firm grasp of the modern design simulation tools.

OBJECTIVE

1. To introduce the concepts and techniques of modern integrated circuit design starting from the idea and behavioural modelling to detailed circuit design at transistor level, circuit layout, and final verifications.
2. To develop knowledge and experience of using professional CAD tools (e.g Microwind,

DSCH2, Quartus II and FPGA) for design and simulation process.
3. To highlight the circuit design rules in the context of integrated circuit mask layout design.
4. To demonstrate a clear understanding in Verilog hardware description language (VHDL) followed by implementation of a system on FPGA board.
5. To provide hands on design experience with professional designing platforms through presentation and mini projects.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **construct** the mask layout and schematic design of any CMOS logic circuits and **compute** simulations using suitable CAD tools.	PO5	C3	1,3	-	6	R,Q,T
CO2	Be able to **analyse** the functionality, timing, power, and parasitic effects from the simulation output and **detects** the interconnection delay and noises.	PO1	C4	-	-	4	R,Q,T
CO3	Be able to **adapt** and **adhere** to CMOS technology-specific layout rules in the placement and routing of transistors and **evaluate** the most effective solution in order to achieve optimized design operation.	PO4	C5	2,3	-	8	R,Q,T
CO4	Be able to **practice** different Combinational and Sequential circuits using hardware description language -Verilog HDL and to **perform** a significant VLSI design projects and presentations.	PO9	C4	1	-	4,5, 6	R,Q,T, PR,Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 313 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **construct** the mask layout and schematic design of any CMOS logic circuits and **compute** simulations using suitable CAD tools.					3							
CO2	Be able to **analyse** the functionality, timing, power, and parasitic effects from the simulation output and **detects** the interconnection delay and noises.	2											
CO3	Be able to **adapt** and **adhere** to CMOS technology-specific layout rules in the placement and routing of transistors and **evaluate** the most effective solution in order to achieve optimized design operation.				1								

CO4	Be able to **practice** different Combinational and Sequential circuits using hardware description language - Verilog HDL and **perform** a significant VLSI design projects and presentations.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	27
Self-Directed Learning	45
Formal Assessment	02
Total	74

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	C3
			CO 2	C4
			CO 3	C5
			CO4	C4
	Labtest-1,Labtest-2	30%	CO 1	C3
			CO 2	C4
			CO 3	C5
			CO 4	C4
	Project and Presentation	25%	CO4	C4
Lab Quiz		25%	CO 1	C3
			CO 2	C4
			CO 3	C5
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. CMOS VLSI Design: A Circuits and Systems Perspective by Neil H.E. Weste, David Harris, Ayan Banerjee.
2. Basic VLSI Design by Douglas A. Pucknell, Kamran Eshraghian.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.28. EECE 222: Electrical Services Design and CAD Laboratory
Level-2 Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 222	Contact Hours	: 4.00
Course Title	: Electrical Services Design and CAD Laboratory	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course will provide a grounding in electrical services and equipment and a better appreciation of many of the issues associated with the design, installation and maintenance of electrical systems. Students will develop their own engineering judgement and confidence when dealing with electrical issues in the practice arena.

OBJECTIVE

1. To instil the knowledge of building codes and standards that is essential for the professionalism in the field of services design.
2. To provide the foundation of Electrical fixtures their layout and the wiring concepts for industrial and residential buildings.
3. To incorporate the concepts of total load calculation and substation design for the transmission of power throughout the building and from the transmission lines.
4. To familiarize with design tools such as AutoCAD for electrical fixture layout and wiring.
5. To instigate arenas of modern electrical home improvement opportunities and electrical safety standards for residential and industrial buildings.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Capable of **describing** and **adhering** the codes and standards related in particular to electrical services in the nation and the world in general.	PO6	P1 C6 A6	1		7	R, Q, T, Pr, PR
CO2	Proficient in **designing** electrical services package and also **manipulate** constraints for efficient design in the field.	PO4	C6 P6	2 3 4	2	5	R, Q, T, Pr, PR
CO3	Use modern CAD tools and propose effective electrical wiring with layout plans to achieve life-long learning in electrical Services design.	PO12	A3 C3	2 3 4		6	R, Q, T, Pr, PR
CO4	Adapt smart electrical amenities for comfort and demonstrate the use of solar cell considering the environmental context and sustainable solution.	PO7	P6 C3 A3	2	3	7	R, Q, T, Pr, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to codes and standards, AutoCAD 2D and 3D for building services design, wiring system design, drafting, and estimation. Design for illumination and lighting. Electrical installations system design: substation, BBT and protection, air-conditioning, heating and lifts. Design for intercom, public address systems, telephone system and LAN. Design of security systems including CCTV, fire alarm, smoke detector, burglar alarm, and sprinkler system. A design problem on a multi-storied building.

CO-PO MAPPING

Ser	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Capable of **describing** and **adapting** the codes and standards related in particular to electrical services in the nation and the world in general.						3						
CO2	Proficient in **designing** electrical services package and also **manipulate** constraints for efficient design in the field.				3								
CO3	Use modern CAD tools and propose effective electrical wiring with layout												3

	plans to achieve life-long learning in electrical Services design.												
CO4	Adapt smart electrical amenities for comfort and demonstrate the use of solar cell considering the environmental context and sustainable solution.							3					

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 28 28
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 30 5 5 5 24
Formal Assessment Continuous Assessment Final Quiz	 14 2
Total	121

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week	**Name of the Topic**
Week 1	Introduction to Electrical Services for buildings and industries and Codes and Standards for electrical designs. (Introduction to BNBC)
Week 2	Familiarization with 2D and 3D AutoCAD Tools
Week 3	Electrical fixture layout and wiring for residential, commercial and industrial buildings (light, fan, conduit layout and circuit diagram)
Week 4	Electrical fixture layout and wiring for residential, commercial and industrial buildings (Power outlet, Telephone, TV-antenna, Conduit layout and Circuit diagram).
Week 5	Lighting load Calculation, External lighting and external area electrification.
Week 6	Cable specifications, Low voltage and essential power distribution inside building, Design of substation using Single Line diagram.
Week 7	Electrical load calculation and Preparation of Bill of Quantities.
Week 8	Telephone and Paging system, CCTV, TV-Transmitter antenna signal distribution.
Week 9	Fire detection & alarm system. Earthing, lightning protection and incorporation of Solar Power
Week 10	Earthing, lightning protection and incorporation Solar Power to Electrical Distribution System.
Week 11	Modern smart devices for improvements of comforts and home security.
Week 12	Project Presentation
Week 13	Lab Test
Week 14	Quiz Test

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous	Lab	20%	CO 1	P1, C6, A6

Assessment (40%)	Participation and Report		CO 2	C6, P6
			CO 3	A3, C3
			CO 4	P6, C3, A3
	Lab Test	30%	CO 1	P1, C6, A6
			CO 2	C6, P6
			CO 3	A3, C3
			CO 4	P6, C3, A3
	Project and Presentation	25%	CO 1	P1, C6, A6
			CO 2	C6, P6
			CO 3	A3, C3
			CO 4	P6, C3, A3
Lab Quiz		25%	CO 1	P1, C6, A6
			CO 2	C6, P6
			CO 3	A3, C3
			CO 4	P6, C3, A3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Design of Electrical Services for Buildings by Barrie Rigby
2. Electrical Wiring Estimating & Costing by S L Uppal

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.29. EECE 401: Control System I
Level-4 Term-I (Spring)

COURSE INFORMATION

Course Code	: EECE 401	Contact Hours	: 3.00
Course Title	: Control System I	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE-201 Course Title: Electronics I Course Code: EECE-207 Course Title: Electronics II	Course Code: EECE- 301 Course Title : Continuous Signals and Linear system

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Control Systems is the study about the analysis and regulation of the output behaviours for dynamical systems which is subjected to input signals. The concepts and tools discussed in this course can be applicable in a wide spectrum of engineering disciplines such as mechanical, electrical, aerospace, manufacturing, and biomedical engineering. The emphasis of this course will be on the basic theories and feedback controller design methods of linear time-invariant systems.

OBJECTIVE

1. Introduce the students with the illustration of various control systems using block diagram/ Signal flow Graph (SFG) as well as the reduction of complicated system to a simplified one.
2. Impart the basic knowledge of electrical system, mechanical system and electro-mechanical system including with their inter-conversion and system transfer function.
3. Use Routh’s stability criteria, root locus technique, Bode diagram and Nyquist stability criteria to analyse the system stability.
4. Impart the in-depth theoretical knowledge of control system engineering to design the practical controlling algorithm.

COURSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcome	Corresponding POs	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Change** the complicated control system into a more simplified form with single transfer function.	PO1	C6	1		3	T, F
CO2	**Evaluate** the output characteristics of pneumatic, hydraulic, and even heat transfer systems with the specified input.	PO1	C5	1		3	T, Mid Term Exam, F
CO3	**Interpret** the basic concepts of stability for various control systems from both the classical and the state-space viewpoints.	PO1	C2	2		3	T, Mid Term Exam, F
CO4	**Design** a feedback control system in both calculation and simulation satisfying the transient and steady state specification for a given practical system.	PO3	C6	3	3	5	ASG, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to control systems. Linear system models: Transfer function, block diagram and signal flow graph (SFG). State variables: SFG to state variables, transfer function to state variable and state variable to transfer function.

Feedback control system: Closed loop systems, parameter sensitivity, transient characteristics of control systems, effect of additional pole and zero on the system response and system types and steady state error. Routh stability criterion.

Analysis of feedback control system: Root locus method and frequency response method.

Design of feedback control system: Controllability and observability, root locus, frequency response and state variable methods. Digital control systems: introduction, sampled data systems, stability analysis in Z-domain.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Change** the complicated control system into a more simplified form with single transfer function.	3											
CO2	**Evaluate** the output characteristics of pneumatic, hydraulic, and even heat transfer systems with the specified input.	3											
CO3	**Interpret** the basic concepts of stability for various control systems from both the classical and the state-space viewpoints.	3											
CO4	**Design** a feedback control system in both calculation and simulation satisfying the transient and steady state specification for a given practical system.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42

Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Control System**	CT 1
Class 1	Introduction to Control System.	
Class 2	System Configurations: Open Loop Control System and Closed Loop Control System.	
Class 3	Transient Response, Steady-State Response and Stability.	
Week 2	**Modeling in the Frequency Domain**	
Class 4	Laplace Transform of a Time Function.	
Class 5	Transfer Functions with Mesh and Nodal Analysis of Electrical Network.	
Class 6	Transfer Functions of Inverting, Non-Inverting Operational Amplifiers.	
Week 3	**Modeling in the Frequency Domain**	
Class 7	Transfer Functions of Translational and Rotational Mechanical System	
Class 8	Transfer Functions for Systems with Gears and Electric Circuit Analogs: Series and Parallel Analog	
Class 9	Mathematical Problem related to Analogous conversion	
Week 4	**Modeling in the Time Domain**	CT 2
Class 10	Space State Representation of Electrical and Translational Mechanical Network	
Class 11	Conversion of a Transfer Function into State Space and State Space to a Transfer Function	
Class 12	Mathematical Problems related to Transfer Function and Space State Representation	
Week 5	**Time Response**	
Class 13	Poles, Zeros, and System Response of a 1^{st} and 2^{nd} order system.	
Class 14	Overdamped responses, Underdamped responses, Undamped responses, Critically damped responses	
Class 15	Designing Problems related to Settling time, Rise Time, %Over Shoot, of 1^{st} and 2^{nd} order system.	
Week 6	**Reduction of Multiple Subsystems**	
Class 16	Derivation of performance parameters of 1^{st} and 2^{nd} order system	
Class 17	Analysis and Design of Gain, Transient Response and Feedback Systems of a 1^{st} and 2^{nd} order system.	
Class 18	Signal-Flow Graphs and related Problems	
Week 7	**Reduction of Multiple Subsystems**	MT
Class 19	Mason’s Rule and Designing Problems related to Mason’s Rule	
Class 20	Controller Canonical Form and Observer Canonical Form related mathematical problems	
Class 21	Similarity Transformations and related mathematical problems	
Week 8	**Routh’s Stability Criteria**	
Class 22	Significance of Routh’s Stability Criteria	

Class 23	Special Case in Routh's Table : (i) Zero in the first column and (ii) Entire Row is Zero	
Class 24	Application of Routh's Table for system stability: Determination of K	
Week 9	**Control System Analysis by Root Locus Method**	
Class 25	Introduction to Root locus technique for system stability	
Class 26	Root Locus Analysis: Without Complex Conjugate Roots	
Class 27	Root Locus Analysis: Without Complex Conjugate Roots (cont.)	
Week 10	**Control System Analysis by Root Locus Method (cont.)**	CT 3
Class 28	Root Locus Analysis: With Complex Conjugate Roots	
Class 29	Root Locus Analysis: With Complex Conjugate Roots (cont.)	
Class 30	Mathematical problems regarding Root Locus system	
Week 11	**Control System analysis by frequency response technique**	
Class 31	Introduction to frequency response method	
Class 32	Introduction to Bode Diagram	
Class 33	Stability analysis using Bode Diagram	
Week 12	**Control System analysis by frequency response technique (cont.)**	
Class 34	Introduction to Polar plot	
Class 35	Stability analysis using Nyquist stability criteria	
Class 36	Nichols plots: Log-magnitude-versus-phase plot	
Week 13	**Root locus approach to control system design**	
Class 37	Introduction to compensator and controller for control system design	
Class 38	Design of series and parallel compensator	
Class 39	Design of PID controller : Industrial automation through PID controller	
Week 14	**Digital control systems**	
Class 40	Introduction to digital control system	
Class 41	Stability analysis in Z-domain	
Class 42	Class review and open discussion on the research scope in control system engineering	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C6
			CO2	C5
			CO 3	C2
	Class Participation	5%	CO 4	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO 2	C5
			CO3	C2
Final Exam		60%	CO 1	C6
			CO 2	C5
			CO 3	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Control Systems Engineering by Norman S. Nise
2. Modern Control Engineering by Katsuhiko Ogata
3. Modern Control Systems by Richard C. Dorf

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.30. EECE 402: Control System I Laboratory
Level-4 Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 402 : Control System I Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 401
Course Title: Control System I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To make the students acquainted with the Control System equipment in a realistic manner, in order to connect theoretical knowledge of Control system with the realities of hardware and simulation through high level technical computing language and Software.

OBJECTIVE

1. To introduce the students to different control system prototyped modules, in order to use the modules to implement some of the important applications of control techniques in real-life.
2. To provide the students the ability to incorporate, analyze and evaluate their achieved knowledge of control system theory in practical aspects.
3. To enable the students to use high level simulation tool like MATLAB, Simulink and LabView to solve different control system problems before implementing the applications in hardware.
4. To augment student's creative thinking, communication and project management skills through projects and presentations.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **assemble** different blocks of control system prototype module **following** the working principle of these blocks to solve real life engineering problem.	PO5	P3			6	R,Q,T
CO2	Be able to **construct** controlled system **relating** the concept of feedback Control Method and controller design techniques and hence **justifying** the use of these methods on system performance in aspect of practical application using both simulating tools and hardware.	PO12	P4	1			R, PR,Pr
CO3	Be able to **construct** sustainable controlled system **adapting** the desired requirements **relating** the basics of control system using environment and sustainable analysis.	PO7	P5	1,2	1,2	7	PR,Pr
CO4	Be able to **perform** as a group and **practice** good teamwork during group projects and presentations.	PO9	A5				PR,Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 401 using different hardware equipment and simulation software like Matlab.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **assemble** different blocks of control system prototype module **following** the working principle of these blocks to solve real life engineering problem.					3							
CO2	Be able to **construct** controlled system **relating** the concept of feedback Control Method and controller design techniques and hence **justifying** the use of these methods on system performance in aspect of practical application using both simulating tools and hardware.												2
CO3	Be able to **construct** sustainable controlled system **adapting** the desired requirements **relating** the basics of control system using environment and sustainable analysis.							2					
CO4	Be able to **perform** as a group and **practice** good teamwork during group projects and presentations.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Experiment	28
Self-Directed Learning	
Preparation of Lab Reports	30
Preparation of Lab-test	4
Preparation of Quiz	5
Preparation of Presentation	5
Engagement in Group Projects	24
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	121

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Session on the Installation Process of LabView.
Week 2	Study of semiconductor temperature transducer(STT)and it's linearity by feedback method: Hardware Implementation and Simulation in LabView.
Week 3	Control of a conveyor system using Programmable Logic Controller (PLC) And Simulation in LabView.
Week 4	Water Level Control by Feedback Transducer: Hardware Implementation and Simulation in LabView
Week 5	Automated Gas Pressure Control by Feedback Method: Hardware Implementation and Simulation in LabView
Week 6	Review

Week 7	Lab Test-1
Week 8	Position Control of DC Motor by Feedback Method:Hardware Implementation and Simulation in LabView.
Week 9	Root Locus Design Method for DC Motor Position Control using Simulating tool MATLAB.
Week 10	PID Controller Design for DC Motor Speed Control using Simulink.
Week 11	Sketching the Bode Plot and Designing a Compensator of a system via Frequency Response in MATLAB.
Week 12	Lab Test-2
Week 13	Lab Quiz
Week 14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	P3
			CO 2	P4
	Labtest-1, Labtest-2	30%	CO 1	P3
	Project and Presentation	25%	CO3	P5
			CO 2	P4
			CO4	A5
Lab Quiz		25%	CO 1	P3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKSs

Control Systems Engineering by Norman S. Nise

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.31. EECE 405: Solid State Devices
Level-4, Term-I (Spring)

COURSE INFORMATION

Course Code	: EECE 405	Lecture Contact Hours	: 3.00
Course Title	: Solid State Devices	Credit Hours	: 3.00

PRE-REQUISITE

Electronics-I (EECE-201), Electronics-II (EECE-207), Math-205 (Differential Equation, Laplace Transform and Fourier Transform)

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To create the background of physics of the compound semiconductor-based electronic devices and also prepare students for advanced courses in solid state and quantum electronics. The course provides an opportunity for students to continue education in undertaking advanced study and research in the variety of different branches of semiconductor device applications.

OBJECTIVE

1. Be able to understand the characteristics, operation and limitation of semiconductor devices.
2. Be able to understand the physical concepts underlying the operation of semiconductor devices.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Acquiring ability to Analyze carrier flow and associated fields due to drift, diffusion, generation, and recombination. Be able to draw and	PO1	C4	CP -1		3	ASG, T, Mid Term Exam, F

	interpret energy band diagrams.						
CO2	Achieving capability to analyze a pn junction (diode) field effect ransistor (FET), including device physics, device operation, and device characteristics and summarize how device design affects performance	PO2	C4	CP 1		2	T, Mid Term Exam, F,
CO3	Become adept in applying mathematical methods for the analysis of solid-state electronics processes and their application to the solution of energy problems.	PO3	C3	CP -2		5	ASG, T, PR ,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Semiconductors in equilibrium: Energy bands, intrinsic and extrinsic semiconductors, Fermi levels, electron and hole concentrations, and temperature dependence of carrier concentrations and invariance of Fermi level.

Carrier transport processes and excess carriers: Drift and diffusion, generation and recombination of excess carriers, built-in-field, Einstein relations, continuity and diffusion equations for holes and electrons and quasi-Fermi level.

PN junction: Basic structure, equilibrium conditions, contact potential, equilibrium Fermi level, space charge, non-equilibrium condition, forward and reverse bias, carrier injection, minority and majority carrier currents, transient and ac conditions, time variation of stored charge, reverse recovery transient and capacitance.

Bipolar junction transistor: Basic principle of pnp and npn transistors, emitter efficiency, base transport factor and current gain, diffusion equation in the base, terminal currents, coupled-diode model and charge control analysis, Ebers-Moll equations and circuit synthesis.

Metal-semiconductor junction: Energy band diagram of metal semiconductor junctions, rectifying and ohmic contacts.

MOS structure: MOS capacitor, energy band diagrams and flat band voltage, threshold voltage and control of threshold voltage, static C-V characteristics, qualitative theory of MOSFET operation, body effect and current-voltage relationship of a MOSFET

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Acquiring ability to Analyze carrier flow and associated fields due to drift, diffusion, generation, and recombination. Be able to draw and interpret energy band diagrams.	3											
CO2	Achieving capability to analyze a pn junction (diode) field effect ransistor (FET), including device physics, device operation, and device characteristics and summarize how device design affects performance		2										
CO3	Become adept in applying mathematical methods for the analysis of solid-state electronics processes and their application to the solution of energy problems.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Semiconductors in equilibrium**	CT 1
Class 1	Energy bands	
Class 2	Energy bands	
Class 3	Intrinsic and extrinsic semiconductors	
Week 2	**Semiconductors in equilibrium**	
Class 4	Fermi levels	
Class 5	Electron and hole Concentrations	
Class 6	Electron and hole Concentrations	
Week 3	**Semiconductors in equilibrium**	
Class 7	Electron and hole Concentrations	
Class 8	Temperature dependence of carrier concentrations	
Class 9	Invariance of Fermi level	
Week 4	**Carrier transport processes and excess carriers**	Mid-term
Class 10	Drift and diffusion Class	
Class 11	Drift and diffusion, Generation and recombination of excess carriers	
Class 12	Generation and recombination of excess carriers, built-in-field	
Week 5	**Carrier transport processes and excess carriers**	
Class 13	Einstein relations,	
Class 14	Continuity and diffusion equations for holes and electrons and quasi-Fermi level.	
Class 15	Continuity and diffusion equations for holes and electrons and quasi-Fermi level.	
Week 6	**PN junction**	
Class 16	Basic structure, equilibrium conditions, contact potential	
Class 17	Equilibrium Fermi level, space charge	
Class 18	Non-equilibrium condition	
Week 7	**PN junction**	
Class 19	Forward and reverse bias	
Class 20	Carrier injection	
Class 21	Potential step and potential barrier; Heisenbergs'suncertainty principle and quantum box	
Week 8	**PN junction**	CT 3
Class 22	Minority and majority carrier currents	
Class 23	Minority and majority carrier currents,	
Class 24	Transient and ac conditions	

Week 9	**PN junction**	
Class 25	Transient and ac conditions	
Class 26	Time variation of stored charge, reverse recovery transient	
Class 27	Capacitance	
Week 10	**Bipolar junction transistor**	
Class 28	Basic principle of pnp and npn transistors,	
Class 29	Emitter efficiency, base transport factor and current gain,	
Class 30	Emitter efficiency, base transport factor and current gain	
Week 11	**Bipolar junction transistor**	CT 4
Class 31	Diffusion equation in the base,	
Class 32	Terminal currents, coupled-diode model and charge control analysis	
Class 33	Ebers-Moll equations and circuit synthesis	
Week 12	**Metal-semiconductor junction**	
Class 34	Energy band diagram of metal semiconductor junctions	
Class 35	Energy band diagram of metal semiconductor junctions	
Class 36	Rectifying and ohmic contacts	
Week 13	**MOS Structure**	
Class 37	MOS capacitor	
Class 38	Energy band diagrams and flat band voltage,	
Class 39	Threshold voltage and control of threshold voltage	
Class 39	Zero resistance and Meissner effect	
Week 14	**MOS Structure**	
Class 40	Static C-V characteristics,	
Class 41	Qualitative theory of MOSFET operation	
Class 42	Body effect and current-voltage relationship of a MOSFET.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C4
			CO2	C4
			CO3	C3
	Class Participation	5%	CO1	A2
			CO3	A2
	Class Attendance	5%	-	-
	Mid-term	10%	CO 1, CO2	C4, C4
Final Exam		60%	CO-1	C4
			CO-2	C4
			CO-3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Semiconductor physics and Device-Donald A neaman
2. Solid State Electronics Devices-Ben.G. Streetman; Prentice Hall of India.
3. Physical Foundations of Solid State and Electron Devices-M. Ferendeci
4. . Semiconductor Devices Physics and Technology S. M. Sze; John Wiley & Sons.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.32. EECE 473: Power Electronics
Level-4 Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 473 : Power Electronics	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE 305 Course Title: Power System -I		Course Code: EECE 201 Course Title: Electronics-I	
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To teach the students the concepts of power semiconductor devices and their control and monitoring mechanism. It is targeted to provide a basic foundation for methods of analyzing power electronic converters suitable for AC/DC, DC/DC and DC/AC electrical energy conversions. Additionally, to impart principles for designing power electronic converters, including their power semiconductors and passive elements.			
OBJECTIVE			
1. To familiarize the students with the basic principle of operation and the characteristics of modern power semiconductor switches used for various power electronics applications. 2. To develop student's skill to understand the operating principle of various AC-DC rectifier and manipulate performance indicating parameters to aid designing of controlled and uncontrolled rectifiers considering specified requirements. 3. To make them understand about the operation of DC-DC converters and enable them to design DC-DC converters to meet specific requirements for practical applications. 4. To impart in depth knowledge to the students on the operating principle of DC-AC inverters and help them to apply Fourier series to manipulate output voltage equations for evaluating the performance of the designed converter. 5. To introduce the students with the operating principle and appropriate applications of AC-AC controller and Motor drives.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Acquiring ability to **illustrate/infer** the physics of power semiconductor switches and their controlling mechanism that are essential in power electronics applications.	PO1	C2			3	T, F
CO2	Achieving ability to **develop** analytical expressions of AC-DC controlled and uncontrolled rectifiers and **design** rectifiers for interfacing with single-phase and three-phase utility system to meet specified requirements by **analysing** total harmonic distortion level.	PO3	C6	1		5	T, Mid Term Exam, F
CO3	Getting in-depth knowledge to understand and **design** different DC-DC converters and DC-AC inverters to meet specific purpose considering all design constraints.	PO2	C6	1,3		4	F, ASG
CO4	Becoming adept in **comparing** different controlling mechanism of AC voltage controller to vary the	PO1	A4	2		4	T, Mid Term Exam, F

	RMS value of the alternating voltage applied to a load by using Thyristors.						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Power semiconductor switches and triggering devices: BJT, MOSFET, SCR, IGBT, GTO, TRIAC, UJT and DIAC.
Rectifiers: Uncontrolled and controlled single phase and three phase.
Regulated power supplies: Linear-series and shunt, switching buck, buck-boost, boost and Cûk regulators.
AC voltage controllers: Single and three phase Choppers. DC motor control. Single phase cyclo-converter.
Inverters: Single phase and three phase voltage and current source. AC motor control. Stepper motor control. Resonance inverters. Pulse width modulation control of static converters.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Acquiring ability to **illustrate/infer** the physics of power semiconductor switches and their controlling mechanism that are essential in power electronics applications.	2											
CO2	Achieving ability to **develop** analytical expressions of AC-DC controlled and uncontrolled rectifiers and **design** rectifiers for interfacing with single-phase and three-phase utility system to meet specified requirements by **analysing** total harmonic distortion level.			2									
CO3	Getting in-depth knowledge to understand and **design** different DC-DC converters and DC-AC inverters to meet specific purpose considering all design constraints.		2										
CO4	Becoming adept in **comparing** different controlling mechanism of AC voltage controller to vary the RMS value of the alternating voltage applied to a load by using Thyristors.	2											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture Practical / Tutorial / Studio Student-Centred Learning	42 - -
Self-Directed Learning	
Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	42 21 21
Formal Assessment	

Continuous Assessment Final Examination	2 3
Total	131
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method	
COURSE SCHEDULE	

Week 1	**Introduction to Power Electronics and Switching Devices**	
Class 1	Introduction to Power Electronics, Applications, Advantages and Dis-advantages	
Class 2	Introduction to switches, Classification and Power losses in switches.	
Class 3	Basics of semiconductor switches, P-N junction diode, BJT, MOSFET.	
Week 2	**Switching Devices**	
Class 4	Introduction to SCR, Two transistor model, Turn-ON and Turn-OFF process of SCR, Characteristics of SCR.	
Class 5	Natural Commutation process in SCR and Forced commutation (Class-A, Class-B)	CT-1
Class 6	Forced commutation (Class-C, Class-D and Class-E), LASCR	
Week 3	**Switching Devices and AC-DC Rectifier**	
Class 7	Operating principle and characteristics of DIAC, TRIAC, IGBT and GTO.	
Class 8	Introduction to rectifier, applications, performance parameters of rectifier, DC harmonic analysis of rectifier.	
Class 9	1-phase half wave rectifier (Uncontrolled & Controlled) with R and R-L load.	
Week 4	**AC-DC Rectifier**	
Class 10	Free-wheeling diode application, 1-phase full wave uncontrolled rectifier with R and R-L load.	
Class 11	1-phase full wave-controlled rectifier with R and R-L load, Multiphase star rectifier.	
Class 12	3-phase half bridge uncontrolled rectifier, 3-phase full bridge uncontrolled rectifier.	CT-2
Week 5	**AC-DC Rectifier**	
Class 13	3-phase controlled half wave rectifier, 3-phase controlled full wave rectifier.	
Class 14	1-phase dual converter, 3-phase dual converter.	
Class 15	1-phase semiconverter, 3-phase semiconverter	
Week 6	**AC-DC Rectifier**	
Class 16	Mathematical Problems on Rectifier	
Class 17	Mathematical Problems on Rectifier	
Class 18	Design problems on controlled and uncontrolled rectifier.	
Week 7	**DC-DC Converter**	
Class 19	Introduction to DC-DC converter, applications, Duty cycle, DC chopper circuit, Classification, Volt-sec balance of inductor, charge balance of capacitor.	
Class 20	Buck converter, Boost Converter, Minimum inductance for CCM.	Mid-term
Class 21	Buck-Boost Converter, Cuk Converter, Minimum inductance for CCM.	
Week 8	**DC-DC Converter**	
Class 22	SEPIC converter, Zeta Converter, Minimum inductance for CCM.	
Class 23	Ripple voltage calculation and choice of filter capacitance of Buck, Boost converter.	
Class 24	Ripple voltage calculation and choice of filter capacitance of Buck-Boost, Cuk, SEPIC and Zeta converter.	
Week 9	**DC-DC Converter**	
Class 25	Non-idealities of the components of DC-DC converter, Choice of Coupling	

	capacitance of Cuk, SEPIC and Zeta converter.	
Class 26	Flyback converter and Forward converter.	
Class 27	Mathematical Problems on DC-DC converter and design problems.	
Week 10	**DC-AC Inverter**	CT-3
Class 28	Introduction to Inverter, applications, 1-phase half bridge VSI, 1-phase full bridge VSI.	
Class 29	Fourier analysis of the output waveforms of 1-phase half and full bridge VSI,	
Class 30	1-phase square wave CSI, 3-phase voltage source square wave inverter, Fourier analysis.	
Week 11	**DC-AC Inverter**	
Class 31	PWM inverter, Series resonant inverter, Multilevel inverter.	
Class 32	Push-Pull configuration, Voltage control of 3-phase inverter.	
Class 33	Offline UPS, Online UPS.	
Week 12	**DC-AC Inverter and AC-AC Controller**	CT-4
Class 34	Mathematical problems on Inverter.	
Class 35	Introduction to AC-AC Controller, applications, AC-AC voltage controller (1-phase).	
Class 36	Bi-directional switch, 3-phase voltage controller (Phase controlled).	
Week 13	**AC-AC Controller**	
Class 37	1-phase and 3-phase Semi-converters (Controlled and uncontrolled)	
Class 38	1-phase dual converter, 3-phase dual converter	
Class 39	Cyclo-converter, 3-phase to 1-phase cyclo-converter	
Week 14	**AC-AC Controller and DC-AC Motor drives**	
Class 40	Mathematical Problems on AC-AC Controller.	
Class 41	Introduction to DC and AC motor drives, 1-phase DC motor drives, 3-phase DC motor drives	
Class 42	Synchronous motor and Stepper motor control drives (AC Drives).	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C6
			CO3	C6
			CO4	A4
	Class Performance	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C6
			CO4	A4
Final Exam		60%	CO1	C2
			CO2	C6
			CO3	C6
			CO4	A4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. Power Electronics Circuits, Devices and Applications- M. H. Rashid

Reference Books:

1. Power Electronics- D. Hart
2. Power Electronics-A first course- Ned Mohan
3. Power Electronics- P.C. Sen

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.33. EECE 474: Power Electronics Laboratory
Level-4 Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 474 : Power Electronics Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
Course Code: EECE 473 Course Title: Power Electronics			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This Power Electronics course is designed to make the students enable to analyze the working basis, electrical and thermal performance of different power semiconductor switches, DC/DC, DC/AC and AC/DC electrical energy conversion techniques and hence design efficient power electronics circuit applicable in real life by using hardware implementation and computer aided simulation tool. Some converter circuits can operate in different modes, depending on circuit and control parameters. Additionally, to examine the effect of these change of parameter on the power electronics devices.			
OBJECTIVE			
1. To enable the students to implement and analyze different power semiconductor switches (MOSFET,BJT,IGBT,SCR,TRIAC) and the loss incurred in these switching process. 2. To provide the students hand-on experience of implementing DC/DC converter, DC/AC inverter and AC/DC rectifier circuits with passive elements. And hence analyzing the operations of this implemented circuit design with varying circuit parameters. 3. To enable the students to use Power Electronics specialized simulation tool LTspice to simulate and verify power electronics circuit connection for proper operation before implementing the circuit in hardware. 4. To make the students capable to construct efficient high performance exhibiting power electronics circuits for power systems including renewable energy, energy saving and industrial applications. 5. To augment student's creative thinking, communication and project management skills through projects and presentations.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **construct** power electronic circuits and **describe** the electrical performance of these converters using hardware and software simulation.	PO5	P2			6	R,Q,T
CO2	Be able to **construct** compact switching converters and **analyse** the safety, legal and compliance impact to install these power electronic devices in real applications.	PO6	P4			7	R,Q,T
CO3	Be able to **identify** the environmental and sustainability impact of different electronic devices.	PO7	P3	1		7	PR,Q
CO4	Be able to **construct** high performance exhibiting power electronics converter **adapting** the desired requirements for electrical energy conversion of real life engineering application.	PO12	P6	1,2	1		PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 473 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **construct** power electronic circuits and **describe** the electrical performance of these converters using hardware and software simulation.					3							
CO2	Be able to **construct** compact switching converters and **analyse** the safety, legal and compliance impact to install these power electronic devices in real applications.						3						
CO3	Be able to **identify** the environmental and sustainability impact of different electronic devices.							3					
CO4	Be able to **construct** high performance exhibiting power electronics converter **adapting** the desired requirements for electrical energy conversion of real life engineering application.												1

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 14 28
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 30 4 5 5 24
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	121

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction to Power semiconductor switches both in hardware implementation and LTspice simulation: BJT as a switch, MOSFET as a switch, IGBT as a switch and SCR as a switch
Week 2	Introduction to Power semiconductor switches both in hardware implementation and LTspice simulation: TRIAC as a switch, switching losses of semiconductor switch and construction of a bi-directional switch.
Week 3	SCR Operation Characteristic in AC Circuit: Hardware implementation and

	LTspice Simulation
Week 4	Hardware implementation and LTspice simulation of Single phase half wave uncontrolled rectifier: with R-Load, with R-L Load, with R-L load and free-wheeling diode; Single phase full wave uncontrolled rectifier: with R Load without output filter
Week 5	Hardware implementation and LTspice simulation of Single phase Full wave uncontrolled rectifier: with R-L Load, with R Load and output filter, with R load and input current and power factor improvement circuit; Three phase full wave uncontrolled rectifier with R load.
Week 6	Lab Test-1
Week 7	Hardware implementation and LTspice simulation of Switching Regulator circuits for controlling DC-DC Converters and Single Phase Square wave Inverter.
Week 8	Hardware implementation and LTspice simulation of Buck Converter, Boost Converter, Buck-Boost converter and Buck-Boost converter with continuous input current.
Week 9	Hardware implementation and LTspice simulation of SEPIC converter, Zeta converter and Cuk converter.
Week 10	Hardware implementation and LTspice simulation of Single Phase Inverter Circuits: Half Bridge Voltage Source Inverter.
Week 11	Hardware implementation and LTspice simulation of Single Phase Inverter Circuits: Square Wave Push Pull Inverter Circuit.
Week 12	Lab Test-2
Week 13	Lab Quiz
Week 14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	P2
			CO 2	P4
	Labtest-1, Labtest-2	30%	CO 1	P2
			CO 2	P4
	Project and Presentation	25%	CO3	P3
			CO4	P6
Lab Quiz		25%	CO 1	P2
			CO 2	P4
			CO 3	P3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1) Power Electronics: Device, Principles and Application –Muhammad H Rashid

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.34. EECE 409: Communication Theory II
Level-4 Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 409 : Communication Theory II	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE 309
Course Title: Communication Theory I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To introduce the students with the basic concept of communication system. The target of the course is to enable the students to have a firm foundation on the communication network architectures and the layers of the OSI model. The course aims to provide the students with the fundamental knowledge on mobile cellular communication, optical fiber communication and satellite communication.

OBJECTIVE

1. To impart basic knowledge on the concepts of digital communication system.
2. To provide in depth knowledge on the fundamentals of communication network and the structure and functionalities of the 7 layers of the OSI model and the relevant mechanisms.
3. To acquaint the students with the basics of mobile cellular communication system.
4. To familiarize the students with the fundamental knowledge of the optical fiber and satellite communication system.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the processes and **compute** different parameters relevant to the digital communication system.	PO3	C3			5	F, ASG
CO2	Be able to **explain** in depth the functionalities of the different layers of the OSI model and **break down** the effectiveness of the network models in use.	PO1	C4	1		4	Mid Term Exam, F
CO3	Be able to **describe** the fundamental concepts and evolution of analog & digital cellular systems and **explain** treatment of co-channel interference for spectrally efficient cellular frequency reuse systems	PO3	C2			5	F, ASG
CO4	Be able to **infer** the basic ideas of optical fiber and satellite communication system.	PO1	C1			3	T, F, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Digital modulations: Overview, detection and demodulation techniques,
Digital receivers, matched filter and correlator receiver, bit error rate calculation.
Error correction coding: block codes, cyclic codes, systematic and non-systematic cyclic codes, decoding techniques.
Networking models: ISO, TCP-IP and ATM reference models.
Different data communication services: Physical layer wired and wireless transmission media.
Data Link Layer: Multiple Access protocols.
IEECE.802 Protocols for LANs and MANs, Switches, Hubs and bridges. High speed LAN
Network Layer: Routing, congestion control, internetworking.
Network layer in internet: IP protocol, IP addresses.

Transmission control protocol, UDP, ATM adaptation layer, application layer, network security, email, domain name system. Simple network management protocol, HTTP, World Wide Web.

Digital cellular systems: cellular concept, frequency reuse techniques, 3G, 4G, 5G and future wireless communication system, Wi-Fi, Bluetooth, Software defined radio.

Modern telephone services & network: Internet telephony, ISDN, Fibre to x (FFTx), VoIP, GPON, NGPON

Introduction to Optical Fiber communication, Satellite communication and RFID

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the processes and **compute** different parameters relevant to the digital communication system.			2									
CO2	Be able to **explain** in depth the functionalities of the different layers of the OSI model and **break down** the effectiveness of the network models in use.	2											
CO3	Be able to **describe** the fundamental concepts and evolution of analog & digital cellular systems and **explain** treatment of co-channel interference for spectrally efficient cellular frequency reuse systems			3									
CO4	Be able to **infer** the basic ideas of optical fiber and satellite communication system.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Topic**	
Class 1	Overview on digital modulations	CT 1
Class 2	detection and demodulation techniques	
Class 3	digital receivers, matched filter	
Week 2		
Class 4	correlator receiver, bit error rate calculation	
Class 5	Error correction coding: block codes, cyclic codes	
Class 6	Systematic and non-systematic cyclic codes, decoding techniques	
Week 3		

Class 7	Introduction to Communication Networks	
Class 8	Protocol stack in communication networks	
Class 9	OSI, TCP-IP and ATM reference models	
Week 4		Mid
Class 10	Physical Layer, Wired & wireless transmission media, power-line & optical fiber media	
Class 11	Switching: Circuit vs Packet, Data Link Layer, Functions	
Class 12	Multiple Access protocols	
Week 5		
Class 13	Multiple Access protocols	
Class 14	IEEE 802 Protocols for LANs and MANs	
Class 15	Switches. Hubs and bridges	
Week 6		
Class 16	Network Layer	
Class 17	Routing algorithms	
Class 18	Congestion control algorithms	
Week 7		CT 2
Class 19	Admission control	
Class 20	Internetworking	
Class 21	Internet network layer: IP protocol, IP addresses	
Week 8		
Class 22	Transport Layer	
Class 23	TCP, UDP for Internet	
Class 24	TCP, UDP for Internet	
Week 9		
Class 25	Application Layer	
Class 26	ATM application layer	
Class 27	Network security	
Week 10		CT 3
Class 28	Email and Domain name system	
Class 29	Simple and Complex network management protocol	
Class 30	HTTP. world wide web, Ideas about cyber security	
Week 11		
Class 31	**Digital cellular systems:** cellular concept, frequency reuse techniques	
Class 32	3G, 4G	
Class 33	5G and future wireless communication system	
Week 12		
Class 34	Wi-Fi, Bluetooth, GPON, NGPON	
Class 35	VoIP, Software defined radio, RFID	
Class 36	Modern telephone services & Network: Internet telephony	
Week 13		
Class 37	ISDN, Fibre to x (FFTx)	
Class 38	Introduction to optical fiber communication-1	
Class 39	Introduction to optical fiber communication-2	
Week 14		
Class 40	Introduction to Satellite communication-1	
Class 41	Introduction to Satellite communication-2	
Class 42	Review Class	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous	Class Test/	20%	CO1	C3

Assessment (40%)	Assignment 1-3		CO3	C2
			CO4	C1
	Class Participation	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C4
Final Exam			CO1	C3
			CO2	C4
			CO3	C2
			CO4	C1
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Digital Communications - Simon Haykin; McGraw Hill International.
2. Digital Communication - G.J Proakis; Prentice Hall of India.
3. Data Communications and Networking by Behrouz A. Forouzan
4. Mobile Cellular Telecommunication Systems - William C.Y Lee, McGraw-Hill.
5. Optical Fiber Communications: Principles & Practice - John M. Senior
6. Digital Satellite Communications by Tri T. Ha, Second Ed. McGraw-Hill.
7. Satellite Communications by Timothy Pratt, Second Ed. Wiley.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.1.35. EECE 400: Final Year Design and Research Project
Level-4 Term-I & II (Spring & Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 400 : Final Year Design and Research Project	Contact Hours Credit Hours	: 12.00 : 6.00

PRE-REQUISITE

GERM 352: Fundamentals of Research Methodology

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of this course is to develop student’s ability to design a comprehensive product/service solution of an applied electrical engineering problem. Students will be able to apply the knowledge and skills obtained through previous courses to design a new integrated solution, validation and proper evaluation of outcomes at different stage of the project. It is also expected to enhance student’s leadership ability in technical project management and be able to contribute in fourth industrial revolution.

OBJECTIVE

1. To formulate a research problem based on the knowledge of major subject/field of study.
2. Design an appropriate solution technique to address the research problem.
3. To reach the ability to evaluate the performance of proposed solution.
4. To compare the outcomes with the latest scientific development.
5. To assess professional, ethical and social impacts of the designed solutions.
6. To perform research tasks using proper project management practices.
7. To develop student’s leadership ability through teamwork.
8. To enhance student’s communication skill through presentation and technical reports.
9. Articulation of the environmental and sustainability analysis in the designed project.

COURSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Identify the research gap and formulate a research problem related to electrical engineering.	PO2	C4	3,4	1	1	IR
CO2	Design an appropriate engineering product/service solution that meets the required technical standard and specifications.	PO3	C6	5	1	2	PR, PPr
CO3	Proficient in investigating the performance of the designed engineering product/service prototype.	PO4	C5, P5	8	3		DR, ID
CO4	Able to evaluate the designed product/service solution with standard scientific specification and communicate the final outcomes.	PO3	C6	5	1	2	FR, FPr, FD
CO5	Able to integrate relevant engineering tools in the process of project design, development and implementation.	PO5	P4, A4	6	1	5	DR, ID, FD
CO6	Capable to understanding of ethical values and professional responsibilities to the society in the different phases of the designed project.	PO8	A4	7	5	2	FR, FPr
CO7	Demonstrate the understanding of the project impact on environmental and sustainability.	PO7	C2	7	4		PR, PPr
CO8	Able to assess societal, health, safety, legal and cultural issue related to the designed project.	PO6	C5	7	4		FR, FPr
CO9	Demonstrate leadership skills, ability to work independently and in a team through project development phases.	PO9	A5			1	FPr, FD
CO10	Able to develop communication skill through technical report writing and presentation.	PO10	A2			1	FR, FPr
CO11	Conduct financial investment analysis and estimate the project cost.	PO11	C2, P2, A3			2	PR, PPr FR, FPr
CO12	Verify the designed problem technological, geographical and cultural adaptation in broader context.	PO12	A5			4	FR
CO13	Be competent in understanding of project time, stakeholder and risk management and able to prepare detail project work breakdown structure (WBS).	PO11	C3, P4, A3			2	PR, PPr FR, FPr
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile; IR- Initial Report, Proposal Report -PR, Proposal Presentation – PPr, Designed Report – DR, Initial Demonstration – ID, FR-Final Report, FPr-Final Presentation, FD- Final Demonstration)							

COURSE CONTENT
Every student will be required to undertake a suitable Final Year Design and Research Project during Level-4 (Term-I&II or Spring & Fall Term) in consultation with the Head of the Department and the faculty guide (or Supervisor) and submit the project or thesis at the end of Level-4 (Fall Semester) on dates announced by the institute (department).

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Identify the research gap and formulate a research problem related to electrical engineering.		3										
CO2	Design an appropriate engineering product/service solution that meets the required technical standard and specifications.			3									
CO3	Proficient in investigating the performance of the designed engineering product/ service prototype.				3								
CO4	Able to evaluate the designed product/service solution with standard scientific specification and communicate the final outcomes.			3									
CO5	Able to integrate relevant engineering tools in the process of project design, development and implementation.					3							
CO6	Capable to understanding of ethical values and professional responsibilities to the society in the different phases of the designed project.								3				
CO7	Demonstrate the understanding of the project impact on environmental and sustainability.											3	
CO8	Able to assess societal, health, safety, legal and cultural issue related to the designed project.						3						
CO9	Demonstrate leadership skills, ability to work independently and in a team through project development phases.									3			
CO10	Able to develop communication skill through technical report writing and presentation.										3		
CO11	Conduct financial investment analysis and estimate the project cost.											3	
CO12	Verify the designed problem technological, geographical and cultural adaptation in broader context.												2

CO13	Be competent in understanding of project time, stakeholder and risk management and able to prepare detail project work breakdown structure (WBS).											3	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Practical / Tutorial / Studio	56
Self-Directed Learning	
Project design and background Research Work under the supervision of Supervisor	84
Project work/Simulation practice at Lab	84
Preparation of report and presentation and demonstration	40
Formal Assessment	
Demonstration	3
Presentation	3
Total	270

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (60%)	Initial Report (IR)	10%	CO 1	C4
	Proposal Report (PR) and Proposal Presentation (PPr)	30%	CO 2	C4
			CO 7	C2
			CO13	C3, P4, A3
			CO 11	C2, P2, A3
	Designed Report – (DR)	10%	CO3	C5, P5
			CO5	P4, A4
	Initial Demonstration (ID)	10%	CO3	C5, P5
			CO5	P4, A4
Final Report and presentation		25%	CO 4	C6
			CO 6	A4
			CO 8	C5
			CO 9	A5
			CO 10	A2
			CO 11	C2, P2, A3
			CO 12	A5
			CO 13	C3, P4, A3
Final demonstration		15%	CO 5	P4, A4
			CO 6	A4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

Books as per the guideline of Faculty Guide or Supervisor.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2 Elective Course
5.2.1 Power

5.2.1.1. EECE 471: Power System II
Level-4 Term-I/II (Spring/Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 471 : Power System II	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE
Course Code: EECE 305 Course Title: Power system I
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
The aim of the course is to develop the students mind in reaching a better understanding of advanced topics in power system transmission and distribution network. The students will be able to learn about grid stability, FACTS & HVDC devices and different power quality issues. The enriched knowledge will help students to solve real-life power engineering problems.
OBJECTIVE
1. Familiarize students with the transmission and distribution network of a power grid. 2. To impart the concepts of Power system stability and power quality indices. 3. Acquaint students with reactive power compensation and FACTS and HVDC devices.
COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be proficient in **analysing** the power system transmission & distribution network functionality and be able to **design** the optimum solution for a complex power system.	PO3	C6	1	1	5	F, ASG, Pr
CO2	Able to use the concept of swing equation and equal area criterion to design the solution of power system stability problems.	PO2	C6	1		4	T, F ASG
CO3	Capable to **understand** the concept of different compensation techniques and operation of FACTS and HVDC devices and **apply** this knowledge to solve the compensation problems.	PO1	C3			4	Mid Term

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)
COURSE CONTENT
Introduction to Power Supply System: Overview of electric power system, power grid of Bangladesh, electrical supply system, comparison of AC and DC transmission, various systems of power transmission, Advantages of High voltage transmission. **Mechanical Design of Overhead Transmission Lines**: Transmission line components, types of insulator, string efficiency and different improvement methods, sag in overhead line, corona in transmission line, power loss due to corona. **Electrical Design of Overhead Transmission Lines**: Overhead line parameters, skin effect, Inductance of single-phase line, three phase line, self GMD and mutual GMD, capacitance of

single phase two wire line and three phase line.
Underground Cables: Construction of Underground cables, Insulation resistance of a single core cable, Capacitance and Dielectric stress of a single core cable, capacitance grading, inter-sheath grading, types of cable fault, capacitance of 3 core cable, Murray Loop test, Varley loop test
Electric Power Distribution System: Classification of distribution system, A.C and D.C distribution, connection schemes of distribution system, design consideration of distribution system
Power System stability: Introduction to power system stability, rotor angle, voltage and frequency stability, Rotor dynamics and swing equation, power angle equation, equal area criterion of stability, multi-machine study of stability
Reactive Power compensation: Introduction to Reactive power compensation in transmission line, power transmission capability, Line compensation: shunt reactor, series and shunt capacitor compensation
FACTS & HVDC: Classification of FACTS devices, series and shunt controller, Study of FACTS device SSSC, TCSC, SVC, TCR, STATCOM, UPFC, Introduction to HVDC, Technical performance, Different HVDC link, Layout
Power quality: sources of power quality problem, characterization of Power quality problem, Harmonic distortion, Power factor and cost analysis, IEEE Power quality standards.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient in **analysing** the power system transmission & distribution network functionality and be able to **design** the optimum solution for a complex power system.			2									
CO2	Able to **use** the concept of swing equation and equal area criterion to **design** the solution of power system stability problems.		2										
CO3	Capable to **understand** the concept of different compensation techniques and operation of FACTS and HVDC devices and **apply** this knowledge to solve the compensation problems.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	48
Self-Directed Learning	94
Formal Assessment	05
Total	147

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Lecture Plan		
Week 1	**Introduction to Power Supply System**	
Class 1	Overview of electric power system, Power grid of Bangladesh	
Class 2	Introduction to electrical supply system, Comparison of AC and DC transmission,	

	Class 3	various systems of power transmission, Advantages of High voltage transmission	
	Week 2	**Mechanical Design of Overhead Transmission Lines**	CT 1
	Class 4	Transmission line components, Types of insulator	
	Class 5	String efficiency calculation, Methods of improving string efficiency	
	Class 6	Mathematical problems related to string efficiency	
	Week 3	**Mechanical Design of Overhead Transmission Lines**	
	Class 7	Sag in overhead line, calculation of Sag	
	Class 8	Corona Effect in overhead line, Power loss due to corona	
	Class 9	Mathematical problems related to Sag and corona	
	Week 4	**Electrical Design of Overhead Transmission Lines**	
	Class 10	Overhead line parameters, Skin effect	
	Class 11	Inductance calculation of single-phase line, three phase line	
	Class 12	Calculation of self GMD and mutual GMD	
	Week 5	**Electrical Design of Overhead Transmission Lines**	
	Class 13	Mathematical problems related to inductance calculation of overhead lines	
	Class 14	Capacitance calculation of single phase two wire line, phase line	CT 2
	Class 15	Mathematical problems related to inductance calculation of overhead lines	
	Week 6	**Underground Cables**	
	Class 16	Underground cables construction, Insulation resistance of a single core cable	
	Class 17	Capacitance and Dielectric stress of a single core cable	
	Class 18	Mathematical problems related to single core cable	
	Week 7	**Underground Cables**	
	Class 19	Cable gradings, capacitance grading, inter-sheath grading	
	Class 20	Types of cable fault, capacitance of 3 core cable, Murray Loop test, Varley loop test	
	Class 21	Mathematical problems related to capacitance grading and cable fault	
	Week 8	**Electric Power Distribution System**	
	Class 22	Classification of distribution system, A.C and D.C distribution	
	Class 23	Connection schemes of distribution system, Design consideration of distribution system	
	Class 24	Mathematical problems related to distribution system	MID TERM
	Week 9	**Power System stability**	
	Class 25	Introduction to power system stability, rotor angle, voltage and frequency stability	
	Class 26	Rotor dynamics and Swing equation	
	Class 27	Mathematical problems related to swing equation	
	Week 10	**Power System Stability**	
	Class 28	Power angle equation, Equal area criterion of stability	
	Class 29	Multimachine study of stability	
	Class 30	Mathematical problems related to equal area criterion problem	
	Week 11	**Reactive Power compensation of Transmission line**	
	Class 31	Reactive power compensation in transmission line, power transmission capability	
	Class 32	Line compensation: shunt reactor, series and shunt capacitor compensation	
	Class 33	Mathematical problems related to transmission line compensation	
	Week 12	**FACTS & HVDC**	

Class 34	Classification of FACTS devices, series and shunt controller	
Class 35	Study of FACTS device: SSSC, TCSC, SVC	
Class 36	Study of FACTS device: TCR, STATCOM, UPFC	
Week 13	**FACTS & HVDC /Power Quality**	CT 4
Class 37	Introduction to HVDC, Technical performance, Different HVDC link, Layout	
Class 38	Power quality, sources of power quality problem	
Class 39	Characterization of Power quality problem, Harmonic distortion	
Week 14	**Power Quality**	
Class 40	Power factor and cost analysis, IEEE Power quality standards	
Class 41	Mathematical problems related to power quality	
Class 42	Revise and summary	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test & Assignment 1-3	20%	CO 2	C3
			CO 1	C6
	Class Participation	5%	CO 1	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO3	C3
Final Exam		60%	CO 1	C6
			CO 2	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Element of Power System Analysis –J. J. Grainger and W. D. Stevenson,
2. Modern Power System Analysis – IJ Nagrath and DP Kothari
3. Principles of Power System, V.K Mehta
4. FACTS Controller in Power Transmission and Distribution, K.R. Padiyar
5. Power Quality, S.M. Halpin, Auburn University

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.1.2. EECE 475: Power Plant Engineering
Level-4 Term-I/II (Spring / Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 475 : Power Plant Engineering	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE 305 Course Title: Power System I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Power Plant Engineering is the introductory step of in-depth knowledge of power plants. This course offers the initial knowledge of different types of power plants to produce electrical energy. At the beginning of the course, the knowledge about hydro-power plant is given. Then with the flow of class, the working principle, general layout, site selection, component, fuel quality, waste management of gas power plant, steam power plant, nuclear power plant along			

with the hydro power plant are manifested. After covering the construction, energy rate and the installation as well as the maintenance cost of these power plants are instructed.

OBJECTIVE

1. Be able to impart elementary knowledge on the layout and principles of operation of various power plants.
2. Be able to familiarize the students with the different component incorporated with different power plants
3. Be able to familiarize with the factors of site selections for diverse types of power plants
4. Be able to impart in depth knowledge the advantages and disadvantages of different power plants along with cost calculation

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to explain the layout and summarize the principles of operation of various power plants	PO1	C2			1-4	T, Mid, F, Cl part
CO2	Be able to identify different component incorporated with different power plants and asses the environmental and sustainability impact of these plants.	PO7	C4			7	ASG
CO3	Be able to predict the suitable locations for different power plants and to compute the installation and maintenance cost	PO2	C3	P1		1-4	T, F, Cl part
CO4	Be able to justify professional ethics to build different types of power plants from fossils and provide the alternative solutions.	PO8	C5			7	ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Power plants: General layout and principles, steam turbine, gas turbine, combined cycle gas turbine, hydro and nuclear.
Power plant instrumentation.
Selection of location: Technical, economic and environmental factors.
Load forecasting.
Generation scheduling: Deterministic and probabilistic.
Electricity tariff: Formulation and types.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to explain the layout and summarize the principles of operation of various power plants	2											
CO2	Be able to identify different component incorporated with different power plants and asses the environmental and sustainability impact of these plants.							3					
CO3	Be able to predict the suitable locations for different power plants and to compute the installation and maintenance cost		2										

CO4	Be able to justify professional ethics to build different types of power plants from fossils and provide the alternative solutions.								3				

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical/Tutorial/Studio	-
Student-centred Learning	-
Self-Directed learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous assessment	2
Final examination	3
Total	131

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week 1	**Load Curve**	CT 1
Class 1	Load duration curves	
Class 2	Load duration curves (contd.)	
Class 3	Location of power plants	
Week 2	**Steam Power Plant**	
Class 4	Selection of location of plants: technical, economic and environmental factors	
Class 5	Basic type of steam generators	
Class 6	Fire-tube boilers and Water-tube boilers	
Week 3	**Steam Power Plant**	
Class 7	Economizers and Super-heaters	
Class 8	Steam generator control	
Class 9	Steam generator control (contd.)	
Week 4	**Steam Power Plant**	CT 2
Class 10	Supercritical boiler: PC vs CFB technology	
Class 11	Introduction to steam turbines	
Class 12	Steam turbines (contd.)	
Week 5	**Hydroelectric Power Plants**	
Class 13	Turbine blading	
Class 14	Turbine blading (contd.)	
Class 15	Introduction to hydroelectric power plants	
Week 6	**Hydroelectric Power Plants**	
Class 16	Advantages and disadvantages of water power	
Class 17	Selection of site for hydroelectric plants	
Class 18	Hydrological cycle	
Week 7	**Hydroelectric Power Plants**	
Class 19	Essential elements of a hydroelectric power plant	
Class 20	Classification of hydroelectric power plants	
Class 21	Hydraulic turbine	

Week 8	**Hydroelectric Power Plants**	MID TERM
Class 22	Turbine size and Pelton wheel	
Class 23	Comparison of turbines	
Class 24	Governing of hydraulic turbines	
Week 9	**Nuclear Power Plants**	
Class 25	Structure of atom, chemical and nuclear reactions	
Class 26	Nuclear stability, binding energy	
Class 27	Radioactive decay, half life	
Week 10	**Nuclear Power Plants**	CT 3
Class 28	Nuclear fission and chain reaction	
Class 29	Heat transfer and fluid flow in nuclear reactors	
Class 30	Types of reactors	
Week 11	**Gas Turbine Plants**	
Class 31	Different types of reactors	
Class 32	PWR, BWR, GCR, LMFBR etc	
Class 33	Gas turbine power plant	
Week 12	**Gas Turbine Plants**	
Class 34	Combined cycle gas turbine plant	
Class 35	Power plant auxiliaries and instrumentation	
Class 36	Load forecasting	
Week 13	**Energy Tariff**	
Class 37	Electricity tariff: formulation and types	
Class 38	Generator Scheduling: Deterministic	
Class 39	Generator Scheduling: Probabilistic	
Week 14	**Load Forecasting**	
Class 40	Solving practical problems while planning to set up new power plants	
Class 41	Solving problems related to load forecasting and electricity tariff of existing power plants	
Class 42	Open discussion	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class test/ Assignment	20%	CO1	C2
			CO2	C4
			CO3	C3
			CO4	C5
	Class Participation	5%	CO1	C2
			CO3	C3
	Class Attendance	5%	-	-
	Mid Term	10%	CO1	C2
Final Exam		60%	CO1	C2
			CO2	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Power Plant Engineering- G R and G. R. Nagpal
2. Power Station Engineering & Economy - William A. Vopat
3. Electric Power Generation, Transmission and Distribution - Singh S.N
4. Principle of Power System - V. K. Mehta
5. Electric Power Engineering Handbook - L.L. Grigsby.
6. Power Plant Engineering- P. K Nag

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.1.3. EECE 477: Power System Protection
Level-4 Term- I/II (Spring/ Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 477 : Power System Protection	Lecture Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE 305
Course Title: Power System

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize the students with the basic power system protection equipment like relays, circuit breakers etc. and their applications for the protection of various electrical systems and its different components.

OBJECTIVE

1. To impart elementary knowledge on the electrical protective devices used in a power system
2. network with types, specification, standard values and limitations.
3. To familiarize the students with the working principle of different protective devices such as fuse, circuit breaker, relay and instrument transformers.
4. To appraise the operating principle of various unit protection schemes such as generator, transformer, motor, bus bar, transmission line, distribution line etc.
5. To convey in depth knowledge on different parameters of protective devices and thereby enable students to design the protection units of generation, transmission and distribution networks on both sides.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Method
CO1	Be able to **demonstrate** the basic operating principles and **interpret** specifications and limitations of various protective devices	PO1	C4			3	T, Mid Term, F
CO2	Developing potential to **compare** the functions of different protective devices	PO1	C4			3	T, Mid Term, F
CO3	Gaining ability to **Analyse** the basic protective measures for various components of different units	PO1	C4	1		3	T, Mid Term, F
CO4	Attaining proficiency in **designing** various protection schemes of generation, transmission and distribution networks on both sides	PO3	C6	2	3	5	F, ASG

(CP- Complex Problem, CA- Complex Activity, KP- Knowledge Profile, T-Test, PR- Project, Q-Quiz, ASG- Assignment, Pr-Presentation, R-Report, F- Final Exam)

COURSE CONTENT

Criteria for detecting faults: Over current, differential current, difference of phase angles, over and under voltages, power direction, symmetrical components of current and voltages, impedance, frequency and temperature.
Instrument transformers: CT and PT. Electromechanical, Electronics and digital Relays: Basic modules, over current, differential, distance and directional. Trip circuits.
Unit protection schemes: Generator, transformer, motor, bus bar, transmission and distribution lines. Miniature circuit breakers and fuses.
Circuit breakers: Principle of arc extinction, selection criteria and ratings of circuit breakers,

types - air, oil, SF6 and vacuum.

CO-PO MAPPING

No	Course Outcomes (CO) of the Course	Program Outcome 1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **demonstrate** the basic operating principles and **interpret** specifications and limitations of various protective devices	3											
CO2	Developing potential to **compare** the functions of different protective devices	3											
CO3	Gaining ability to **analyse** the basic Protective measures for various components of different units	3											
CO4	Attaining proficiency in **designing** various protection schemes of generation, transmission and distribution networks on both sides			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning activities	Engagement (hours) 42
Teaching and Learning activities Face-to-Face Learning	-
Lecture	-
Practical/Tutorial/Studio Student-centred Learning	
Self-Directed learning	42
Non-face-to-face learning	21
Revision of the previous lecture at home Preparation for final examination	21
Formal Assessment	2
Continuous assessment Final examination	3
Total	131

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week 1	**Power System protection**	CT 1
Class 1	Purpose of power system protection	
Class 2	Criteria for detecting faults and respective relays	
Class 3	Over current Protection	
Week 2	**Generator Protection**	
Class 4	Differential protection of generator	
Class 5	Differential protection transformer	
Class 6	Protection for difference of phase angles	
Week 3	**Generator Protection (cont.)**	
Class 7	Over voltage protection	
Class 8	Under voltage protection	
Class 9	Protection from unsymmetrical components of current and voltage	
Week 4	**Generator Protection (cont.)**	CT 2
Class 10	Over and under frequency protection	
Class 11	Current transformer	
Class 12	Protection transformers	
Week 5	**Relays**	

	Class 13	Basic module and working principles of electromechanical relays	
	Class 14	Basic module and working principles of electronics relays	
	Class 15	Basic module and working principles of digital relays	
	Week 6	**Relays (cont.)**	
	Class 16	Over current relay	
	Class 17	Differential relay	
	Class 18	Distance relay	
	Week 7	**Relays (cont.)**	Mid Term
	Class 19	Directional relay	
	Class 20	Trip circuits	
		Unit Protection	
	Class 21	Unit protection schemes: Generator	
	Week 8	**Unit Protection(cont.)**	
	Class 22	Unit protection schemes: Transformer	
	Class 23	Unit protection schemes: Motor	
	Class 24	Unit protection schemes: Bus bar	
	Week 9	**Unit protection (cont.)**	
	Class 25	Unit protection schemes: Transmission lines	
	Class 26	Unit protection schemes: Distribution lines	
	Class 27	Miniature circuit breakers	
	Week 10	**Fuses and Circuit Breaker**	CT 3
	Class 28	Fuses	
	Class 29	Basics of circuit breakers	
	Class 30	Principle of arc extinction	
	Week 11	**Circuit Breaker (cont.)**	
	Class 31	Selection criteria of circuit breakers	
	Class 32	Types of circuit breakers: air and oil	
	Class 33	Types of circuit breakers: SF_6 and vacuum	
	Week 12	**Design problem**	
	Class 34	Rating of circuit breakers	
	Class 35	Designing practical power system protection unit generation side-1	
	Class 36	Designing practical power system protection unit distribution side-1	
	Week 13	**Design problem** (**cont**.)	
	Class 37	Designing practical power system protection unit transmission side-1	
	Class 38	Designing practical power system protection unit generation side-2	
	Class 39	Designing practical power system protection unit distribution side-2	
	Week 14	**Design problem** (**cont**.)	
	Class 40	Designing practical power system protection unit transmission side-2	
	Class 41	Open discussion	
	Class 42	Presentation	

ASSESSMENT STRATEGY

Components	Grading		CO	Bloom's taxonomy
Continuous Assessment (40%)	Class test/ Assignment	20%	CO1, CO2, CO3	C4
	Class Participation	5%	CO4	C6
	Class Attendance	5%	-	-
	Mid Term	10%	CO1, CO2, CO3	C4
Final Exam		60%	CO1, CO2, CO3,CO4	C4,C6
Total marks		100%		

(CO= Course Outcome, C=Cognitive Domain, P=Psychomotor Domain, A=Affective Domain)

TEXT AND REFERENCE BOOKS
1. Switchgear Protection and Power System- Sunil S. Rao 2. Power System Protection and Switchgear- Badri Ram 3. Fundamental of Power System Protection- Y. G. Paithankar 4. Power System Protection- P.M. Anderson

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.1.4. EECE 478: Power System Protection Laboratory
Level-4 Term- II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 478 : Power System Protection Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
Course Code: EECE 477 Course Title: Power System Protection			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This sessional course is designed to make the students enable to understand the basic working principle of protective devices like relay, circuit breaker, fuse etc and their applications for the protection of power system equipment such as generator, motor and transformer. It is targeted to provide a strong foundation to the students on modelling of power system protective scheme using relay and circuit breaker considering all types of fault in the system.			
OBJECTIVE			
1. To enable the students to understand the use of basic power system protective equipments like relay, circuit breaker, fuse, CT, PT etc. for real life power system protection. 2. To provide the students hand-on experience of implementing various protective schemes for the protection of Generator, Induction motor and Transformer etc. 3. To enable the students to use proper protection scheme and relay considering the type and location of fault. 4. To make the students capable to construct efficient protection scheme for power system protection using software like ETAP, PSAF etc. for the application in real life problems. 5. To augment student's creative thinking, communication and project management skills through projects and presentations.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to explain **the** basic working principle of various types of relay, circuit breaker, CT, PT etc. and identify their environmental impact in power system protection.	PO7	P2			7	R
CO2	Attaining knowledge to **compare** different topologies of protection for alternator, induction motor, transformer etc and **choose** best protection scheme considering the type, severity and location of fault using har	PO5	C3, P1			6	Q, R, T
CO3	Achieving ability to **analyze** a	PO6	C4, A3			7	PR, Pr

	particular real life problem on protection of power system equipment and **propose** best scheme for protection considering different technical constraints, public health and safety.						
CO4	Developing capability to **design** any project on protection system considering appropriate ratings of circuit breaker and relay coordination concept.	PO11	P6	3	1		PR, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 477 using different hardware equipment’s and simulation software.

CO-PO MAPPING

No	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to explain **the** basic working principle of various types of relay, circuit breaker, CT, PT etc. and identify their environmental impact in power system protection.							2					
CO2	Attaining knowledge to **Compare** different topologies of protection for alternator, induction motor, transformer etc and **choose** best protection scheme considering the type, severity and location of fault using har					2							
CO3	Achieving ability to **analyze** a particular real life problem on protection of power system equipment and **propose** best scheme for protection considering different technical constraints, public health and safety.						2						
CO4	Developing capability to **design** any project on protection system considering appropriate ratings of circuit breaker and relay coordination concept.											1	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Experiment	28
Self-Directed Learning	

Preparation of Lab Reports	30
Preparation of Lab-test	4
Preparation of Quiz	5
Preparation of Presentation	5
Engagement in Group Projects	24
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	121

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

	Week 1	Exp 1: Familiarization with the protection equipments.
	Week 2	Exp 2: Generator synchronization
	Week 3	Exp 3: Differential protection of a synchronous generator
	Week 4	Exp 4: Overspeed protection of a synchronous generator
	Week 5	Exp 5: Reverse power protection of a synchronous generator
	Week 6	Lab Test-1
	Week 7	Exp 6: Overvoltage protection of a synchronous generator
	Week 8	Exp 7: Overcurrent protection of a synchronous generator
	Week 9	Exp 8: Mechanical overload/underload protection of a three phase induction motor
	Week 10	Exp 9: Differential protection of a three phase power transformer
	Week 11	Exp 10: Restricted Earth Fault Protection of Transformer
	Week 12	Lab Test-2
	Week 13	Lab Quiz
	Week 14	Project Presentation + Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (70%)	Lab participation and Report	25%	CO 1	P1
			CO 2	P2
			CO 3	P3
	Lab Test	30%	CO 1	P1
			CO 2	P2
			CO 3	P3
	Project and Presentation	15%	CO4	A4
Lab Quiz		30%	CO 1	P1
			CO 2	P2
			CO 3	P3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. Switchgear protection and Power Systems – Sunil S. Rao

Reference Books:

1. Power System Protection and Switchgear – Badri Ram
2. Fundamentals of power system protection – Y. G. Paithankar

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.1.7. EECE 479: Power System Reliability
Level-4 Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 479 : Power System Reliability	Lecture Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE 305 Course Title: Power System

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of the course is to enhance student's knowledge and analytical ability in power system reliability analysis. It focuses on the learning of advanced reliability topics such as various probabilistic methods, reliability indices with an insightful understanding in power system applications. The students will also be able to solve real-life power grid reliability problems using this obtained knowledge.

OBJECTIVE

1. Familiarize students with the various probabilistic methods and reliability indices.
2. To impart the concepts of failure rate, restoration times, systems redundancy for the reliability analysis of both interconnected transmission grid and distribution network
3. Acquaint students with the various probabilistic generation and load models using Markov process to solve power system reliability problems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be proficient in **analysing** various reliability indices and be able to **design** probabilistic generation and load models to solve power system reliability problems.	PO3	C6	1	1	5	F, ASG, Pr
CO2	Able to **use** the concept failure rate, restoration times, systems redundancy and **illustrate** the idea in distribution system reliability analysis	PO1	C3	1		4	T, F
CO3	Capable to **understand** Markov process and reliability parameters in grid reliability analysis and **apply** different probabilistic methods to solve reliability issues	PO1	C3			4	Mid Term

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to Power System Reliability: Probabilistic reliability criteria, review of probability concepts, binomial probability distribution, poission probability distribution, Normal probability distribution, **Power System Reliability Concept:** Failure rate and outage, reliability cost and reliability worth, concepts of adequacy and security, methods of assessment

Generating capacity basic probability methods: Generating unit unavailability, capacity outage probability tables, comparison of deterministic and probabilistic criteria, a recursive algorithm for capacity model building

Reliability Indices: Loss of load probability (LOLP), Concepts and evaluation techniques, scheduled outages, load forecast uncertainty, force outage rate uncertainty, LOLE computation, evaluation of energy indices, energy limited systems generating capacity frequency and duration

method, system risk indices, Individual state load model, Cumulative state load model
Reliability assessment in interconnected System: Probability array method in two interconnected system, Factors affecting the emergency assistance, effect of tie capacity, tie line reliability, effect of number of tie lines, Effect of load forecast uncertainty, reliability evaluation technique of three interconnected system and multiconnected system.
Reliability assessment in distribution system: Additional interruption indices, customer-oriented indices, load and energy indices, Probability distribution of reliability indices, failure rate, restoration times, Series and parallel systems and redundancy, Temporary and transient failures, Inclusion of weather effects, Common mode failures, Inclusion of breaker failures.
Reliability assessment in Substation: Operating and failure states of system components, Open & short circuit failures, Malfunction of normally closed Breakers
Markov process: Markov process, Analysis of Probabilistic generation and load models and Solution of actual problems regarding reliability of an existing power system model

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient in **analysing** various reliability indices and able to **design** probabilistic generation and load models to solve power system reliability problem			2									
CO2	Able to **use** the concept failure rate, restoration times, systems redundancy and **illustrate** the idea in distribution system reliability analysis.	3											
CO3	Capable to **understand** Markov process and reliability parameters in grid reliability analysis and **apply** different probabilistic methods to solve reliability issues.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	48
Self-Directed Learning	94
Formal Assessment	05
Total	147

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Lecture Plan

Week 1	**Introduction to Power System Reliability**	**CT 1**
Class 1	Introduction to Power system Reliability, Probabilistic reliability criteria	
Class 2	Review of probability concepts, Binomial probability distribution	
Class 3	Poission probability distribution, Normal probability distribution	
Week 2	**Power System Reliability Concept**	
Class 4	Reliability concepts: Failure rate and outage	
Class 5	Reliability cost and reliability worth, Concepts of adequacy and security	
Class 6	Methods of assessment	
Week 3	**Generating capacity---basic probability methods**	
Class 7	Generating unit unavailability, Capacity outage probability tables	

Class 8	Comparison of deterministic and probabilistic criteria	
Class 9	A recursive algorithm for capacity model building	
Week 4	**Reliability Indices**	**CT 2**
Class 10	Loss of load probability (LOLP), Concepts and evaluation techniques	
Class 11	Related Mathematical Problems and solution	
Class 12	Scheduled outages, Load forecast uncertainty	
Week 5	**Reliability Indices**	
Class 13	Force outage rate uncertainty, LOLE Computation	
Class 14	Evaluation of energy indices, Energy limited systems	
Class 15	Related Mathematical Problems and solution	
Week 6	**Generating Capacity- Frequency and Duration method**	
Class 16	System risk indices, Individual state load model	
Class 17	Cumulative state load model	
Class 18	Related Mathematical Problems and solution	
Week 7	**Reliability assessment in interconnected System**	
Class 19	Probability array method in two interconnected system	
Class 20	Factors affecting the emergency assistance, effect of tie capacity, tie line reliability	
Class 21	Effect of number of tie lines, Effect of load forecast uncertainty	
Week 8	**Reliability assessment in interconnected System**	
Class 22	Reliability evaluation technique of three interconnected system	
Class 23	Reliability evaluation technique of multiconnected system	
Class 24	Related Mathematical Problems and solution	
Week 9	**Reliability assessment in distribution system**	
Class 25	Additional interruption indices, customer-oriented indices, load and energy indices	
Class 26	Probability distribution of reliability indices, failure rate, restoration times	
Class 27	Related Mathematical Problems and solution	
Week 10	**Reliability assessment in distribution system**	
Class 28	Series and parallel systems and redundancy, Temporary and transient failures	
Class 29	Inclusion of weather effects	
Class 30	Related Mathematical Problems and solution	
Week 11	**Reliability assessment in distribution system**	
Class 31	Common mode failures	
Class 32	Inclusion of breaker failures	
Class 33	Related Mathematical Problems and solution	
Week 12	**Reliability assessment in Substation**	
Class 34	Operating and failure states of system components	
Class 35	Open & short circuit failures, Malfunction of normally closed Breakers	
Class 36	Related Mathematical Problems and solution	
Week 13	**Markov process**	**CT 4**
Class 37	Markov process	
Class 38	Analysis of Probabilistic generation and load models 1	
Class 39	Analysis of Probabilistic generation and load models 2 & 3	
Week 14	**Reliability assessment problem formulation**	
Class 40	Solution of actual problems regarding reliability of an existing power system model 1	
Class 41	Solution of actual problems regarding reliability of an existing power system model 2, 3	
Class 42	Review	

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.1.6. EECE 481: Power System Operation & Control
Level-4 Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 481 : Power System Operation & control	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE 305 Course Title: Power system I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The aim of the course is to develop the thinking process of the student in reaching a sound understanding of broad-range of topics in the power system operation and control area. It focuses on the learning of advanced power system contents such as economic operation, automatic generation control, SCADA, power system security analysis, state estimation and electricity market to build student's confidence to understand the paradigm shift of conventional power systems towards smart grid.			
OBJECTIVE			
1. Familiarize students with the economic operation of a power system. 2. To impart the concepts of power system automatic generation control, SCADA system, state estimation and security analysis. 3. Acquaint students with the basic knowledge on the electricity market and smart grid. 4. To relate the power system operation and control knowledge with the real operation.			
COURSE OUTCOMES & GENERIC SKILLS			

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be proficient in **analysing** the economic operation of power systems and be able to **design** the optimum solution for a complex power system.	PO3	C6	1	1	5	F, ASG, Pr
CO2	Able to use the concept of automatic generation control, SCADA system in power system control and illustrate the idea in power system state estimation	PO1	C3	1		4	F ASG
CO3	Capable of understanding the power system security and electricity market concept and **applying** different methods to solve the power system contingency problems in smart grid.	PO1	C3			4	Mid Term

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Economic Operation of Power System: Load distribution techniques, performance curves**,** Economic dispatch using Lagrange method, Transmission loss equation, economic dispatch using transmission loss, Unit commitment and its constraints**,** Dynamic programming and Forward & backword DP method.

Optimal Power flow (OPF) analysis: Optimal power flow problem formulation, classification of OPF algorithms, Transmission system operation, emergency state, overvoltage correction

Automatic Generation Control (AGC): Basics generator control loop, Functions of AGC Speed governor, modes of governor operation, Model for a control area.

Power System Security Analysis: Power system security, reliability and economy, Contingency analysis by dc model**,** System reduction for contingency, contingency ranking

SCADA: Components and architecture of SCADA**,** Communication topology, SCADA Functions, Phasor measurement unit (PMU), EMS

State Estimation: Concept of state and measurement variables, state estimation in EMS, Least Square method, observability**,** bad data detection and identification**,** AC power system state estimation formulation

Electricity Market: Electricity market model & operating mechanism, Market stakeholder, determination of market clearing spot price

Distribution Side Management (DSM) & Smart grid: Distributed generation, demand side management features, demand response, concept of microgrid, grid evolution, Smart grid concept, architecture, and future grid control techniques

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient in **analysing** the economic operation of power system and be able to **design** the optimum solution for a complex power system			3									
CO2	Able to **use** the concept of automatic generation control, SCADA system in power system control and **illustrate** the idea in power system state estimation	3											
CO3	Capable of **understanding** the power system security and electricity market concept and **apply** different methods to solve the power system contingency problems in smart grid	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Self-Directed Learning	48 94
Formal Assessment	05
Total	147

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Power System Operation and Control**	
Class 1	Overview of vertically integrated power system	**CT 1**
Class 2	Basic principle of Power System Operation and control.	
Class 3	Introduction of deregulated power market, grid transformation	
Week 2	**Economic Operation of Power System**	
Class 4	Load distribution techniques, performance curves	
Class 5	Economic dispatch using Lagrange method, Transmission loss equation	
Class 6	Economic dispatch with transmission loss, Penalty factor	

	Week 3	**Economic Operation of Power System**	
	Class 7	Mathematical problems related to economic dispatch	
	Class 8	Mathematical problems related to economic dispatch	
	Class 9	Unit commitment and its constraints, Dynamic programming method to solve UC	
	Week 4	**Economic Operation of Power System**	
	Class 10	Forward and Backward DP method	**CT 2**
	Class 11	Mathematical problems related to Unit commitment	
	Class 12	Mathematical problems related to Unit commitment	
	Week 5	**Optimal Power flow (OPF) analysis**	
	Class 13	Optimal power flow problem formulation, classification of OPF algorithms	
	Class 14	Transmission system operation, emergency state, overvoltage correction	
	Class 15	Mathematical problems related Optimal power flow	
	Week 6	**Automatic Generation Control (AGC)**	
	Class 16	Basics generator control loop, Functions of AGC	
	Class 17	Speed governor, modes of governor operation, Model for a control area	
	Class 18	Mathematical problems related to AGC	
	Week 7	**Power System Security Analysis**	
	Class 19	Power system security, Reliability and economy	**Mid-term**
	Class 20	Contingency analysis of single and multiple contingency in power system	
	Class 21	Contingency analysis by dc model	
	Week 8	**Power System Security Analysis**	
	Class 22	System reduction for contingency, contingency ranking	
	Class 23	Mathematical problems related to contingency analysis	
	Class 24	Mathematical problems related to contingency analysis	
	Week 9	**SCADA**	
	Class 25	Components and architecture of SCADA, EMS	
	Class 26	Communication topology of SCADA	
	Class 27	SCADA Functions & Phasor measurement unit (PMU),	
	Week 10	**State Estimation of Power System**	
	Class 28	Concept of state and measurement variables, state estimation in EMS	
	Class 29	Least Square method, observability	
	Class 30	Bad data detection and identification	
	Week 11	**State Estimation of Power System**	
	Class 31	AC power system state estimation formulation	**CT 3**
	Class 32	Mathematical problems related to state estimation	
	Class 33	Mathematical problems related to state estimation	
	Week 12	**Electricity Market**	
	Class 34	Introduction to Electricity market model & structure	
	Class 35	Different types of market models, electricity pricing	
	Class 36	Market stakeholder, determination of market clearing spot price	
	Week 13	**Distribution Side Management (DSM) & Smart grid**	
	Class 37	Mathematical problems related to electricity market price	
	Class 38	Distributed generation, demand side management features, demand response	
	Class 39	Concept of microgrid, grid evolution to smart grid	
	Week 14	**Industrial Lecture/Review**	
	Class 40	Smart grid concept, architecture,	
	Class 41	Future smart future control techniques & integrated power system	
	Class 42	Review and summary	
	Class 42	Review and summary	
ASSESSMENT STRATEGY			

	Components		Grading	CO	Bloom's Taxonomy
	Continuous Assessment (40%)	Class Test & Assignment 1-3	20%	CO2	C3
		Mid term	10%	CO3	C3
		Class Attendance	5%		
		Class Performance	5%		
	Final Exam		60%	CO 1	C6
				CO 2	C3
	Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P= Psychomotor, and A= Affective Domain)

TEXT AND REFERENCE BOOKS

1. Element of Power System Analysis –J. J. Grainger and W. D. Stevenson,
2. Power generation operation and control – Allen J. Wood, Bruce F. Wollenberg
3. Modern Power System Analysis – IJ Nagrath and DP Kothan
4. Power System Optimization – Kthori and Dhillon
5. Reliability Evaluation of Power System – Billinton and Allan

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.1.7. EECE 483: High Voltage Engineering

Level-4 Term- I/II (Spring/ Fall)

COURSE INFORMATION

Course Code	: EECE 483	Contact Hours	: 3.00
Course Title	: High Voltage Engineering	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To provide the students with an introduction to high voltage engineering, including basics of electrical breakdown, high voltage generation, high voltage test systems, measurement and analysis techniques as applied to power system apparatus such as cables, insulators, transformers, and generators.

OBJECTIVE

1. Be able to impart fundamental concepts of high voltage generation and measurement.
2. Be able to familiarize the students with the concept and in-depth knowledge of electrical breakdown in different insulators (gases, liquids and solids).
3. Be able to familiarize the students with non-destructive insulation quality assessment techniques.
4. Be able to deliver students with the understanding of insulation co-ordination and over voltage protection.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO's	Bloom's Taxonomy	CP	CA	KP	Assessment Method
CO 1	Be able to **apply the understanding** of fundamental concepts of high voltage Generation and measurement in related practical fields.	PO1	C3	1		3	T, F
CO 2	Be able to **analyse** the breakdown phenomenon in gases, liquids and solid insulators.	PO2	C4	1		4	T, Mid Term, F
CO 3	Be able to **evaluate** an insulator's performance based on quality	PO2	C5	2	4	4	Mid Term, F, ASG

	assessment techniques						
CO 4	Be able to **design** a high voltage system considering insulation coordination and over voltage protection.	PO3	C6	3	4	5	PR/ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Generation of high voltages: Rectifier circuits for high voltage dc generation, Cockroft-Walton voltage multiplier circuit, Electrostatic Generator, Cascaded transformer for high voltage ac generation, series resonant circuit, single stage and multistage impulse generator circuits, impulse current generation.

Measurement techniques: Peak voltage measurement by spark gap, Electrostatic voltmeter, Generating voltmeter, The Chubb-Fortesque method, Peak voltmeter with potential divider, Impulse voltage measurement using voltage dividers, measurement of high dc and impulse current.

Breakdown Phenomenon: Breakdown in gases. Breakdown in non-uniform fields and corona discharges. Conduction and breakdown in liquids. Breakdown in solid dielectrics: intrinsic breakdown, thermal breakdown and electromechanical breakdown.

High voltage testing: Testing of overhead line insulators, testing of cables, testing of bushings, testing of power transformer and circuit breakers.

Non-destructive test techniques: Loss in a di-electric, measurement of resistivity, measurement of dielectric constant and loss factor, high voltage Schering bridge, partial discharges

Insulation Coordination: Lightning and switching surges. Basic insulation level. Surge diverters, arresters. Principles of insulation coordination on high voltage and extra high voltage power systems.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **apply the understanding** of fundamental concepts of high voltage generation and measurement in related practical fields.	3											
CO2	Be able to **analyse** the breakdown phenomenon in gases, liquids and solid insulators.		2										
CO3	Be able to **evaluate** an insulator's performance based on quality assessment techniques		3										
CO4	Be able to **design** a high voltage system considering insulation coordination and over voltage protection.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final exam	42 21 21

Formal Assessment Continuous Assessment Final Examination		2 3
Total		131
TEACHING METHODOLOGY		
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method		
COURSE SCHEDULE		
Week 1	**Introduction to high voltage and HVDC generation**	CT 1
Class 1	Introduction to high voltage engineering, high voltage dc generation	
Class 2	Rectifier circuits, ripple minimization	
Class 3	Cockroft-Walton voltage multiplier circuit	
Week 2	**HVDC Generation and HVAC Generation**	
Class 4	Electrostatic generator	
Class 5	HVAC generation by cascaded transformer	
Class 6	Tesla coils, series resonant circuits	
Week 3	**Impulse Generation**	
Class 7	Definition, shape and representation of impulse	
Class 8	Single and multistage impulse generation	
Class 9	Impulse current generation	
Week 4	**Measurement techniques**	CT 2
Class 10	Spark gap method	
Class 11	Electrostatic and Generating voltmeter	
Class 12	The Chubb-Fortesque method	
Week 5	**Measurement techniques**	
Class 13	Peak voltmeter with potential divider	
Class 14	Impulse voltage measurement using voltage dividers	
Class 15	Measurement of high dc and impulse current	
Week 6	**High voltage testing**	
Class 16	Testing of overhead line insulators	
Class 17	Testing of cables, testing of bushings	
Class 18	Testing of power transformer	
Week 7	**High voltage testing and breakdown**	Mid Term
Class 19	Testing of circuit breakers	
Class 20	Mechanism of breakdown of gases	
Class 21	Townsend's first and second ionization co-efficient	
Week 8	**Breakdown**	
Class 22	Cathode processes- secondary effect	
Class 23	Townsend breakdown mechanism	
Class 24	Streamer mechanism, Paschen's law, Penning effect	
Week 9	**Breakdown**	
Class 25	Time lag	
Class 26	Breakdown in liquid dielectrics	
Class 27	Treatment and testing of transformer oil	
Week 10	**Breakdown**	CT 4
Class 28	Breakdown in solid dielectric- intrinsic and electro-mechanical breakdown	
Class 29	Breakdown due to treeing and tracking,	
Class 30	Thermal and electro-chemical breakdown, breakdown in vacuum	
Week 11	**Transients, Over voltage, Insulation coordination**	
Class 31	Lightning mechanism	
Class 32	Switching surges	
Class 33	Insulation coordination,	
Week 12	**Transients, Over voltage, Insulation coordination**	

Class 34	Over voltage protection, ground wires	
Class 35	Basic insulation level: EV	
Class 36	Basic insulation level: HV	
Week 13	**Non-destructive test**	
Class 37	Basic insulation level: EHV	
Class 38	Loss in a di-electric	
Class 39	Measurement of resistivity	
Week 14	**Non-destructive test**	
Class 40	Measurement of di-electric constant and loss factor	
Class 41	High voltage Schering bridge	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C3
			CO2	C4
	Class Participation	5%	CO4	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO2, CO1	C4,.C3
Final Exam		60%	CO 4	C6
			CO 2	C4
			CO 3	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

High Voltage Engineering by Naidu; Tata McGraw-Hill

High Voltage Engineering by Wadhwa; NewAge India

Reference Books:

High Voltage Engineering by M. Khalifa; Dekker

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.2 Electronics

5.2.2.1. EECE 451: Processing and Fabrication Technology
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code	: EECE 451	Contact Hours	: 3.00
Course Title	: Processing and Fabrication Technology	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE-317
Course Title: VLSI I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is designed on the semiconductor processing and fabrication technology. This course is very important to develop the future workforces for semiconductor industry including with solar cells and other electronic devices. It is essential for students who desire to be specialized one in the fabrication process of electronic device. The course covers the basics of the fabrication and processing technology of various elementary and compound semiconductor materials such as silicon, III-V, II-VI and organic materials.

OBJECTIVE

1. Introduce the students with the mechanism of various fabrication techniques for bulk and single crystal growth for semiconductor material.
2. Teach about the probable defects which may be generated during the growth processes.
3. Illustrate in details the fundamental steps of fabrication process such as oxidation, diffusion, lithography, etching, cleaning and metallization.
4. Impart the in-depth theoretical knowledge of fabrication technique for monolithic IC taking into account the physical challenges.

COURSE OUTCOMES& GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Compare** the mechanism of various growth techniques for bulk and single crystal.	PO1	C5	1		3	T, F
CO2	**Correlate** the characteristics and qualities of growth semiconductor with the fabrication process and equipment used.	PO1	C1	1		3	T, Mid Term, F
CO3	**Explain** the wafer manufacturing processes, thermal oxidation, decant diffusion, physical/chemical vapor deposition, photolithography and etching processes.	PO3	C2	2		5	T, Mid Term, F
CO4	**Select** appropriate fabrication technique for monolithic Integrated Circuit (IC) with given specification.	PO3	C5	3	3	5	F, ASG, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Substrate materials: Crystal growth and wafer preparation, epitaxial growth technique, molecular beam epitaxy, chemical vapor phase epitaxy and chemical vapor deposition (CVD). Doping techniques: Diffusion and ion implantation.
Growth and deposition of dielectric layers: Thermal oxidation, CVD, plasma CVD,

sputtering and silicon-nitride growth.

Etching: Wet chemical etching, silicon and GaAs etching, anisotropic etching, selective etching, dry physical etching, ion beam etching, sputtering etching and reactive ion etching.

Cleaning: Surface cleaning, organic cleaning and RCA cleaning.

Lithography: Photo-reactive materials, pattern generation, pattern transfer and metalization.

Discrete device fabrication: Diode, transistor, resistor and capacitor. Integrated circuit fabrication: Isolation - pn junction isolation, mesa isolation and oxide isolation. BJT based microcircuits, p-channel and n-channel MOSFETs, complimentary MOSFETs and silicon on insulator (SOI) devices. Testing, bonding and packaging.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the mechanism of various growth techniques for bulk and single crystal.	3											
CO2	**Correlate** the characteristics and qualities of growth semiconductor with the fabrication process and equipment used.	3											
CO3	**Explain** the wafer manufacturing processes, thermal oxidation, decant diffusion, physical/chemical vapor deposition, photolithography and etching processes.			3									
CO4	**Select** appropriate fabrication technique for monolithic Integrated Circuit (IC) with given specification.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Bulk Crystal Growth Techniques**	CT 1
Class 1	Introduction to Processing and Fabrication Technology	
Class 2	Substrate materials: Crystal growth and wafer preparation	
Class 3	Silicon Ingot using CZ technique, Floating Zone Technique	
Week 2	**Introduction to Epitaxial Growth Techniques**	
Class 4	Liquid phase epitaxial (LPE) technique	

Class 5	Chemical vapor phase epitaxy and chemical vapor deposition (CVD)	
Class 6	Metal Organic Chemical Vapor Deposition (MOCVD)technique	
Week 3	**Introduction to Epitaxial Growth Techniques**	
Class 7	Molecular Beam epitaxial (MBE) technique	
Class 8	Introduction to the fabrication process of extrinsic compound semiconductor.	
Class 9	Metal organic molecular beam epitaxial growth technique (MOMBE)	
Week 4	**Doping techniques**	CT 2
Class 10	Atomistic Analysis on diffusion type doping technique.	
Class 11	Ion beam implantation doping technique.	
Class 12	Mathematical problems regarding doping.	
Week 5	**Thermal Oxidation and PECVD**	
Class 13	Introduction to the significance of different oxide and dielectric layers in semiconductor industry	
Class 14	Mechanism of thermal oxidation and estimation of the oxide thickness	
Class 15	Plasma Enhanced Chemical Vapor Deposition (PECVD) technique for the growth dielectric	
Week 6	**Lithography**	
Class 16	Introduction to Lithography process and significance	
Class 17	'Spin-Coating' process of inserting the photoresist material on the wafer	
Class 18	Details the each step of lithography process to transfer a pattern to the wafer	
Week 7	**Etching Process**	MT
Class 19	Introduction to Etching process and significance in semiconductor inductry	
Class 20	Wet chemical etching and Dry etching	
Class 21	Reactive Ion Beam Etching (RIBE) in semiconductor technology	
Week 8	**Cleaning**	
Class 22	'Cleaning' and 'Importance of Cleaning'	
Class 23	Details of RCA cleaning and Mega-sonic Cleaning	
Class 24	Details of Ultrasonic Cleaning and Ozone Cleaning	
Week 9	**Metallization**	
Class 25	Introduction to the metal and alloys for metallization process.	
Class 26	E-beam evaporation technique for Metallization	
Class 27	Sputtering and CVD process of Metallization	
Week 10	**Device Isolation**	CT 3
Class 28	Pattern transfer and metalization	
Class 29	Discrete device fabrication: Diode, transistor, resistor and capacitor	
Class 30	Discrete device fabrication: Diode, transistor, resistor and capacitor	
Week 11	**Fabrication of Practical Devices**	
Class 31	Introduction to the different ways of p-n junction fabrication	
Class 32	Fabricating the bipolar junction transistor (n-p-n) using the diffusion process	
Class 33	Fabrication of Resistor and Capacitor in Integrated Circuit	
Week 12	**Silicon on Insulator (SOI) technology**	
Class 34	Comparison of MOS and Silicon on Insulator (SOI) technology	
Class 35	SIMOX process of fabricating SOI based devices	
Class 36	Smart-Cut process of fabricating SOI based devices	
Week 13	**Fabrication of ICs**	
Class 37	Introduction to the significance of IC fabrication technology.	
Class 38	Fabrication process of CMOS	
Class 39	Fabrication process of monolithic IC	
Week 14	**Packaging of ICs**	
Class 40	Introduction to Testing, bonding and packaging	
Class 41	Through-hole Mount package, and Surface Mount Package of ICs	

Class 42	Ball grid array and Wafer level chip scale packaging approach for Chip scale package	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C5
			CO2	C1
			CO3	C2
	Class Participation	5%	CO4	C5
	Class Attendance	5%	-	-
	Mid term	10%	CO 2	C1
			CO3	C2
Final Exam		60%	CO 1	C5
			CO 2	C1
			CO 3	C2
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Fabrication Engineering at the Micro and Nanoscale by Stephen A Campbell
2. An Introduction to VLSI Physical Design – C. K. Wong
3. Electronic and Optoelectronic properties of semiconductor structure by Jasprit Sing

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.2.2. EECE 453: Analog Integrated Circuits
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION

Course Code	: EECE 453	Lecture Contact Hours	: 3.00
Course Title	: Analog Integrated Circuits	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 201 Course Title: Electronics I	Course Code: EECE 317 Course Title: VLSI I	Course Code: EECE 457 Course Title: VLSI II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Analog Integrated Circuit is one of the advanced courses for students of electronics specialization for that very reason the course is quintessential for research in the aforementioned field. The contents of the course focus on the advanced operations of MOS devices where special emphasis is given on MOS amplifiers (Single stage and differential). Unwanted issues that arises in CMOS designs is also addressed along with preliminary ideas of CMOS devices (Reference generators, Current mirrors and switched capacitor circuits) that is used frequently in advanced VLSI designs. Irrespective of its contents the course also gives the students a flavour of researches in IC design that is vital in the day to day life of designer.

OBJECTIVE

1. **Familiarize** students with the basic physics and operation of MOS devices.
2. **Develop** the quality of using essential analytical tools for quantifying behaviors of CMOS circuits like single-stage amplifiers, differential amplifiers and current mirrors.
3. **Address** the imperfection of Noise that occurs in CMOS designs and its subsequent effects on circuits.
4. **Introduce** the concepts of advanced Bandgap reference generators and discrete time systems implemented by means of switched capacitor circuits.

5. **Discuss** the design, operation and behaviors of oscillator and phase locked loop circuits

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be capable in **recalling** the physics of MOSFET and **explain** the underlying principles of MOS transistors, second order effects and parasitic effects.	PO1	C2			1	T, F
CO2	Capable to **analyse** the topologies of the single stage FET amplifiers and differential amplifiers **demonstrate** the mirroring technique of current sources without compromising the voltage headroom.	PO1	C4			3	T, F
CO3	Be adept in **interpreting** the effects of different noise (thermal shot and flicker) that occur in analogue circuits and **apprise** the trade-offs that poses to performance parameters of the amplifier circuits.	PO2	C5	P1		3	Mid Term
CO4	Be proficient in **devising** reference generators using band gap techniques as well as **evaluating** the speed and precision of Switched capacitor amplifiers as a foundation to **analyse** discrete time systems (i.e. comparators, filters, etc.)	PO2	C6	P1		3	Mid Term

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Review of FET amplifiers: Passive and active loads and frequency limitation. Current mirror: Basic, cascade and active current mirror. Differential Amplifier: Introduction, large and small signal analysis, common mode analysis and differential amplifier with active load. Noise: Introduction to noise, types, representation in circuits, noise in single stage and differential amplifiers and bandwidth. Band-gap References: Supply voltage independent biasing, temperature independent biasing, proportional to absolute temperature current generation and constant transconductance biasing. Switch capacitor circuits: Sampling switches, switched capacitor circuits including unity gain buffer, amplifier and integrator. Phase Locked Loop (PLL): Introduction, basic PLL and charge pumped PLL.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be capable in **recalling** the physics of MOSFET and **explain** the underlying principles of MOS transistors, second order effects and parasitic effects.	3											
CO2	Capable to **analyse** the topologies of the single stage FET amplifiers and differential amplifiers **demonstrate** the mirroring technique of current sources without compromising the voltage headroom.	3											
CO3	Be adept in **interpreting** the effects of different noise (thermal shot and flicker) that		3										

	occur in analogue circuits and **apprise** the trade-offs that poses to performance parameters of the amplifier circuits.												
CO4	Be proficient in **devising** reference generators using band gap techniques as well as **evaluating** the speed and precision of Switched capacitor amplifiers as a foundation to **analyse** discrete time systems (i.e. comparators, filters, etc.)		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of previous and (or) subsequent lecture at home Preparation for final Exam	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	**Introduction**	
Class 1	Background, Review of MOS Transistor	
Class 2	2nd order effect of MOS Transistor, Device Layout, Capacitance and Small Signal Model	
Class 3	Short Channel Effects, CMOS Processing Technology	
Week 2	**FET Amplifiers**	
Class 4	Single Stage Amplifiers	CT 1
Class 5	Amplifiers with passive and active loads	
Class 6	Differential Amplifiers	
Week 3	**FET Amplifiers (Contd.)**	
Class 7	Common Mode Response	
Class 8	Differential pairs with active loads	
Class 9	Gilbert Cell	
Week 4	**Current Mirror and Biasing**	
Class 10	Basic Current Mirror	
Class 11	Cascode Current Mirror	
Class 12	Active Current Mirror	
Week 5	**Current Mirror and Biasing (Contd.)**	
Class 13	Active Current Mirror (Contd.)	
Class 14	Biasing Techniques	CT 2
Class 15	Biasing Techniques (Contd.)	
Week 6	**Noise**	
Class 16	Statistical Characteristics	
Class 17	Types of Noise	
Class 18	Noise in Single stage and Differential Amplifiers	

Week 7	**Noise (Contd.)**	
Class 19	Noise Bandwidth	
Class 20	Noise power trade-off	
Class 21	Mathematical problems on Noise	
Week 8	**Bandgap Reference**	Mid Term
Class 22	General Consideration	
Class 23	Supply-independent biasing	
Class 24	Temperature independent references	
Week 9	**Bandgap Reference (Contd.)**	
Class 25	PTAT current generation	
Class 26	Constant transconductance biasing	
Class 27	Speed and noise issues, Low voltage bandgap references	
Week 10	**Switched-Capacitor Circuits**	
Class 28	General considerations	
Class 29	Sampling switches	
Class 30	Switched-capacitor amplifiers	
Week 11	**Switched-Capacitor Circuits (Contd.)**	CT 3
Class 31	Switched-capacitor integrator	
Class 32	Switched-capacitor amplifiers common-mode feedback	
Class 33	Implementation in switched capacitor circuit in filter, comparator ADC and DAC circuits design.	
Week 12	**Oscillators and PLL**	
Class 34	General Considerations	
Class 35	Ring oscillator and LC oscillator	
Class 36	Voltage controlled oscillator	
Week 13	**Oscillators and PLL (Contd.)**	
Class 37	Simple PLL	
Class 38	Charged pumped PLL	
Class 39	Nonideal effects in PLL, Applications of Oscillators and PLL	
Week 14	**Practical Problem and Solution**	
Class 40	Practical problems and solution based on topics covered	
Class 41	Complex engineering problem and solution	
Class 42	Summary	

ASSESSMENT STRATEGY

<table>
<tr><th colspan="2">Components</th><th>Grading</th><th>CO</th><th>Bloom’s Taxonomy</th></tr>
<tr><td rowspan="4">Continuous Assessment (40%)</td><td>Class Test/ Assignment 1-3</td><td>20%</td><td>CO1, CO2</td><td>C2, C4</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>-</td><td>-</td></tr>
<tr><td>Class Attendance</td><td>5%</td><td>-</td><td>-</td></tr>
<tr><td>Mid term</td><td>10%</td><td>CO3, CO4</td><td>C5, C6</td></tr>
<tr><td colspan="2" rowspan="2">Final Exam</td><td rowspan="2">60%</td><td>CO 1</td><td>C2</td></tr>
<tr><td>CO 2</td><td>C4</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Design of Analog CMOS Integrated Circuits – Behzad Razavi, 2nd Edition
2. Analog Integrated Circuit Design – T. Chan Carusone, D. Johns and K. Martin
3. Analysis and Design of Analog Integrated Circuits – P. Gray, P. Hurst, S. Lewis, and R. Meyer
4. CMOS Analog Circuit Design – D. Holberg and P. Allen, 2012

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.2.3. EECE 455: Compound Semiconductor and Heterojunction Devices
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 455 : Compound Semiconductor and Heterojunction Devices	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE
Course Code: EECE 315 and EECE 405 Course Title: Electrical Properties of Material and Solid State Device
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To familiarize with the characteristics of compound semiconductors as well as with different heterojunction devices. In a broader perspective, to acquaint with various device modelling and material characterization techniques and relate them to the current trends in research and developments.
OBJECTIVE
1. To impart the knowledge on different characteristics of compound semiconductors along with their comparative superiorities over silicon. 2. To provide a comparative study of physics and underlying technology between homojunction and heterojunction of semiconductor materials. 3. To disseminate knowledge about the structure and basic working principle of various heterojunction devices. 4. To develop the ability to apply different device modeling and characterization techniques into various proposed/upcoming semiconductor devices.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	To **define** and **explain** different characteristic properties of compound semiconductor materials and its advantages over prevailing materials.	PO1	C2			3	T, F
CO2	To be able to **contrast** between different types of semiconductor material junctions- homo junction and heterojunction.	PO2	C4			4	T, Mid Term Exam, F
CO3	To be able to **comprehend** and **describe** the structure and basic operating principle of practically developed heterojunction devices.	PO1	C5			4	Mid Term Exam, F
CO4	To be adept in **designing** heterojunction based upcoming electronic, optoelectronic and photonic devices using promising compound semiconductors.	PO3	C6			5	Pr /ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Compound Semiconductor: Zinc-blende crystal structures, growth techniques, alloys, band gap, and density of carriers in intrinsic and doped compound semiconductors.
Hetero-Junctions: Band alignment, band offset, Anderson's rule, single and double sided hetero- junctions, quantum wells and quantization effects, lattice mismatch and strain and

common hetero-structure material systems.
Hetero-junction diode: Band bending, carrier transport and I-V characteristics.
Hetero-junction field effect transistor: Structure and principle, band structure, carrier transport and I-V characteristics.
Hetero-structure Bipolar Transistor (HBT): Structure and operating principle, quasi-static analysis, extended Gummel-Poon model, Ebers-Moll model, secondary effects and band diagram of a graded alloy base HBT.
Resonant Tunnelling Devices: Physics and operation of Resonant Tunnelling Diodes. Resonant Tunnelling Transistors: Device physics, operation and characteristics.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To **define** and **explain** different characteristic properties of compound semiconductor materials and its advantages over prevailing materials.	3											
CO2	To be able to **contrast** between different types of semiconductor material junctions- homojunction and heterojunction.		2										
CO3	To be able to **comprehend** and **describe** the structure and basic operating principle of practically developed heterojunction devices.	3											
CO4	To be adept in **designing** heterojunction based upcoming electronic, optoelectronic and photonic devices using promising compound semiconductor.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE

Week 1	Compound Semiconductor	CT 1
Class 1	Types of semiconductors. Introduction to compound semiconductor.	
Class 2	Advantages of compound semiconductors- tunable bandgap and carrier mobility.	
Class 3	Review of crystal directions and planes, crystal structure- diamond, zinc blende and wurtzite crystal structure.	
Week 2	**Growth Technique and Band Structure**	

Class 4	E-K diagram, Bandgap- direct and indirect bandgap materials.	
Class 5	Vegard's law coupled with bowing parameters, Virtual crystal approximation.	
Class 6	Ternaries and Quaternaries- Growth techniques.	
Week 3	**Lattice Mismatch and Strain**	
Class 7	Epitaxial growth- lattice mismatch and strain, defects and dislocations.	
Class 8	Concept of Effective mass and Carrier mobility.	
Class 9	Effect of temperature and strain on bandgap and carrier mobility.	
Week 4	**Band Diagram and Carrier Concentration**	
Class 10	Fermi-Dirac probability & charge carrier density in semiconductor materials.	
Class 11	Impurity, doping and Fermi energy level positioning.	
Class 12	Band diagram drawing - band alignment.	
Week 5	**Hetero-Junctions**	
Class 13	Homojunction and Heterojunction- An introduction.	CT 2
Class 14	Energy band alignment and band offset, Anderson's rule.	
Class 15	Single and double sided heterojunctions.	
Week 6	**Hetero-Junctions, Quantum Well and Superlattices**	
Class 16	Quantum wells and Superlattices- quantization effects.	
Class 17	Quantum wells and Superlattices- quantization effects.	
Class 18	2DEG – 2 dimensional electron gas.	
Week 7	**Metal – Semiconductor Heterojunction**	
Class 19	Electrostatics, Non-ideal effects on the barrier height.	
Class 20	I-V characteristics of a Schottky diode.	
Class 21	Difference between Schottky diode and PN junction diode.	
Week 8	**Hetero-junction Diode**	
Class 22	Hetero-junction diode: Band bending in isotype and anisotype junctions	Mid Term
Class 23	I-V characteristics of heterojunction diodes.	
Class 24	Carrier transport phenomena in heterojunction diodes.	
Week 9	**Hetero-junction field effect transistor**	
Class 25	Hetero-junction field effect transistor: Structure and operating principle.	
Class 26	Hetero-junction field effect transistor: Structure and operating principle.	
Class 27	Energy band structure, carrier transport and I-V characteristics.	
Week 10	**Hetero-junction field effect transistor**	
Class 28	Energy band structure, carrier transport and I-V characteristics.	
Class 29	Non-Ideal effects and frequency response of the FET devices.	
Class 30	A brief introduction on HEMT.	
Week 11	**Hetero-structure bipolar transistor**	
Class 31	Hetero-structure bipolar transistor (HBT): Structure and operating principle.	CT 3
Class 32	Hetero-structure bipolar transistor (HBT): Structure and operating principle.	
Class 33	Quasi-static analysis.	
Week 12	**Hetero-structure bipolar transistor**	
Class 34	Extended Gummel-Poon model of HBT.	
Class 35	Extended Gummel-Poon model of HBT.	
Class 36	Ebers-Moll model of HBT.	
Week 13	**Hetero-structure bipolar transistor**	
Class 37	Ebers-Moll model of HBT.	
Class 38	Secondary effects and band diagram of a graded alloy base HBT.	
Class 39	Secondary effects and band diagram of a graded alloy base HBT.	
Week 14	**Resonant Tunnelling Devices**	
Class 40	Introduction on RTD physics and operating principle.	
Class 41	Resonant Tunnelling Transistors: device physics, operation and characteristics.	
Class 42	Discussion on scope of research and Review class.	

ASSESSMENT STRATEGY				
Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C4
			CO4	C6
	Class Participation	5%	CO4	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C4
			CO3	C5
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C5
Total Marks		100%		

(CO= Course Outcome, C= Cognitive Domain, P= Psychomotor Domain, A= Affective Domain)

TEXT AND REFERENCE BOOKS

1. 'Physics of Semiconductor Devices (3rd Edition)' by S M Sze.
2. 'Semiconductor Physics And Devices: Basic Principles (4th Edition)' by Donald A. Neamen.

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.2.4. EECE 457: VLSI II
Level-4, Term-I/II (Spring/ Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 457 : VLSI II	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE 317
Course Title: VLSI I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This theory course is focused on introducing students with different circuit topologies, training them in designing schematics and layouts of multistage logic networks with minimum delay, proper transistor and interconnect scaling, give them a generalized idea about CMOS manufacturing process of transistors and developing their potential in testing the designed networks. This course also is focused on providing students with an overall idea of hardware implementation of these designs from single cell unit to full custom IC designs and make them capable of differentiating between different FPGA architectures. Finally, this course will familiarize students to industrially recognized circuit simulator and computation software like Cadence.

OBJECTIVE

1. To impart to the students an overview of advanced VLSI design approach.
2. To teach students about designing large scale logic networks with proper transistor scaling and make them skilled in modelling and optimizing total delay in those networks. .
3. To develop students' knowledge about the manufacturing process and testing process for designed IC.
4.To give an overall idea of implementation strategies of VLSI designs at hardware level ranging from single cell design to different FPGA architectures.
5. To grow their skills in designing various application specific ICs.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods

CO1	Be proficient enough to **design** circuit topologies and multistage logic networks in the most efficient manner and model total delay in the network by applying the knowledge of logical effort, RC delay modelling and interconnect delay modelling.	PO3	C6	1		3	T, F
CO2	Be skilled enough to design layouts of different networks complying with layout design rules and explain CMOS manufacturing process.	PO3	C6	1		3	T, F
CO3	Be able to evaluate / test different VLSI designs using various techniques such as logic verification, silicon debug, fault modelling, observability and controllability and test pattern generation.	PO1	C4	1		4	Mid Term Exam, F
CO4	Be able to design an application specific using latest technology tools for solving real-life problems and differentiate between various FPGA architectures	PO3	C6	1		5	T,ASG,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Logical Effort: Delay in a Logic Gate, Multistage Logic Networks, Choosing the Best Number of Stages

Cascode and Current Mirror: Cascode Basics, Cascode Amplifier, Practical Cascode, Current Mirror Basics, CMOS Current Mirror, Example

CMOS Manufacturing Process: Manufacturing Issues, Example, Layout Design Rules, Process Enhancements

Testing: Logic Verification, Silicon Debug, Manufacturing Test, Fault Models, Observability and Controllability, Design for Test, Scan

Wire: Introduction, Interconnect Modeling, Wire Resistance, Wire Capacitance, Wire RC Delay, Crosstalk, Wire Engineering, Repeaters

Scaling & Packaging: Scaling, Transistors, Interconnect, Future Challenges, Economics, Packaging

Application Specific IC: VCO Design, PLL Design, Filter Design, I/O Pad Design, Low Power IC Design

Implementations Strategies: Full Custom IC Design, Semi-Custom IC Design, Standard Cell Design and Cell Libraries

Implementations Strategies: FPGA Building Block Architectures, Global, Detailed, Special Routing

CAD Tools: SPICE, Cadence, Schematic Entry, Verification, Layout Extraction, Application Specific Circuit Design, Summary

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient enough to design multistage logic networks in the most efficient manner and model total delay in the network by applying the knowledge of logical effort, RC delay modelling and			2									

	interconnect delay modelling.												
CO2	Be skilled enough to design layouts of different schematic networks complying with layout design rules and explain CMOS manufacturing process.			2									
CO3	Be able to evaluate / test different VLSI designs using various techniques such as logic verification, silicon debug, fault modelling, observability and controllability and test pattern generation.	2											
CO4	Be able to design an application specific using latest technology tools for solving real-life problems and differentiate between various FPGA architectures			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 14 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	124

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Logical Effort**	CT 1
Class 1 Class 2 Class 3	Delay in a Logic Gate, Multistage Logic Networks	
Week 2	**Logical Effort**	
Class 4 Class 5 Class 6	Choosing the Best Number of Stages, example, summary	
Week 3	**Cascode and Current Mirror**	
Class 7	Cascode Basics	
Class 8	Cascode Amplifier	
Class 9	Practical Cascode	
Week 4	**Cascode and Current Mirror**	CT 2
Class 10 Class 11 Class 12	Current Mirror Basics, CMOS Current Mirror, Example	
Week 5	**CMOS Manufacturing Process**	

Class 13	Manufacturing Issues, example, summary	CT 2
Class 14		
Class 15		
Week 6	**CMOS Manufacturing Process**	
Class 16	Layout Design Rules, Process Enhancements	
Class 17		
Class 18		
Week 7	**Testing**	Mid-Term
Class 19	Logic Verification, Silicon Debug	
Class 20	Manufacturing Test, Fault Models	
Class 21	Observability and Controllability, Design for Test, Scan	
Week 8	**Wire**	
Class 22	Introduction, Interconnect Modeling, Wire Resistance	
Class 23	Wire Capacitance, Wire RC Delay, Crosstalk,	
Class 24	Wire Engineering, Repeaters	
Week 9	**Scaling & Packaging**	
Class 25	Scaling, Transistors, Interconnect, Future Challenges, Economics, Packaging	
Class 26		
Class 27		
Week 10	**Application Specific IC**	CT-4
Class 28	VCO Design, PLL Design, Filter Design	
Class 29		
Class 30		
Week 11	**Application Specific IC**	
Class 31	I/O Pad Design, Low Power IC Design	
Class 32		
Class 33		
Week 12	**Implementations Strategies**	
Class 34	Full Custom IC Design, Semi-Custom IC Design, Standard Cell Design and Cell Libraries	
Class 35		
Class 36		
Week 13	**Implementations Strategies**	
Class 37	FPGA Building Block Architectures, Global, Detailed, Special Routing	
Class 38		
Class 39		
Week 14	**CAD Tools**	
Class 40	SPICE, Cadence, Schematic Entry, Verification	
Class 41	Layout Extraction	
Class 42	Application Specific Circuit Design, Summary	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test 1-3	20%	CO1	C6
			CO2	C6
			CO4	C6
	Assignment	5%	CO4	C6
	Attendance	5%		
	Mid term	10%	CO3	C4
Final Exam		60%	CO1	C6
			CO2	C6
			CO3	C4
			CO4	C6

Total Marks	100%	

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. CMOS VLSI Design - A Circuits and System Perspective by N. H. E. Weste and D. Harris
2. Basic VLSI Design - Douglas A. Pucknell; Prentice Hall of India private Ltd.

Reference Books:

1. Introduction to VLSI – D. Bricius; McGraw-Hill international.
2. Design of Analog CMOS Integrated Circuits by Behzad Razavi.3. CMOS Circuit Design, Layout and Simulation by R. Jacob Baker, Harry H. Li, David E Boyce.
4. An Introduction to VLSI Physical Design by M. Sarrafzadeh, C.K. Wong.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.2.5. EECE 458: VLSI II Laboratory
Level-4, Term-II (Fall)

COURSE INFORMATION			
Course Code	: EECE 458	Contact Hours	: 3.00
Course Title	: VLSI II Laboratory	Credit Hours	: 1.50

PRE-REQUISITES

Course Code: EECE 317, EECE 318, EECE 457
Course Title: VLSI I, VLSI I Laboratory, VLSI II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

In VLSI industry, a professional engineer can have many roles such as device engineer, systems engineer, verification engineer as well as CAD engineer. This laboratory course is solely focused on building a foundation for preparing students to adopt such roles with ease by engaging them in designing schematics and layouts of multistage logic networks while complying with given design specifications and maintaining minimum delay and power consumption. This course also aims to train students to synthesis RTL designs of ASICs consisting of different combinational and sequential networks and develop physical designs of those ASICs as well. Finally, this course will also engage students to work as a team and design a processor that will be able to execute certain computational operations.

OBJECTIVE

1. To familiarize students with industry level software for electronic design automation (e.g. Cadence)
2. To develop students' skills in schematic design, layout design, symbol creation and simulation of basic logic gates and multistage networks
3. To introduce students with basics of ASIC front end design such as writing appropriate testbench, RTL Synthesis, Floor Planning, Power Planning, Cell Placements, Clock Tree Synthesis (CTS), Post-CTS Timing, Routing and Physical Verification
4. To build students' proficiency in creating FSM (Finite State Machines) in accordance with the given design specifications
5. To develop a collaborative nature among students that will habituate them in working as a team while designing and testing large scale processors and benefit them in their professional life as an engineer in VLSI industry

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Being skilled enough to **apply** knowledge of CMOS design process of logic gates and **construct**	PO5	C3,P5	2		6	R,Q,T

	schematics of multistage logic networks using these logic gates in the most efficient way adapting to specific design requirements**.**						
CO2	Be able to **originate** layout design based project on a given schematic and organize all the components of the layout in an optimized manner such as to minimize total area staying within the constraints of design rules.	PO11	P7	2			PR , Pr R,
CO3	Be able to **design** RTL schematics of large scale ASICs and **originate** physical designs from the designed RTL networks.	PO9	P7	2			R,PR,Q
CO4	Being proficient in **designing** finite state machines by adapting to given design specifications	PO12	P7	2			PR , Pr R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 457 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Being skilled enough to **apply** knowledge of CMOS design process of logic gates and **construct** schematics of multistage logic networks using these logic gates in the most efficient way adapting to specific design requirements**.**					2							
CO2	Be able to **originate** layout design based project on a given schematic and organize all the components of the layout in an optimized manner such as to minimize total area staying within the constraints of design rules.											2	
CO3	Be able to **design** RTL schematics of large scale ASICs and **originate** physical designs from the designed RTL networks.									3			
CO4	Being proficient in **designing** finite state machines by adapting to given design specifications					2							

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 10 20
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz	 30 9 10

Engagement in Project Preparation of Project Presentation	14 3
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	107

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, individual effort and performance evaluation

COURSE SCHEDULE

Week 1	Account, Tool Setup and Study of the Basic I-V Equation of the MOS transistor in the Technology Library
Week 2	Schematic Design, Symbol Creation and Simulation of a 2-input NAND Gate
Week 3	Parameterized Cell (P-cell) based Layout Design of a 2 Input NAND Gate with Cadence Virtuoso Layout Suite L
Week 4	Schematic Driven Layout design of a 2 Input NAND Gate with Virtuoso Layout Suite XL (VXL) Editor
Week 5	Design of a Two Stage CMOS Operational Amplifier and Study of its DC and AC Characteristics using Cadence Virtuoso
Week 6	**Lab Test-I**
Week 7	ASIC Front End Design: RTL Design, Simulation and Synthesis of a 8-Bit Booth Multiplier using Cadence
Week 8	ASIC Front End Design: Physical Design of a 8-Bit Booth Multiplier using Cadence
Week 9	ASIC Front End Design: RTL design, Simulation and Synthesis of an 8-bit Up/Down Counter using Cadence
Week 10	ASIC Front End Design: Physical Design of an 8-bit Up/Down Counter using Cadence
Week 11	Design of a Finite State Machine in Cadence
Week 12	**Lab Test-II**
Week 13	**Project Demonstration and Presentation**
Week 14	**Lab Quiz**

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (80%)	Lab participation and Report	25%	CO1	C3,P5
			CO2	P7
			CO3	P7
			CO4	P7
	Labtest-1,Labtest-2	30%	CO1	C3,P5
	Project Demonstration and Presentation	25%	CO2	P7
			CO3	P7
			CO4	P7
Lab Quiz		20%	CO1	C3,P5
			CO2	P7
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. CMOS VLSI Design: A Circuits and Systems Perspective-- Neil H.E. Weste, David Harris
2. The Design of CMOS Radio-Frequency Integrated Circuits(2nd Edition)-- Thomas H. Lee
3. CMOS: Circuit Design, Layout, and Simulation(4th Edition)-- R. Jacob Baker
4. Design of Analog CMOS Integrated Circuits-- Behzad Razavi

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.2.7. EECE 459: Optoelectronics
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 459 : Optoelectronics	Lecture Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE
Course Code: EECE 405 Course Title: Solid State Devices
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This course builds on the basic knowledge of both fundamental physics and state-of-the-art technologies for optoelectronic components in order to understand present and future technologies for applications in optical communications, sensor/imaging techniques as well as energy conversion that has found renewed interest recently due to world-wide demands of energy saving and new energy production. The course will include the introductions to various physical processes for optical transitions, operation principles of key optoelectronic devices including LEDs, lasers, photodetectors, electro-optical modulators and photovoltaic devices; functionalities of optical interconnect and signal transmission as well as the basic design consideration for on-chip optical processor and optoelectronic integrated circuits.
OBJECTIVE
1. Familiarize the students with optoelectronic properties of materials and their applications to optoelectronic devices and photonic integrated circuits that emit, modulate, switch, and detect photons. 2. Impart basic knowledges about fundamental and applied aspects of optoelectronic device physics and its applications to the design and operation of laser diodes, light-emitting diodes, photodetectors and optical modulator. 3. Expose the students with optoelectronic device characteristics in detail using concepts from quantum mechanics and solid state physics. 4. Acquaint students with the techniques to improve the operation of optoelectronic devices and device characteristics that have to be optimized for new applications.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the fundamental physical processes of optoelectronic transitions and **apply** the concepts to different optoelectronic devices.	PO1	C3	P1		3	T, F
CO2	Achieving capability to **define,** in depth, the principles/functionality of the most important optoelectronic devices, **compare** and **evaluate** the different device designs.	PO1	C5	P1		3	T, Mid Term Exam, F
CO3	Be competent to **infer** modeling to **analyze** the physics behind semiconductor optoelectronic devices.	PO1	C4			4	Mid Term Exam, F, ASG
CO4	Be proficient to **demonstrate** an understanding of the basic design requirements for optoelectronic integration and **discriminate** different material as well as design elements to accomplish an on-chip	PO3	C5	P2	A1	5	T, F, Pr

	optical processor or a simple optical communication system.						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Properties of Light: Particle and wave nature of light, polarization, interference, diffraction and blackbody radiation.
Optical Properties in Semiconductor: Direct and indirect band-gap materials, radiative and non-radiative recombination, optical absorption, photo-generated excess carriers, minority carrier life time, luminescence and quantum efficiency in radiation, pn junction principles, heterojunctions.
Light Emitting Diode (LED): Principles, materials for visible and infrared LED, internal and external efficiency, loss mechanism, structure and coupling to optical fibers.
Stimulated Emission and Light Amplification: Spontaneous and stimulated emission, Einstein relations, population inversion, absorption of radiation, optical feedback and threshold conditions, Erbium-Doped Fiber Amplifiers, gas Lasers,
Semiconductor Lasers: Population inversion in degenerate semiconductors, laser cavity, operating wavelength, threshold current density, power output, hetero-junction lasers, optical and electrical confinement, introduction to quantum well lasers, single frequency semiconductor lasers, vertical cavity surface emitting lasers, semiconductor optical amplifiers.
Photo-detectors: Principle of the pn junction photodiode, Shockley–Ramo theorem, quantum efficiency and responsivity, pin photodiode, avalanche photodiodes, heterojunction photodiodes, Schottky junction photodetector, phototransistors, photoconductive detectors and gain, noise in photodetectors.
Photovoltaic Devices: Solar cell: basic principle, solar energy and spectrum, operating point and fill factor, equivalent circuit of a solar cell, solar cell structures and efficiencies.
Modulation of Light: Polarization, light propagation in an anisotropic medium, birefringent optical devices, optical activity and circular birefringence, electro-optic effects, integrated optical modulators, acousto-optic modulators, optical isolators, nonlinear optics and second harmonic generation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the fundamental physical processes of optoelectronic transitions and **apply** the concepts to different optoelectronic devices.	3											
CO2	Achieving capability to **define,** in depth, the principles/functionality of the most important optoelectronic devices, **compare** and **evaluate** the different device designs.	3											
CO3	Be competent to **infer** modeling to **analyze** the physics behind semi-conductor optoelectronic devices.	3											
CO4	Be proficient to **demonstrate** an understanding of the basic design requirements for optoelectronic integration and **discriminate** different material as well as design elements to accomplish an on-chip optical processor or a simple optical communication system.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio	 42 -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Properties of Light**	CT 1
Class 1	Particle and wave nature of light, refractive index and dispersion	
Class 2	Snell's law, Fresnel's equations, temporal and spatial coherence	
Class 3	Multiple interference and optical resonators, diffraction principles	
Week 2	**Optical Properties in Semiconductor**	
Class 4	Direct and indirect band-gap materials, radiative and non-radiative recombination	
Class 5	Photo-generated excess carriers, minority carrier life time, luminescence and quantum efficiency in radiation	
Class 6	Optical absorption, pn junction principles, heterojunctions	
Week 3	**Light Emitting Diode (LED)**	
Class 7	Principles, materials for visible and infrared LED	
Class 8	Heterostructure high intensity LEDs and their output spectrum	
Class 9	Quantum well high intensity LEDs	
Week 4	**Light Emitting Diode (LED)**	CT 2
Class 10	LED structures, efficiencies and luminous flux	
Class 11	Basic LED characteristics, phosphors and white LEDs	
Class 12	LEDs for optical fiber communications	
Week 5	**Stimulated Emission and Light Amplification**	
Class 13	Spontaneous and stimulated emission, absorption of radiation	
Class 14	Population inversion, four-level laser system	
Class 15	Einstein relations, emission and absorption cross-sections	
Week 6	**Stimulated Emission and Light Amplification**	
Class 16	Erbium-doped fiber amplifiers	
Class 17	Gas lasers: the He-Ne laser	
Class 18	The output spectrum of a gas laser	
Week 7	**Stimulated Emission and Light Amplification**	Mid Term
Class 19	Laser oscillations: threshold gain coefficient and gain bandwidth	
Class 20	Optical cavity, phase condition and laser modes	
Class 21	Pulsed lasers: Q-switching and mode locking	
Week 8	**Semiconductor Lasers**	
Class 22	Principle of the semiconductor laser diode	
Class 23	Heterostructure laser diodes, quantum well devices	
Class 24	Steady state semiconductor rate equations: the laser diode equation	
Week 9	**Semiconductor Lasers**	

Class 25	Single frequency semiconductor lasers	
Class 26	Vertical cavity surface emitting lasers	
Class 27	Semiconductor optical amplifiers	
Week 10	**Photo-detectors**	CT 3
Class 28	Principle of the pn junction photodiode, quantum efficiency	
Class 29	Responsivity, the pin photodiode	
Class 30	Avalanche photodiode, impact ionization and avalanche multiplication	
Week 11	**Photo-detectors**	
Class 31	Heterojunction photodiodes	
Class 32	Schottky junction photodetector, phototransistors	
Class 33	Photoconductive detectors and photoconductive gain, noise in photodetectors	
Week 12	**Photovoltaic Devices**	
Class 34	Solar cells: basic principles, solar energy and spectrum	
Class 35	Operating point and fill factor, equivalent circuit of a solar cell	
Class 36	Solar cell structures and efficiencies	
Week 13	**Modulation of Light**	
Class 37	Polarization, Malus's law	
Class 38	Light propagation in an anisotropic medium: birefringence	
Class 39	Birefringent optical devices, optical activity and circular birefringence	
Week 14	**Modulation of Light**	
Class 40	Electro-optic effects: Pockels effect and Kerr effect	
Class 41	Integrated optical modulators, acousto-optic modulators	
Class 42	Optical isolators, nonlinear optics and second harmonic generation	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C3
			CO 2	C5
			CO 3	C4
			CO 4	C5
	Class Participation	5%	CO 4	C5
	Class Attendance	5%	-	-
	Mid term	10%	CO 2	C5
			CO 3	C4
Final Exam			CO 1	C3
			CO 2	C5
			CO 3	C4
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Book:

1. Optoelectronics and Photonics: Principles and Practices, 2nd Edition - S.O. Kasap.

Reference Books:

1. Optical Electronics in Modern Communications – Amnon Yariv.
2. Opto-Electronics – an Introduction - J. Wilson, J.F.B. Hawkes.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.2.7. EECE 461: Semiconductor Device Theory
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 461 : Semiconductor Device Theory	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE	
Course Code: EECE 315 Course Title: Electrical Properties of Material	Course Code: EECE 405 Course Title: Solid State Devices

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
To teach the students the basic concepts of lattice vibration, generation and absorption of phonons in different types of crystals. It is targeted to provide a basic foundation to understand band structure, band diagram, effective mass of electron and hole in isotropic and anisotropic crystals. Additionally, this course is designed to give the students fundamentals of scattering phenomena by impurity and phonons that are present in a crystal. Finally, this course is aimed to teach the students the fundamental applications of quantum physics in nano devices that may rule the semiconductor industry in future.

OBJECTIVE
1. Be able to impart basic knowledge of lattice vibration, generation and absorption of different types of phonons (acoustic and optical) in monoatomic and diatomic crystals. **2.** To familiarize the students with different methods to obtain band structure, band diagram and effective mass of electron and hole in isotropic and anisotropic crystals. **3.** To teach the students the fundamentals of scattering of electrons by impurity and phonon that are present in crystals. **4.** Be able to provide the knowledge of fundamental quantum mechanics that is essential in modeling nano devices.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **explain** generation and absorption of phonons by lattice vibration in monoatomic and diatomic crystals.	PO1	C2	1		3	T, Mid Term Exam, F
CO2	Achieve ability to **estimate** band structure, band diagram and **compute** effective mass of electrons and holes in isotropic and anisotropic crystals.	PO3	C3	1		5	T, Mid Term Exam, F
CO3	Be adept to **illustrate** the scattering of electrons in semiconductor devices by impurity and phonon.	PO1	C3	1		3	T, F
CO4	Be able to **compare** the aspects of modern quantum electronics with classical electronics and **apply** basic quantum physics to nano devices.	PO2	C3, A4	2		4	T, ASG, Pr, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Lattice vibration: Simple harmonic model, dispersion relation, acoustic and optical phonons. Free electron model, Electrical conductivity.

Band structure: Isotropic and anisotropic crystals, band diagrams and effective masses of different semiconductors and alloys.

Scattering theory: Perturbation theory, Fermi-Golden rule for static and oscillating potentials, scattering rates for impurity and phonons, inter-band and inter-sub-band optical absorption, mobility.

Quantum mechanical model of carrier transport: Tunnelling transport, current and conductance, resonant tunnelling, resonant tunnelling diodes, super-lattices and mini-bands. Introduction to inter sub-band transition devices.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **explain** generation and absorption of phonons by lattice vibration in monoatomic and diatomic crystals.	3											
CO2	Achieve ability to **estimate** band structure, band diagram and **compute** effective mass of electrons and holes in isotropic and anisotropic crystals.			3									
CO3	Be adept to **illustrate** the scattering of electrons in semiconductor devices by impurity and phonon.	3											
CO4	Be able to **compare** the aspects of modern quantum electronics with classical electronics and **apply** basic quantum physics to nano devices.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE		
Week 1		CT 1
Class 1	Introduction to Course Outline, Timeline and Fundamental ideas	
Class 2	Lattice Vibration: 1D Monoatomic Crystal	
Class 3	1D Monoatomic Crystal: Vibration Modes, Group Velocity and Phase Velocity, Attenuation	
Week 2		
Class 4	1D Monoatomic Crystal: Vibration Modes, Group Velocity and Phase Velocity, Attenuation	
Class 5	Lattice Vibration: 1D Diatomic Crystal	
Class 6	Boundary Conditions of Lattice Vibration: Fixed End and Periodic	
Week 3		
Class 7	Vibrational Density of States	
Class 8	Dispersion Relation of Lattice Vibration	
Class 9	Optical Excitation of Lattice Waves in Ionic Crystal	
Week 4		CT 2
Class 10	Phonon and Photon: Maxwell Boltzmann Distribution	
Class 11	Thermal Properties: Einstein's Theory	
Class 12	Thermal Properties: Debye Theory	
Week 5		
Class 13	Band structure: Isotropic and anisotropic crystals	
Class 14	Band Structures: Electrons in Crystal	
Class 15	Finite Quantum Well, Bloch Theorem	
Week 6		
Class 16	Kronig-Penny Model	
Class 17	Nearly Free Electron Model	
Class 18	Tight Binding Model for Solids	
Week 7		Mid Term
Class 19	Tight Binding Model for Solids (cntd)	
Class 20	Density of States: 3D, 2D, 1D and 0D systems	
Class 21	Effective Mass of electron and hole	
Week 8		
Class 22	Scattering: Time Independent Perturbation Theory	
Class 23	Scattering: Time Independent Perturbation Theory	
Class 24	Time Dependent Perturbation Theory: Fermi's Golden Rule	
Week 9		
Class 25	Time Dependent Perturbation Theory: Fermi's Golden Rule	
Class 26	Impurity Scattering	
Class 27	Impurity Scattering: Born Approximation	
Week 10		CT3
Class 28	Scattering Potential with Circular Symmetry	
Class 29	Fermi's Golden Rule for Time Varying Potential	
Class 30	Scattering by Photons	
Week 11		
Class 31	Scattering by Phonons	
Class 32	Classical Models of Carrier Transport	
Class 33	Transport Theory: Beyond Drude	
Week 12		
Class 34	Tunneling Transport	
Class 35	Tunneling Transport: Transfer Matrix	

Class 36	Transmission and Reflection in Finite Energy Barrier	
Week 13		
Class 37	Current Density and Conductance from Transmission Coefficient -1	
Class 38	Current Density and Conductance from Transmission Coefficient -2	
Class 39	Resonance Tunneling	
Week 14		
Class 40	Resonant Tunnelling Diodes	
Class 41	Super-lattices and Mini-bands	
Class 42	Introduction to Inter Sub-band Transition Devices.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C3, A4
	Class Participation	5%	CO 4	C3, A4
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C3
			CO 3	C3
Final Exam		60%	CO1	C2
			CO 2	C3
			CO 3	C3
			CO 4	C3, A4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Solid State Physics For Engineering and Materials Science by John P. McKelvey
2. Fundamentals of Solid State Engineering by Manijeh Razeghi
3. Semiconductor Physical Electronics by Sheng S. Li

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.2.9. EECE 463: Introduction to Nanotechnology
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code	: EECE 463	Lecture Contact Hours	3.00
Course Title	: Introduction to Nanotechnology	Credit Hours	3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The goal of this course is to obtain a rich understanding of the capabilities of nanotechnology tools, and how to use this equipment for nano-scale fabrication and characterization. The nanoscale is the next frontier of the Maker culture, where designs become reality. To become a Nanotechnology Maker pioneer, this course will introduce the students to the practical knowledge, skills, and tools that can turn nanotechnology ideas into physical form and enable them to image objects at the nano-scale.

OBJECTIVE
1. To make known the definitions of nanotechnology and nanoscience as research and technology development fields. 2. To impart the historical perspective on major findings that resulted in the establishment of nanotechnology as a research field; understand the motivation behind the research. 3. To familiarize with selected topics in nanoscience, including experimental techniques, materials, basic principles, and nanoscale material properties.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** and **explain** Nanotechnology and Nanoscience and **contrast** them with the macro-scale electronic devices.	PO1	C2			3	T, F
CO2	Be able to **explain** the operation of modern day Nano tools used in the research field and to **relate** to their chronological development from major scientific breakthroughs.	PO2	C2			4	T, Mid Term Exam, F
CO3	Be able to **describe** the importance of materials and their properties at the atomic and nanometer level and the intimate relationship between material scale (nanostructure) and the properties/functionality of materials from research literature.	PO4	C5			8	Mid Term Exam, Pr/ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Why Nanotechnology: importance, size scales, quantum size effects, revolutionary applications, potentials.
Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence, other techniques.
Basics of Fabrication: fabrication and processing industry, wafer manufacturing, deposition techniques: evaporation, sputtering, chemical vapor deposition, epitaxy; Wet and dry etching techniques; photolithography, electron beam lithography, stamp technology.
Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques. Nanoelectronics: overview of quantum mechanics, Schrodinger equation, particle in a box. Band theory of solids.
Importance of nanoelectronics, Moore's law, ITRS roadmap.
Tunneling devices: quantum tunneling, resonant tunneling diodes.
Single electron transistor: Coulomb blockade.
Quantum confinement: wires and dots, carbon nanotubes, graphenes.
Brief introductions on Molecular electronics and nanobiology.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **define** and **explain** Nanotechnology and Nanoscience and **contrast** them with the macro-scale electronic devices.	3											

CO2	Be able to **explain** the operation of modern day Nano tools used in the research field and to **relate** to their chronological development from major scientific breakthroughs.		1										
CO3	Be able to **describe** the importance of materials and their properties at the atomic and nanometer level and the intimate relationship between material scale (nanostructure) and the properties/functionality of materials from research literature.				1								

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE

Week 1	**Introduction to Nano**	
Class 1	Why Nanotechnology: importance, size scales, quantum size effects, Revolutionary applications, potentials.	CT 1
Class 2	Why Nanotechnology: importance, size scales, quantum size effects, Revolutionary applications, potentials.	
Class 3	Why Nanotechnology: importance, size scales, quantum size effects, Revolutionary applications, potentials.	
Week 2	**Growth Technique and Band Structure**	
Class 4	Why Nanotechnology: importance, size scales, quantum size effects, Revolutionary applications, potentials.	
Class 5	Why Nanotechnology: importance, size scales, quantum size effects, Revolutionary applications, potentials.	
Class 6	Why Nanotechnology: importance, size scales, quantum size effects, Revolutionary applications, potentials.	
Week 3	**Lattice Mismatch and Strain**	
Class 7	Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence, other techniques.	
Class 8	Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence,	

	other techniques.	
Class 9	Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence, other techniques.	
Week 4	**Band Diagram and Carrier Concentration**	
Class 10	Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence, other techniques.	
Class 11	Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence, other techniques.	
Class 12	Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence, other techniques.	
Week 5	**Hetero-Junctions**	
Class 13	Basics of Fabrication: fabrication and processing industry, wafer manufacturing, deposition techniques: evaporation, sputtering, chemical vapour deposition, epitaxy; Wet and dry etching techniques; photolithography, electron beam lithography, stamp technology.	
Class 14	Basics of Fabrication: fabrication and processing industry, wafer manufacturing, deposition techniques: evaporation, sputtering, chemical vapor deposition, epitaxy; Wet and dry etching techniques; photolithography, electron beam lithography, stamp technology.	CT 2
Class 15	Basics of Fabrication: fabrication and processing industry, wafer manufacturing, deposition techniques: evaporation, sputtering, chemical vapour deposition, epitaxy; Wet and dry etching techniques; photolithography, electron beam lithography, stamp technology.	
Week 6	**Hetero-Junctions, Quantum Well and Superlattices**	
Class 16	Basics of Fabrication: fabrication and processing industry, wafer manufacturing, deposition techniques: evaporation, sputtering, chemical vapour deposition, epitaxy; Wet and dry etching techniques; photolithography, electron beam lithography, stamp technology.	
Class 17	Basics of Fabrication: fabrication and processing industry, wafer manufacturing, deposition techniques: evaporation, sputtering, chemical vapour deposition, epitaxy; Wet and dry etching techniques; photolithography, electron beam lithography, stamp technology.	
Class 18	Basics of Fabrication: fabrication and processing industry, wafer manufacturing, deposition techniques: evaporation, sputtering, chemical vapour deposition, epitaxy; Wet and dry etching techniques; photolithography, electron beam lithography, stamp technology.	
Week 7	**Metal – Semiconductor Heterojunction**	
Class 19	Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques.	
Class 20	Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques.	
Class 21	Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques.	Mid Term
Week 8	**Hetero-junction Diode**	
Class 22	Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques.	
Class 23	Bottom-up processes: chemical and organic synthesis techniques, self-	

	assembly, other techniques.	
Class 24	Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques.	
Week 9	**Hetero-junction field effect transistor**	
Class 25	Nanoelectronics: overview of quantum mechanics, Schrodinger equation, particle in a box. Band theory of solids. Importance of nanoelectronics, Moore's law, ITRS roadmap.	
Class 26	Nanoelectronics: overview of quantum mechanics, Schrodinger equation, particle in a box. Band theory of solids. Importance of nanoelectronics, Moore's law, ITRS roadmap.	
Class 27	Nanoelectronics: overview of quantum mechanics, Schrodinger equation, particle in a box. Band theory of solids. Importance of nanoelectronics, Moore's law, ITRS roadmap.	
Week 10	**Hetero-junction field effect transistor**	CT 3
Class 28	Nanoelectronics: overview of quantum mechanics, Schrodinger equation, particle in a box. Band theory of solids. Importance of nanoelectronics, Moore's law, ITRS roadmap.	
Class 29	Nanoelectronics: overview of quantum mechanics, Schrodinger equation, particle in a box. Band theory of solids. Importance of nanoelectronics, Moore's law, ITRS roadmap.	
Class 30	Nanoelectronics: overview of quantum mechanics, Schrodinger equation, particle in a box. Band theory of solids. Importance of nanoelectronics, Moore's law, ITRS roadmap.	
Week 11	**Hetero-structure bipolar transistor**	
Class 31	Tunneling devices: quantum tunneling, resonant tunneling diodes.	
Class 32	Tunneling devices: quantum tunneling, resonant tunneling diodes.	
Class 33	Tunneling devices: quantum tunneling, resonant tunneling diodes.	
Week 12	**Hetero-structure bipolar transistor**	
Class 34	Tunneling devices: quantum tunneling, resonant tunneling diodes.	
Class 35	Tunneling devices: quantum tunneling, resonant tunneling diodes.	
Class 36	Tunneling devices: quantum tunneling, resonant tunneling diodes.	
Week 13	**Hetero-structure bipolar transistor**	
Class 37	Single electron transistor: Coulomb blockade. Quantum confinement: wires and dots, carbon nanotubes, graphenes.	
Class 38	Single electron transistor: Coulomb blockade. Quantum confinement: wires and dots, carbon nanotubes, graphenes.	
Class 39	Single electron transistor: Coulomb blockade. Quantum confinement: wires and dots, carbon nanotubes, graphenes.	
Week 14	**Resonant Tunnelling Devices**	
Class 40	Brief introductions on Molecular electronics and nanobiology.	
Class 41	Brief introductions on Molecular electronics and nanobiology.	
Class 42	Discussion on scope of research and Review class.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C2
	Class Participation	5%	CO3	C5
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C2
			CO3	C5
Final Exam		60%	CO1	C2

		CO2	C2
		CO3	C5
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Nano: The Essentials by T. Pradeep
2. Introduction to Nanoscience by S. M. Lindsay
3. Nanotechnology: An Introduction by Jeremy Ramsden
4. Fundamentals of Nanoelectronics by George Hanson

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.2.10. EECE 465: Semiconductor and Nanoscale Devices
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION

Course Code	: : EECE 465	Contact Hours	: 3.00
Course Title	: Semiconductor and Nanoscale Devices	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of this course is to introduce the students with advanced physics of nanoscale device phenomena. With a touch to quantum mechanics, the students will be prepared for the competitive research field of emerging nanoscale semiconductor devices.

OBJECTIVE

1. To introduce with the advanced physical phenomena related to the applications in modern day electronics.
2. To impart the ability to apply basic quantum mechanics to atomic and semiconductor models.
3. To provide the knowledge for deriving equations of charge transport in semiconductors under normal operating conditions.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** theories of advanced physical phenomena behind many real life applications regarding energy and thermal issues in modern day electronics.	PO1	C2			3	T, F
CO2	Be adept in **applying** basic quantum mechanical equations for **explaining** atomic level physics.	PO1	C3			3	T, Mid Term Exam, F
CO3	Be able to **explain** the charge transport equations that play a pivotal role in any kind of current conducting nanoscale devices.	PO1	C2			4	Mid Term Exam, Pr/ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Lattice vibration: Simple harmonic model, dispersion relation, acoustic and optical phonons.

Free electron model: Electrical conductivity.
Scattering theory: Perturbation theory, Fermi-Golden rule for static and oscillating potentials, scattering rates for impurity and phonons, inter-band and inter-sub-band optical absorption, and mobility.
Quantum mechanical model of carrier transport: Tunneling transport, current and conductance, resonant tunneling, resonant tunneling diodes, super-lattices and mini-bands. Introduction to inter sub-band transition devices.
Advanced MOS aspects including sub-nm technology: Fin-FET, Gate All Around (GAA) and Multi-gate MOS devices, SOI devices, Junction less transistors, GFET
Bioelectronics, Biosensors and biomimetic devices, FETs with Biomaterials: Enzyme-FET, Immuno-FET, Microbial-FET

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to understand theories behind advanced physical phenomena behind many real life applications regarding energy and thermal issues in modern day electronics.	3											
CO2	Be adept in basic quantum mechanical equations for explaining atomic level physics.	3											
CO3	Be able to explain the charge transport equations that play a pivotal role in any kind of current conducting nanoscale devices.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Cantered Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE

Week 1	**Lattice Vibration**
Class 1	Crystal Dynamics, Propagating waves, Interaction of atom
Class 2	Propagating waves: Mathematical model
Class 3	Propagating waves: Mathematical model
Week 2	**1 Dimensional Lattice**

Class 4	1D monoatomic lattice : Displacement solution	
Class 5	1D monoatomic lattice : Dispersion relation	CT 1
Class 6	1D monoatomic lattice : Boundary Conditions	
Week 3	**Propagating Waves**	
Class 7	Density of States calculation, Allowed and Forbidden modes and sates.	
Class 8	Transverse Waves: Dispersion relation.	
Class 9	Linear Diatomic Lattice: Equation of Motion and Dispersion relation.	
Week 4	**Tight Binding Theory**	
Class 10	Hamiltonian formation	
Class 11	Matrix elements: Self-energy integrals	CT 2
Class 12	E-K relationship	
Week 5	**Scattering Rates : Impurity Scattering**	
Class 13	Fermi's Golden rule	
Class 14	Impurity scattering : Total scattering rate and Transport time	
Class 15	Oscillating potential	
Week 6	**Scattering Rates : Phonon Scattering**	
Class 16	Longitudinal acoustic phonons	
Class 17	Deformation potential	
Class 18	Perturbing potential and Matrix elements for scattering terms in Tight-Binding theory.	
Week 7	**Carrier Transport**	
Class 19	Drift and Diffusion model of carrier transport	
Class 20	Inter-valley carrier transport	
Class 21	Ballistic transport	
Week 8	**Tunnelling Transport**	
Class 22	Quantum Mechanical solution	
Class 23	Concept of Transmission, Transmittance.	Mid Term
Class 24	S and T- Matrices.	
Week 9	**Advanced MOS aspects including sub-nm technology**	
Class 25	Introduction to advanced MOS devices	
Class 26	Introduction to sub-nm technology	
Class 27	Fin-FET	
Week 10	**Advanced MOS aspects including sub-nm technology**	
Class 28	Gate All Around (GAA)	
Class 29	Multi-gate MOS devices	
Class 30	SOI devices	
Week 11	**Junctionless Transistor and Graphene FET**	
Class 31	Introduction to Junction less transistors	CT3
Class 32	Junction less MOSFETs	
Class 33	GFET	
Week 12	**Bioelectronics, Biosensors and biomimetic devices**	
Class 34	Introduction to Bioelectronics	
Class 35	Introduction to Biosensors	
Class 36	Introduction to biomimetic devices	
Week 13	**FETs with Biomaterials**	
Class 37	Introduction to FETs with Biomaterials	
Class 38	Enzyme-FET	
Class 39	Immuno-FET	
Week 14	**FETs with Biomaterials and Review**	
Class 40	Microbial-FET	

Class 41	Discussion on scope of research	
Class 42	Review class.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C3
	Class Participation	5%	CO3	C2
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C3
			CO3	C2
Final Exam		60%	CO1	C2
			CO2	C3
			CO3	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Solid State Physics: For Engineering and Materials Science - John P. McKelvey
2. Semiconductor Physical Electronics - Sheng S. Li
3. Fundamentals of Solid State Engineering - Manijeh Razeghi
4. The Physics of Low-Dimensional Semiconductors: An Introduction - John H. Davi

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3 <u>Communication</u>

5.2.3.1. EECE 403: Telecommunication Engineering
Level-4 Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 403 : Telecommunication Engineering	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE-309 Course Title: Communication Theory I			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To teach the students the concepts, principles and working of basic telecommunication system. It is targeted to provide a basic foundation for technology areas like communication systems, telecommunication industries as well as various wireless communication system design.			
OBJECTIVE			
1. Impart basic knowledge of evaluation of telecommunication engineering, working principles of various switching system of telephone network, basics of optical network system components, variety of networking aspects, SONET/SDH. and telecom apparatus. 2. Familiarize the students about different parameters of analog and digital communication techniques along with software and hardware architectures of complex telecommunication system. 3. Expose the students with concepts of reliability analysis of switching networks and fundamental evaluation of mobile technologies: 2G, 3G and 4G in detail 4. Impart in depth knowledge to analyze an optical fiber based wide area network for designing of optical communication link.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Recognize** the fundamentals of Digital communication systems to comprehend the evolution and development of telecommunication systems such as FDMA, TDMA, PDH and SDH.	PO1	C5	1		3	T, F
CO2	**Analyze** the performance of lost call systems, queuing systems, digital switching systems which includes hardware and software architectures, interfaces and methodology for proper maintenance of digital switching systems for real life complex telecommunication system.	PO1	C4	1		3	T, Mid Term Exam, F
CO3	**Design** and **select** the appropriate telecom switching systems by analyzing the hardware architecture, recovery strategy and reliability analysis for modelling and estimating telecom traffic along with evaluation of mobile technologies like 2G, 3G and 4G.	PO3	C6	1	1	5	T, Mid Term Exam, F, ASG, Pr

CO4	**Apply** the fundamental principles of optics and light wave to **evaluate** optical fiber based wide area networks and **design** optical fiber communication systems.	PO3	C6	1	1	5	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Principle, evolution, networks, exchange and international regulatory bodies.
Telephone apparatus: Microphone, speakers, ringer, pulse and tone dialling mechanism, side-tone mechanism, local and central batteries and advanced features.
Switching system: Introduction to analog system, digital switching systems – space division switching, blocking probability and multistage switching, time division switching and two-dimensional switching.
Traffic analysis: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing.
Modern telephone services and network: Internet telephony, facsimile, integrated services digital network, asynchronous transfer mode and intelligent networks. Fiber to the home (FFTH), Fiber access networks: EPON, GEPON, WDM-PON and TDM-PON. Introduction to cellular telephony and satellite communication.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Recognize** the fundamentals of Digital communication systems to comprehend the evolution and development of telecommunication systems such as FDMA, TDMA, PDH and SDH.	3											
CO2	**Analyze** the performance of lost call systems, queuing systems, digital switching systems which includes hardware and software architectures, interfaces and methodology for proper maintenance of digital switching systems for real life complex telecommunication system.	3											
CO3	**Design** and **select** the appropriate telecom switching systems by analyzing the hardware architecture, recovery strategy and reliability analysis for modelling and estimating telecom traffic along with evaluation of mobile technologies like 2G, 3G and 4G.			3									
CO4	**Apply** the fundamental principles of optics and light wave to **evaluate** optical fiber based wide area networks and **design** optical fiber communication systems.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	84
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	5
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction**	CT 1
Class 1	Basic telephony	
Class 2	Simple Telephone Communication	
Class 3	Half-duplex telephone communication	
Week 2	**Switching Techniques**	
Class 4	Introduction to step by step switching	
Class 5	Function of telephone control circuit	
Class 6	Introduction to digital switching system	
Week 3	**Different stages of Switching**	
Class 7	Three stage switching	
Class 8	Blocking probability	
Class 9	Mathematical problem on Lee's blocking probability	
Week 4	**Different types of Switching**	CT 2
Class 10	Time division switching	
Class 11	STS switching	
Class 12	TST switching	
Week 5	**Traffic**	
Class 13	Traffic analysis	
Class 14	Arrival distribution	
Class 15	Mathematical modeling on traffic analysis	
Week 6	**Optical Fiber Communication Basic**	
Class 16	Fiber optic transmission system	
Class 17	Single mode fiber	
Class 18	Chromatic dispersion	
Week 7	**Transmission Basics**	Mid Term
Class 19	Electrical and optical transducer	
Class 20	Photo detector	
Class 21	Synchronous transmission	
Week 8	**Multiplexing**	
Class 22	Basic idea on Multiplexing	
Class 23	Frequency Division multiplexing	
Class 24	Time division multiplexing	
Week 9	**Multiplexing**	

<table>
<tr><td>Class 25</td><td>Mathematical problem on multiplexing</td><td rowspan="3"></td></tr>
<tr><td>Class 26</td><td>Frequency division multiplexing</td></tr>
<tr><td>Class 27</td><td>Time division multiplexing</td></tr>
<tr><td>Week 10</td><td>Multiplexing</td><td rowspan="12">CT 4</td></tr>
<tr><td>Class 28</td><td>Orthogonal frequency division multiplexing</td></tr>
<tr><td>Class 29</td><td>Poission’s Arrival Distribution</td></tr>
<tr><td>Class 30</td><td>Mathematical modeling</td></tr>
<tr><td>Week 11</td><td>Modern Telephone Services</td></tr>
<tr><td>Class 31</td><td>Telephone network</td></tr>
<tr><td>Class 32</td><td>Basic topologies</td></tr>
<tr><td>Class 33</td><td>Idea on PSTN</td></tr>
<tr><td>Week 12</td><td>Modern Telephone Services</td></tr>
<tr><td>Class 34</td><td>Digital cellular communication system</td></tr>
<tr><td>Class 35</td><td>CDMA</td></tr>
<tr><td>Class 36</td><td>Synchronous Optical Network (SONET)</td></tr>
<tr><td>Week 13</td><td>Modern Telephone Services</td><td rowspan="8"></td></tr>
<tr><td>Class 37</td><td>The SONET/SDH Hierarchy</td></tr>
<tr><td>Class 38</td><td>Mathematical modeling of SONET</td></tr>
<tr><td>Class 39</td><td>Basic idea on satellite communication system</td></tr>
<tr><td>Week 14</td><td>Satellite Basics</td></tr>
<tr><td>Class 40</td><td>Low earth orbit satellite</td></tr>
<tr><td>Class 41</td><td>Revision</td></tr>
<tr><td>Class 42</td><td>Open Discussion</td></tr>
</table>

ASSESSMENT STRATEGY

<table>
<tr><td colspan="2">Components</td><td>Grading</td><td>CO</td><td>Bloom’s Taxonomy</td></tr>
<tr><td rowspan="9">Continuous Assessment (40%)</td><td rowspan="4">Class Test/ Assignment 1-3</td><td rowspan="4">20%</td><td>CO1</td><td>C5</td></tr>
<tr><td>CO2</td><td>C4</td></tr>
<tr><td>CO3</td><td>C6</td></tr>
<tr><td>CO4</td><td>C6</td></tr>
<tr><td>Class Participation</td><td>5%</td><td>CO4</td><td>C6</td></tr>
<tr><td>Class Attendance</td><td>5%</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Mid term</td><td rowspan="2">10%</td><td>CO2</td><td>C4</td></tr>
<tr><td>CO3</td><td>C6</td></tr>
<tr><td colspan="2" rowspan="4">Final Exam</td><td rowspan="4">60%</td><td>CO1</td><td>C5</td></tr>
<tr><td>CO2</td><td>C4</td></tr>
<tr><td>CO3</td><td>C6</td></tr>
<tr><td>CO4</td><td>C6</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
<tr><td colspan="5">(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

TEXT & REFERENCE BOOKS

1. Digital switching systems – Syed R. Ali; Mc Graw Hill international
2. Digital Telephony – John Bellamy; John Wiley & sons, Inc
3. Telecommunication Switching Systems and Networks – Thiagarajan Viswanathan; Prentice Hall of India.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.2. EECE 433: Microwave Engineering
Level-4 Term-I/II (Spring/Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 433 : Microwave Engineering	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE 217 Course Title: Engineering Electromagnetics			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To teach the students the concepts, principles and working of basic microwave circuits and systems. It is targeted to provide a basic foundation for technology areas like communication systems, RF industries as well as various communication system design.			
OBJECTIVE			
1. Impart basic knowledge to analyze micro-wave circuits incorporating hollow, dielectric and planar waveguides, transmission lines, filters and other passive components, active devices. 2. Familiarize the students about the theoretical principles underlying 'S' parameters to characterize microwave devices and circuits. 3. Expose the students with concepts of impedance matching and introduce them with different types of techniques for designing matching network. 4. Impart in depth knowledge to examine the free space communication link and develop equations to determine the link carrier-to-noise ratio performance factor for microwave link design.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment methods
CO1	**Recognize** field theory for analyzing microwave transmission lines and **compare** the propagation characteristics of EM waves in various wave guide structures to strengthen the concepts of basic microwave engineering.	PO1	C4	1		3	T, F
CO2	Analyze microwave networks using impedance, admittance, transmission and scattering matrix representations to explore practical complex network.	PO1	C4			3	T, Mid Term Exam, F
CO3	Infer the appropriate impedance matching techniques and design microwave matching networks using L section, single and double stub and quarter wave transformer for specific real-life application	PO3	C6	2,5	2	5	Mid Term Exam, F, ASG, Pr
CO4	Analyze microwave communication link and summarize the best parameters: signal power budget, noise evaluation and link carrier to noise ratio for designing a	PO3	C5	5	1	5	T, F

	microwave communication model.						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Transmission lines: Voltage and current in ideal transmission lines, reflection, transmission, standing wave, impedance transformation, Smith chart, impedance matching and lossy transmission lines.
Waveguides: General formulation, modes of propagation and losses in parallel plate, rectangular and circular waveguides.
Microstrips: Structures and characteristics.
Rectangular resonant cavities: Energy storage, losses and Q. Radiation: Small current element, radiation resistance, radiation pattern and properties, Hertzian and halfwave dipoles.
Antennas: Mono pole, Horn, Dipole Antenna.
Wireless Communication: The Friis Formula, Link Budget and Link Margin, Radio Receiver Architectures, Noise Characterization of a Receiver, Radar Systems, The Radar Equation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Recognize** field theory for analyzing microwave transmission lines and **compare** the propagation characteristics of EM waves in various wave guide structures to strengthen the concepts of basic microwave engineering.	3											
CO2	**Analyze** microwave networks using impedance, admittance, transmission and scattering matrix representations to explore practical complex network.	3											
CO3	**Infer** the appropriate impedance matching techniques and design microwave matching networks using L section, single and double stub and quarter wave transformer for specific real-life application			3									
CO4	**Analyze** microwave communication link and **summarize** the best parameters: signal power budget, noise evaluation and link carrier to noise ratio for designing a microwave communication model.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	84
Non-face-to-face learning	42
Revision of the previous lecture at home	21

Preparation for final examination	21
Formal Assessment Continuous Assessment Final Examination	5 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Microwave**	CT 1
Class 1	Basic idea about Microwave: Frequency, Range, Advantages, Applications	
Class 2	Introduction to electromagnetic plane waves: Electric and Magnetic Wave Equations, Poynting Theorem	
Class 3	Uniform Plane Waves and Reflection	
Week 2	**Microwave Transmission Lines**	
Class 4	Plane Wave Propagation in Lossy Media and dielectric, Vertical and Horizontal Polarization.	
Class 5	Distributed elements concept, Telegrapher’s equations	
Class 6	Lossless and Lossy lines, Basics of transmission line equations	
Week 3	**Microwave Transmission Lines**	
Class 7	Microwave measurement parameters: VSWR, Reflection co-efficient, Transmission co-efficient	
Class 8	Line Impedance and Junction, General solutions TE waves	
Class 9	General solutions TM and TEM waves	
Week 4	**Smith Chart**	CT 2
Class 10	Smith Chart: Usage of Smith Chart, Important features of Smith Chart	
Class 11	VSWR and Smith Chart	
Class 12	Characteristics of Smith Chart and Smith Admittance Chart	
Week 5	**Smith Chart**	
Class 13	Mathematical problems related to Smith Chart	
Class 14	Impedance Matching: Single Stub matching and related mathematical problems	
Class 15	Double Stub matching and related mathematical problems	
Week 6	**Microwave Waveguides**	
Class 16	Basic idea of different types of microwave connectors	
Class 17	Rectangular Waveguides: Solution of Wave Equations in Rectangular coordinates (TE mode)	
Class 18	Wave Equation in Rectangular coordinates (TM mode) and related mathematical problems	
Week 7	**Microwave Waveguides**	Mid Term
Class 19	Wave Equation in Rectangular coordinates (TEM mode) and related mathematical problems	
Class 20	Power in rectangular waveguide and related mathematical problems	
Class 21	Circular Waveguides: Solution of Wave Equations in cylindrical coordinates (TE mode)	
Week 8	**Microwave Waveguides**	
Class 22	Wave Equations in cylindrical coordinates (TM mode) and related mathematical problems	
Class 23	Wave Equations in cylindrical coordinates (TEM mode) and related mathematical problems	
Class 24	Microwave Cavities: Rectangular resonator	
Week 9	**Cavity Resonator**	
Class 25	Circular cavity resonator	

Class 26	Q factor of a cavity resonator, Small current element, Radiation resistance	
Class 27	Radiation Pattern and Properties, Hertzian and Halfwave dipoles	
Week 10	**Microwave Components**	CT 4
Class 28	Waveguide Tees: E-plane Tee, H-plane Tee	
Class 29	Magic Tee	
Class 30	Waveguide Connectors	
Week 11	**Microwave Components and Microstrip**	
Class 31	Directional Couplers, S Matrix of Directional Coupler	
Class 32	Microstrip Lines, Parallel Strip Lines	
Class 33	Coplanar Strip Lines	
Week 12	**Antenna**	
Class 34	Basics of Antenna: Working principles and types.	
Class 35	Radiation Mechanism of Antenna: Two Wire and Dipole Antenna	
Class 36	Current Distribution on a thin wire antenna	
Week 13	**Wireless Communication**	
Class 37	Introduction to Wireless Communication, the Friis Formula	
Class 38	Link Budget and Link Margin	
Class 39	Noise characterization of a receiver	
Week 14	**Wireless Communication**	
Class 40	Introduction to Radar System: Basic Block Diagram and Working Principles	
Class 41	The Radar Equation and Related Mathematical Problems	
Class 42	Pulse Radar and Doppler Radar	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Test	20%	CO 1	C4
			CO 2	C4
			CO 3	C6
			CO4	C5
	Assignment	5%	CO 2	C4
			CO 3	C6
	Attendance	5%		
	Mid Term	10%	CO 1	C4
			CO2	C4
Final Term		60%	CO 1	C4
			CO 2	C4
			CO 3	C6
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Microwave Devices and Circuits - Samuel Y. Liao; Prentice Hall of India.
2. D. M. Pozar, Microwave Engineering, Second Edition, John Wiley & Sons, 1998.
3. Foundations for Microwave Engineering– E. Colliong; McGraw-Hill International.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.3. EECE 434: Microwave Engineering Laboratory
Level-4 Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 434 : Microwave Engineering Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
Course Code: EECE 433 Course Title: Microwave Engineering			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To teach the students the fundamental concepts, principles, properties and application of microwave signals. It is targeted to provide a basic foundation for designing microwave circuits and systems using hardware and computer aided tools.			
OBJECTIVE			
1. To impart the students in-depth knowledge about the behaviour and characteristics of microwave signals. 2. To familiarize the students to test microwave equipment to make measurements of power, frequency, VSWR, Return loss, and Insertion loss. 3. To impart the basic usage of Smith Chart, Watt 2002, Kurono 2728 etc. modern tools for modelling and designing transmission line parameters, antenna parameters etc. 4. Be familiarize the students to develop engineering design and report writing skills with the help of project work.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	To acquire knowledge and understanding of fundamental properties of microwave signal along with their application with appropriate microwave bench setup.	PO5	P4			6	R, Q, LT
CO2	To apply different methods to determine circuit properties for passive/active microwave devices.	PO9	P1	2	1		R, LT
CO3	To construct different microwave system models and examine their performance characteristics using hardware and computer aided design methods.	PO5	P6	3	1	6	R, Q, LT
CO4	To perform as a group member and assist others during group projects and presentations.	PO10	A4				PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 433 using different hardware equipment and simulation software

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To acquire knowledge and understanding of fundamental					3							

	properties of microwave signal along with their application with appropriate microwave bench setup.												
CO2	To apply different methods to determine circuit properties for passive/active microwave devices.								3				
CO3	To construct different microwave system models and examine their performance characteristics using hardware and computer aided design methods.					3							
CO4	To perform as a group member and assist others during group projects and presentations.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching).

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	24
Lecture	8
Experiment	16
Self-Directed Learning	47
Preparation of Lab Reports	8
Preparation of Lab-test	10
Preparation of Quiz	8
Preparation of Presentation	5
Engagement in Group Projects	16
Formal Assessment	4
Continuous Assessment	3
Final Quiz	1
Total	75

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Observation of Radiation pattern, Beam width and Directionality of Microwave Signal for appropriate designing problem.
Week 2	Calculation of microwave Power using Bolometers for measuring transmission characteristics of microwave signal.
Week 3	Measurement of wavelengths and wave impedance by a slotted waveguide section in free space.
Week 4	Measurement of Skin Depth using penetration properties of microwave signal for different materials.
Week 5	Measurement of wavelength (λ), VSWR, reflection coefficient $\lvert\rho\rvert$ and transmission coefficient (T) using a slotted coaxial transmission line and a microwave generator for measuring the performance of a microwave signal.
Week 6	Review
Week 7	Lab Q iz-1
Week 8	Determination of unknown load impedance of a terminated transmission line Smith's Chart for matching the load impedance.

Week 9	Measurement of radial pattern of E-Plane and H-Plane in 360° domain by Horn Antenna using Watts 2002 software.
Week 10	Familiarization with RADAR (Radio Detection and Ranging) Module, for analyzing Microwave component of Radar and Radar Echo (Video) Output.
Week 11	Practice
Week 12	Lab Test
Week 13	Lab Quiz-2
Week 14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (70%)	Lab participation and Report	25%	CO1	P4
			CO2	P1
			CO3	P6
	Lab Test	30%	CO1	P1
			CO2	P2
			CO3	P6
	Project and Presentation	15%	CO4	A4
Lab Quiz		30%	CO1	P4
			CO2	P1
			CO3	P6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Microwave Devices and Circuits - Samuel Y. Liao; Prentice Hall of India.
2. D. M. Pozar, Microwave Engineering, Second Edition, John Wiley & Sons, 1998.
3. Foundations for Microwave Engineering– E. Colliong; McGraw-Hill International.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.4. EECE 435: Optical Fiber Communication
Level-4 Term- I/II (Spring / Fall)

COURSE INFORMATION

Course Code	: EECE 435	Contact Hours	: 3.00
Course Title	: Optical Fiber Communication	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 217 Course Code: EECE 309
Course Title: Engineering Electromagnetics Course Title: Communication Theory

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The motto of Optical Fiber Communication course is to expose modern high-capacity telecommunications network based on optical fiber technology and its state-of-the-art advancements. Upon successful completion of this course, students will obtain the knowledge needed to perform fiber-optic communication system engineering calculations, identify system trade-offs and apply this knowledge to modern fiber optic networks. Accordingly, this will enable the students to understand the most recent literature in the field of fiber-optic communications as well as formulate the expertise in their future professional engineering practice.

OBJECTIVE

1. Familiarize the students about various optical fiber modes, configurations and transmission characteristics of optical fibers.

2. Impart basic knowledges about various optical sources, detectors and transmission limitations.
3. Expose the students with modulation, multiplexing and demultiplexing in fiber optic systems along with various coupling techniques.
4. Acquaint students to enrich the knowledge about optical communication systems as well as fiber optic access networks.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **recall** the basic knowledge of ray optics theory and **explain** the transmission characteristics of fiber.	PO1	C2	P1		3	T, F
CO2	Achieving capability to **illustrate** the characteristics of optical sources and detectors and **compare** the different types of optical amplifier in basis of their principles, applications and receiver analysis.	PO1	C5	P1		3	T, Mid Exam, F
CO3	Be competent in **demonstrating** various multiplexing techniques, passive optical components and **analyze** channel impairments like losses and dispersions.	PO1	C4			4	Mid Exam, F, ASG
CO4	Be proficient to **infer** advanced optical transmission systems and **design** a fiber optic link based on budgets.	PO3	C6	P2	A1	5	ASG, F, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Evolution and background of optical fiber communication, light propagation theories

Light propagation through optical fiber: Ray optics theory and mode theory.

Optical fiber Characteristics: Types and characteristics, transmission characteristics, fiber joints and fiber couplers.

Light sources: Light emitting diodes and laser diodes. Detectors: PIN photo-detector and avalanche photo-detectors.

Receiver analysis: Direct detection and coherent detection, noise and limitations.

Transmission limitations: Chromatic dispersion, nonlinear refraction, four wave mixing and laser phase noises.

Optical amplifier: Laser and fiber amplifiers, applications and limitations.

Multi-channel optical system: Frequency division multiplexing, wavelength division multiplexing and optical CDMA. Radio on fiber technology, Fiber optic access network.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **recall** the basic knowledge of ray optics theory and **explain** the transmission characteristics of fiber	3											

CO2	Achieving capability to **illustrate** the characteristics of optical sources and detectors and **compare** the different types of optical amplifier in basis of their principles, applications and receiver analysis.	3											
CO3	Be competent in **demonstrating** various multiplexing techniques, passive optical components and **analyze** channel impairments like losses and dispersions.	3											
CO4	Be proficient to **infer** advanced optical transmission systems and **design** a fiber optic link based on budgets.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Optical Fiber communication**	CT 1
Class 1	Introduction and evolution of optical fiber communication	
Class 2	Background and different theories behind light propagation	
Class 3	Advantages and applications optical fiber communication	
Week 2	**Light Propagation through Optical Fiber**	
Class 4	Ray optics theory	
Class 5	Mode theory	
Class 6	Total internal reflection, ideal characteristics of optical fiber	
Week 3	**Optical Fiber Characteristics**	
Class 7	Qualities of real optical fibers, transmission characteristics	
Class 8	Fiber joints and fiber couplers	
Class 9	Mathematical modelling of optical fibers	
Week 4	**Light Sources**	CT 2
Class 10	Introduction, types and requirements	
Class 11	Light sources: LEDs	
Class 12	Light sources: Lasers	
Week 5	**Light Sources**	

Class 13	Detectors: PIN photo-detector	
Class 14	Detectors: Avalanche photo-detector	
Class 15	Transmission Limitations	
Week 6	**Receiver Analysis**	
Class 16	Fundamental receiver operation-preamplifiers	
Class 17	Direct detection and coherent detection	
Class 18	Noise and limitations	
Week 7	**Transmission Limitations**	Mid Term
Class 19	Attenuation, absorption, scattering losses	
Class 20	Bending losses, core and cladding losses, signal dispersion	
Class 21	Inter symbol interference and bandwidth-intra model dispersion	
Week 8	**Transmission Limitations**	
Class 22	Material dispersion, waveguide dispersion, polarization mode dispersion	
Class 23	Chromatic dispersion, intermodal dispersion	
Class 24	Nonlinear refraction	
Week 9	**Transmission Limitations**	
Class 25	How noise effects transmission and detection in optical fibers	
Class 26	Nonlinear effects, limitations in practical transmission and detection systems	
Class 27	Four wave mixing, laser phase noises	
Week 10	**Optical Amplifier**	CT 4
Class 28	Introduction to optical amplifiers	
Class 29	How amplifiers used to improve real systems	
Class 30	Different types of optical amplifiers	
Week 11	**Optical Amplifier**	
Class 31	Laser amplifiers, fiber amplifiers	
Class 32	Different approaches to improve amplifiers	
Class 33	Mathematical problems regarding transmission and detection systems	
Week 12	**Multi-channel Optical System**	
Class 34	Optical fiber based communication	
Class 35	Multi-channel using optical fibers: FDMA	
Class 36	Multi-channel using optical fibers: WDMA	
Week 13	**Multi-channel Optical System**	
Class 37	Multi-channel using optical fibers: CDMA	
Class 38	Design problems regarding multi-channel using optical fiber	
Class 39	Radio on fiber technology	
Week 14	**Multi-channel Optical System**	
Class 40	Fiber optic access networks: Ideas	
Class 41	Fiber optic access networks: Implementations and Limitations	
Class 42	Scope of research in optical communication system	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C2
			CO 2	C5
			CO 3	C4
			CO 4	C6
	Class Participation	5%	CO 4	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO 2	C5
			CO 3	C4
Final Exam			CO 1	C2

		CO 2	C5
		CO 3	C4
		CO 4	C6
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. Optical Fiber Communications: Principles & Practice - John M. Senior.

Reference Books:

1. Fiber Optic Communication System - Gerd Keiser.

2. Fiber Optic Communications - D C Agrawal.

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.3.5. EECE 437: Digital Communication
Level 4, Term I/II (Spring / Fall)

COURSE INFORMATION

Course Code	: EECE 437	Contact Hours	: 3.00
Course Title	: Digital Communication	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 309
Course Title: Communication Theory

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To familiarize the students with the basics of digital communication system including the mathematical modelling of communication channel, performance of digital transmission system, different modulation/demodulation techniques, channel coding/decoding, etc. It is targeted to provide a strong understanding to the students about the practical reliable digital communication system by optimizing channel capacities using error-control coding.

OBJECTIVE

1. To familiarize the students with the basic principles of a digital communication by analyzing communication channel with help of probability theory, stochastic process and information theory.
2. To develop student's skill to convert different analog waveforms into coded pulses and analyze the performance characteristics of digital transmission systems.
3. To make them capable to analyze different modulation/demodulation schemes and channel coding/decoding for Additive White Gaussian Noise (AWGN) channel.
4. To develop the ability to design a reliable practical digital communication system with different error-control coding.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Be able to **know** the basic architecture of digital communication system and **recognize** the characteristics and modelling of communication channels with the help of probability theory, stochastic process and information theory.	PO1	C1			4	T, F
CO2	Attaining knowledge to	PO2	C4			4	T, Mid, F

	characterize and transformation of communication signals and systems from a mathematical viewpoint with robustness, bandwidth preservation and minimal computational complexity and **compute** the performance of digital transmission system.						
CO3	Achieving ability to **analyze** different modulation/demodulation schemes and channel coding/decoding for Additive White Gaussian Noise (AWGN) channel with an emphasis on optimum demodulation, decoding techniques and their performances.	PO2	C4			4	T, Mid, F
CO4	Developing capability to **devise** the way to address the practical issue of reliable communication by optimizing channel capacity through the adaption of different error-correcting codes.	PO3	C6		1	5	F, ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Communication channels, mathematical model and characteristics. Probability and stochastic processes.
Source coding: Mathematical models of information, entropy, Huffman code and linear predictive coding.
Digital transmission system: Base band digital transmission, inter-symbol interference, bandwidth, power efficiency, modulation and coding trade-off. Digital band pass transmission.
Modulation: Binary and M-arry modulation schemes, coherent and non-coherent receiver structure.
Receiver for AWGN channels: Correlation demodulator, matched filter demodulator and maximum likelihood receiver.
Channel capacity and coding: Channel models and capacities and random selection of codes. Block codes and conventional codes: Linear block codes, convolution codes and coded modulation. Spread spectrum signals and system.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **know** the basic architecture of digital communication system and **recognize** the characteristics and modelling of communication channels with the help of probability theory, stochastic process and information theory.	3											

CO2	Attaining knowledge to **characterize** and transformation of communication signals and systems from a mathematical viewpoint with robustness, bandwidth preservation and minimal computational complexity and **compute** the performance of digital transmission system.		3										
CO3	Achieving ability to **analyze** different modulation/demodulation schemes and channel coding/decoding for Additive White Gaussian Noise (AWGN) channel with an emphasis on optimum demodulation, decoding techniques and their performances.		3										
CO4	Developing capability to **devise** the way to address the practical issue of reliable communication by optimizing channel capacity through the adaption of different error-correcting codes.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	
Class 1	Introduction to Digital Communication
Class 2	Introduction to communication channel
Class 3	Mathematical model and characteristics of communication channel
Week 2	
Class 4	Probability and stochastic processes
Class 5	Source coding
Class 6	Mathematical models of information, entropy
Week 3	

Class 7	Introduction to Huffman coding
Class 8	Encoding and decoding method of Huffman coding
Class 9	Applications of Huffman coding
Week 4	
Class 10	Introduction to linear predictive coding
Class 11	Encoding and decoding method of linear predictive coding
Class 12	Applications of linear predictive coding
Week 5	
Class 13	Digital transmission system
Class 14	Base band digital transmission
Class 15	Inter-symbol interference
Week 6	
Class 16	Bandwidth, power efficiency
Class 17	Modulation and coding trade-off
Class 18	Digital band pass transmission
Week 7	
Class 19	Introduction to Binary and M-arry modulation
Class 20	Binary and M-arry modulation schemes (1)
Class 21	Binary and M-arry modulation schemes (2)
Week 8	
Class 22	Coherent and non-coherent receiver structure(1)
Class 23	Coherent and non-coherent receiver structure(2)
Class 24	Receiver for AWGN channels
Week 9	
Class 25	Correlation demodulator
Class 26	Matched filter demodulator
Class 27	Maximum likelihood receiver
Week 10	
Class 28	Channel capacity and coding
Class 29	Channel models and capacities
Class 30	Random selection of codes
Week 11	
Class 31	Introduction to block codes and convolution codes
Class 32	Different types of block codes
Class 33	Linear block codes: Introduction and coding method
Week 12	
Class 34	Linear block codes: Decoding method and applications
Class 35	Conventional codes: Introduction and coding method
Class 36	Conventional codes: Decoding method and applications
Week 13	
Class 37	Introduction to Coded modulation
Class 38	Coded modulation schemes
Class 39	Different types of coded modulation
Week 14	
Class 40	Trade-off between the existing coding methods
Class 41	Spread spectrum signals and system
Class 42	Review of the topics

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous	Class Test/ Assignment 1-3	20%	CO1	C1
			CO2	C4

Assessment (40%)			CO3	C4
	Class Participation	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C4
			CO3	C4
Final Exam		60%	CO1	C1
			CO2	C4
			CO3	C4
			CO4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

REFERENCE BOOKS

1. Digital Communications - Simon Haykin; McGraw Hill International.
2. Digital Communication - G.J Proakis; Prentice Hall of India.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.6. EECE 438: Digital Communication Laboratory
Level-4, Term-II (Fall)

COURSE INFORMATION

Course Code Course Title	: EECE 438 : Digital Communication Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 437 — Course Title: Digital Electronics
Course Code: EECE 309 — Course Title: Communication Theory

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To get the students familiarized with in depth elements of digital communication system. To further develop their skills on designing and analysing Digital communication system with Matlab. Also, to get them acquainted with Simulink a modern system design toolbox that enables them to contribute in future research work.

OBJECTIVE

1. To acquaint the students with the fundamental elements of digital communication system.
2. To develop students' skills on evaluating and analysing various digital modulation techniques.
3. To familiarize the students with various line coding and source schemes that help to protect the integrity of transmitted data through intermediate channels.
4. To enhance students' skill on communication system design with modern tools like Simulink.
5. To develop communication and project management skills in the students through presentation and project.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Be proficient to **demonstrate** skills on debugging Matlab coding errors and analyse the real life communication technologies for society.	PO6	P3			7	R,Q,T
CO2	Be able to **reproduce** digital modulation schemes and **evaluate** their performance on noisy	PO2	P3			4	R,Q,T

	channels via Matlab.						
CO3	Be able to **design** various real-life communication system based on strict criteria with modern tools like Simulink.	PO4	C5		1	8	PR,Pr
CO4	Be able to **discuss** and **perform** as a group and **assist** other group members during group projects and presentations.	PO10	A1, P5	1			PR,Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASGj – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 437 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient to **demonstrate** skills on debugging Matlab coding errors and analyse the real life communic-ation technologies for society.						2						
CO2	Be able to **reproduce** digital modulation schemes and **evaluate** their performance on noisy channels via Matlab.			2									
CO3	Be able to **design** various real-life communication system based on strict criteria with modern tools like Simulink.					3							
CO4	Be able to **discuss** and **perform** as a group and **assist** other group members during group projects and presentations.									2			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	
Preparation of Lab Reports	24
Preparation of Lab-test	6
Preparation of Quiz	6
Preparation of Presentation	5
Engagement in Group Projects	26
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	120

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method
COURSE SCHEDULE

Week 1	Familiarization with basic Matlab syntax and Simulink used specifically for digital communication and signal processing.
Week 2	Introduction to source coding and implementation of Huffman coding with Matlab and Simulink.
Week 3	Implementation of line coding techniques [NRZ, RZ, AMI, MC] with Matlab and Simulink.
Week 4	Implementation of line coding techniques [Miller, BnZs, Differential MC] with Matlab and Simulink.
Week 5	Delta modulation, Delta-Sigma modulation, their implementation and evaluation by Matlab and Simulink.
Week 6	Problem solving and Preparation for Lab Test - I
Week 7	Lab Test – I
Week 8	Analysing digital modulation schemes [ASK, OOK] and their spectrum analysis with Matlab and Simulink
Week 9	Analysing digital modulation schemes [FSK, PSK] and their spectrum analysis with Matlab and Simulink.
Week 10	Introduction to linear block coding and implementation with Matlab and Simulink.
Week 11	Problem solving and Preparation for Lab Test - II
Week 12	Lab Test -II
Week 13	Quiz and Viva
Week 14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	P3
			CO 2	P3
	Labtest-1, Labtest-2	30%	CO 1	P3
			CO 2	P3
	Project and Presentation	25%	CO3	C5
			CO4	A1, P5
Lab Quiz		25%	CO 1	p3
			CO 2	P3
Total Marks		100%		

Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Digital Communications - Simon Haykin; McGraw Hill International.
2. Digital Communication - G.J Proakis; Prentice Hall of India.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.7. EECE 439: Mobile Cellular Communication
Level-4, Term-II (Fall)

COURSE INFORMATION			
Course Code	: EECE 439	Contact Hours	: 3.00
Course Title	: Mobile Cellular Communication	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 403 Course Title: Telecommunication Engineering	Course Code: EECE 437 Course Title: Digital Communication

CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To familiarize the students with the evolution of various wireless standards from first-generation cellular standards through emerging fifth-generation cellular standards and fundamental concepts of mobile cellular communication system. It is targeted to provide a strong understanding to the students about the basic concepts of cellular frequency reuse, the land mobile radio propagation environment, spectrum utilization, radio resource management, diversity combining techniques and multiple access techniques.
OBJECTIVE
1. To familiarize the students with the basic concepts and evolution of cellular mobile communication system. 2. To develop student's skill to analyze frequency reuse systems for co-channel interferences and modelling the land mobile radio propagation environment. 3. To make them capable to understand spectrum utilization through channel assignment techniques and radio resource management through handoffs. 4. To develop the ability to explain different diversity techniques, multi-carrier modulation techniques and multiple access techniques.
COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Be able to **know** the basic fundamental concepts and evolution of analog & digital cellular systems and **explain** treatment of co-channel interference for spectrally efficient cellular frequency reuse systems	PO1	C2			4	T, F
CO2	Attaining knowledge to **analyze** the modelling of mobile radio propagation for fixed-to-mobile channels and mobile-to-mobile channels statistical by **identifying** the statistical characterization of multipath-fading and polarization.	PO2	C4			4	T, Mid F
CO3	Achieving ability to **recognize** spectrum utilization by using fixed and non-fixed channel assignment techniques and **evaluate** cellular radio resource management by exploring different kind of handoffs.	PO2	C6			4	T, Mid, F
CO4	Developing capability to **categorize** different diversity techniques, multi-carrier modulation techniques and multiple access techniques for **developing** the concepts about TDMA, CDMA, 3G and 4G wireless systems.	PO3	C6		1	5	F, ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
Introduction: Concept, evolution and fundamentals. Analog and digital cellular systems. Cellular Radio System: Frequency reuse, co-channel interference, cell splitting and components.

Mobile radio propagation: Propagation characteristics, models for radio propagation, antenna at cell site and mobile antenna.
Frequency Management and Channel Assignment: Fundamentals, spectrum utilization, fundamentals of channel assignment, fixed channel assignment, non-fixed channel assignment, traffic and channel assignment.
Handoffs and Dropped Calls: Reasons and types, forced handoffs, mobile assisted handoffs and dropped call rate.
Diversity Techniques: Concept of diversity branch and signal paths, carrier to noise and carrier to interference ratio performance. Multi-carrier modulation, Orthogonal FDM (OFDM).
Multiple Access Techniques: FDMA, TDMA, CDMA, MC-CDMA and receiver.
Digital cellular systems: Global system for mobile, time division multiple access and code division multiple access. 3G and 4G wireless system, future wireless communication system, Wi-Fi, Wi-max and other IEEE standards of wireless communication system.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **know** the basic fundamental concepts and evolution of analog & digital cellular systems and **explain** treatment of co-channel interference for spectrally efficient cellular frequency reuse systems	3											
CO2	Attaining knowledge to **analyze** the modelling of mobile radio propagation for fixed-to-mobile channels and mobile-to-mobile channels statistical by **identifying** the statistical characterization of multipath-fading and polarization.		3										
CO3	Achieving ability to **recognize** spectrum utilization by using fixed and non-fixed channel assignment techniques and **evaluate** cellular radio resource management by exploring different kind of handoffs.		3										
CO4	Developing capability to **categorize** different diversity techniques, multi-carrier modulation techniques and multiple access techniques for **developing** the concepts about TDMA, CDMA, 3G and 4G wireless systems.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21

Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE	
Week 1	
Class 1	Brief History of Wireless Systems and Standards
Class 2	Evolution of mobile cellular communications systems
Class 3	Fundamentals of analog and digital cellular systems. (1)
Week 2	
Class 4	Fundamentals of analog and digital cellular systems. (2)
Class 5	Propagation Modeling: Fixed-to-Mobile Channels (1)
Class 6	Propagation Modeling: Fixed-to-Mobile Channels (2)
Week 3	
Class 7	Propagation Modeling: Mobile-to-Mobile Channels
Class 8	Propagation Modeling: Statistical Characterization of Multipath-Fading Channels
Class 9	Propagation Modeling: Statistical Characterization of Multipath-Fading Channels
Week 4	
Class 10	Propagation Modeling: Polarized Channel Modeling
Class 11	Propagation Modeling: Shadowing and Path-loss models
Class 12	Cellular Radio System: Frequency reuse, co-channel interference
Week 5	
Class 13	Cellular Radio System: Co-channel interference (1)
Class 14	Cellular Radio System: Co-channel interference (2)
Class 15	Cellular Radio System: Cell splitting and components.
Week 6	
Class 16	Modulation: QAM,
Class 17	Modulation: PSK
Class 18	Modulation: Orthogonal Modulation and Variants
Week 7	
Class 19	Orthogonal Frequency Division Multiplexing
Class 20	Multi-Antenna Techniques: Diversity Combining (1)
Class 21	Multi-Antenna Techniques: Diversity Combining (2)
Week 8	
Class 22	Multi-Antenna Techniques: Selective Combining
Class 23	Multi-Antenna Techniques: Maximal Ratio Combining (1)
Class 24	Multi-Antenna Techniques: Maximal Ratio Combining (2)
Week 9	
Class 25	Multiple Access Techniques: FDMA
Class 26	Multiple Access Techniques: TDMA
Class 27	Multiple Access Techniques: CDMA
Week 10	
Class 28	Multiple Access Techniques: MC-CDMA
Class 29	Multi-Carrier Techniques
Class 30	Orthogonal Frequency Division Multiplexing
Week 11	
Class 31	Radio Resource Management
Class 32	Handoffs and Dropped Calls: Reasons and types
Class 33	Handoffs and Dropped Calls: forced handoffs

Week 12	
Class 34	Handoffs and Dropped Calls: mobile assisted handoffs
Class 35	Handoffs and Dropped Calls: dropped call rate.
Class 36	Channel Assignment Techniques: Fundamentals
Week 13	
Class 37	Channel Assignment Techniques: spectrum utilization, fundamentals of channel assignment
Class 38	Channel Assignment Techniques: fixed channel assignment, non-fixed channel assignment,
Class 39	Channel Assignment Techniques: traffic and channel assignment.
Week 14	
Class 40	Global system for mobile, time division multiple access and code division multiple access.
Class 41	3G and 4G wireless system, future wireless communication system,
Class 42	Wi-Fi, Wi-max and other IEEE standards of wireless communication system.

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C4
			CO3	C6
	Class Participation	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO2	C4
			CO3	C6
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C6
			CO4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Mobile Cellular Telecommunication Systems - William C.Y Lee.
2. Principles of Mobile Communication- Gordon L. Stüber; Springer

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.8. EECE 441: Random Signal and Processes

Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION

Course Code	: EECE 441	Contact Hours	: 3.0
Course Title	: Random Signal and Processes	Credit Hours	: 3.0

PRE-REQUISITE

Course Code: EECE 301	Course Code: EECE 311
Course Title: Continuous Signals & Linear Systems	Course Title: Digital Signal Processing I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of this course is to introduce the students to the principles of random signals and to provide tools so that they can deal with systems involving random signals and/or noise. The students will also be able to process the random signals.

OBJECTIVE

1. To familiarize the students about the fundamentals tools to characterize random signals by probability theory and random variables.
2. To acquaint the students about the operation on random variables through expectation operation and moments of random variables.
3. To make the students skilled in solving the functions of random variables and performing operations on multiple random variables.
4. To provide the students the basic ideas of random processes characterization and make them capable to solve the engineering problems involving random processes.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be proficient in **analysing** the random signals **using** probability theory and random variables.	PO2	C4 A1	P1		4	T, F
CO2	Be able to **adapt** to the ideas of the moments of random variables in order to **perform** operations on random variables.	PO3	P6 A5	P1		4	T, Mid
CO3	Be able to **manipulate** the random variable operations to **describe** the single and multiple random variable functions.	PO3	P5 C4 A1	P3		4	Mid
CO4	To **adhere** to the ideas of random processes characterization to **evaluate** the real life signals and systems involving random processes.	PO4	A4 C4	P3		8	F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Probability and random variables. Probability theory including sample space and events, elementary set theory, conditional probability, independent events. Distribution and density functions. The Bernoulli trial and Bernoulli distribution. Events defined by random variables, continuous and discrete random variables.

Moments of random variables: Expectation operation of random variables. Moments of random variables and characteristic functions. The limit theorems. Transformation of a random variable. Special probability distribution.

Multiple random variables: Joint distribution and density functions of multiple random variables. Functions of random variables. Expectation of functions of random variables. Independent random variables. Sums of independent random variables. Central limit theorem.

Random Processes. Classification of random processes, characterization of a random process, Correlation functions. Process measurements. Stationarity and ergodicity. Gaussian and Poisson random processes.

Spectral Estimation. Power spectral density functions, cross spectral densities. Response of linear systems to random inputs. Noise models.

Discrete time random processes. Mean-square error estimation, Detection and linear filtering.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient in **analysing** the		3										

	random signals **using** probability theory and random signals.												
CO2	Be able to **adapt** to the ideas of the moments of random variables in order to **perform** operations on random variables.			3									
CO3	Be able to **manipulate** the random variable operations to describe the single and multiple random variable functions.			3									
CO4	To **adhere** to the ideas of random processes characterization to **evaluate** the real life signals and systems involving random processes.				3								

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of previous and (or) subsequent lecture at home Preparation for final exam	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE

Lecture Plan		
Week 1	**Probability Theorem**	**CT-1**
Class 1	Axioms of probability theorem and implications. Problem solving based on axiomatic approach.	
Class 2	Conditional probability. Bayes theorem. Mathematical problems solving.	
Class 3	The Bernoulli trial and Bernoulli distribution.	
Week 2	**Random Variables**	
Class 4	Introduction to random variables. Events defined by random variables, continuous and discrete random variables.	
Class 5	Distribution and density functions. Types of distribution functions.	
Class 6	Problem solving regarding different distribution and density functions.	
Week 3	**Expectation Operation of Random Variables**	
Class 7	Classification of discrete random variables. Mathematical problem solving on Poisson distribution.	
Class 8	Introduction to expectation operation. Mathematical problems on determining the expected value of random variables.	
Class 9	Expectation operation on functions of random variables, regarding mathematical problem solving.	
Week 4	**Expectation Operation of Random Variables**	
Class 10	Moments of random variables. Mean, variance calculation of random	

	variables.	CT-2
Class 11	Problem solving on calculating mean, variance, mean square value of random variables.	
Class 12	The limit theorems. Linear transformation of a random variable.	
Week 5	**Multiple random variables**	
Class 13	Special probability distribution.	
Class 14	Joint distribution and density functions of multiple random variables.	
Class 15	Mathematical problems on calculating joint pdf and joint cdf.	
Week 6	**Operation on multiple random variables**	
Class 16	Independent random variables. Sums of independent random variables.	
Class 17	Moments of sum of random variables.	
Class 18	Central limit theorem. Problems solving on operation on multiple random variables.	
Week 7	**Operation on multiple random variables**	**Mid Term**
Class 19	Joint moments. Mathematical problem solving on calculating mean, variance, mean square value of multiple random variables.	
Class 20	Joint moments. Mathematical problem solving on calculating mean, variance, mean square value of multiple random variables (continued).	
Class 21	Transform methods.	
Week 8	**Random Processes**	
Class 22	Introduction to random processes. Classification of random processes.	
Class 23	Correlation functions. Properties of autocorrelation function. Mean, covariance and autocorrelation function calculation.	
Class 24	Mathematical problem solving on mean, variance and autocorrelation function calculation.	
Week 9	**Random Processes**	
Class 25	Stationarity and independence. Strict sense stationarity and wide sense stationarity.	
Class 26	Properties of WSS processes. Problem solving on determining if a process is stationary.	
Class 27	Problem solving on determining if a process is stationary.	
Week 10	**Random Processes**	
Class 28	Cross correlation function. Properties of cross correlation function.	
Class 29	Problem solving on measurements of correlation functions.	
Class 30	Ergodicity. Problem solving on determining if a process is ergodic.	
Week 11	**Spectral characteristics of random processes**	
Class 31	Power spectral density and its properties.	
Class 32	Wiener Kinchen Theorem. Conversion of auto correlation function to power spectral density and vice versa.	
Class 33	Mathematical problem solving on the fourier transform pairs (ACF and PSD).	
Week 12	**Spectral characteristics of random processes**	
Class 34	Cross power density spectrum and its properties.	
Class 35	Relation between cross power density spectrum and cross correlation.	
Class 36	Mathematical problem solving on conversion of cross correlation function to cross power spectral density and vice versa.	
Week 13	**Models of random process and noise model**	**CT-4**
Class 37	Gaussian random process. Mathematical problems on gaussian random processes.	
Class 38	White noise. Properties of white noise.	
Class 39	Problem solving on white gaussian noise.	
Week 14	**Linear Systems with random inputs**	
Class 40	Transmission of WSS process through LTI systems.	

Class 41	Transmission of white gaussian noise process through LTI systems.	
Class 42	Mathematical problems regarding LTI transmission.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment	20%	CO1, CO2	C4, A1, P6, A5
			CO4	A4, C4
	Midterm	10%	CO2, CO3	P6, A5 P5, C4, A1, P1
	Class Participation	5%	CO4	A4, C4
	Class Attendance	5%	-	-
Final Exam		60%	CO1	C4, A1
			CO4	A4, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. Fundamentals of Applied Probability and Random Processes - Oliver C. Ibe.

Reference Books:

1. Probability, Random Variables, and Random Signal Principles by Peyton Peebles.
2. Probability, Random Variables, and Stochastic Processes by Athanasios Papoulis, S. Unnikrishna Pillai.
3. Probability and Random processes by Scott L. Miller and Donald Childers.
4. Probability, Random Variables, and Random Processes: Theory and Signal Processing Applications by John J. Shynk; Wiley-Interscience.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.9. EECE 443: Satellite Communication
Level-4, Term-I/II (Spring/ Fall)

COURSE INFORMATION

Course Code Course Title	: EECE 443 : Satellite Communication	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE-309 Course Title: Communication Theory I	Course Code: EECE-409 Course Title: Communications Theory II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To teach and familiarize the students with orbital mechanics, satellites, earth station and their various elements. It is also targeted to provide them basic understanding on multiple access techniques and digital modulation techniques used in satellite communication. Finally, get them oriented with a clear understanding of VSAT networks.

OBJECTIVE

1. To acquaint the students with orbital mechanics.
2. To familiarize the students about the basic architecture of earth station, satellite and their primary elements.
3. To enhance students' skill on Multiple access techniques and digital modulation techniques.
4. To get the students oriented with various Jamming attacks on data and their possible solutions.
5. To provide the students with detailed working procedure of a working VSAT network system.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding	Bloom's	CP	CA	KP	Assessment

		PO	Taxonomy				Methods
CO1	Be able to describe the mechanism of internal elements of earth station and satellite and theoretical idea on orbital mechanics and also analyse various kinds of orbitals and their satellites.	PO1	C1			3	T, Mid
CO2	Be able to compute link power budget for satellites in the presence of rain-induced attenuation, ionospheric scintillation, fading, interference and other kinds of propagation impairments.	PO3	C3			4	T, Mid , F
CO3	Be able to explain multiple access techniques and digital modulation techniques used in satellite communication and evaluate the effect of tone and pulsed jamming over spread spectrum technique.	PO2	C4			3	T, F
CO4	Be able to explain the principles, concepts and operation of VSAT network systems.	PO1	C2			3	F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Elements of Satellite Communication Satellite: Orbit and Description, Orbital geometry and mechanics, Azimuth and elevation, coverage angle and slant range, eclipse effect, placement of satellite.
Earth Station: Earth station antenna, High power amplifier, Low-noise amplifier, Upconverter, Down-converter.
Satellite Link: Basic link analysis, interference analysis, rain-induced attenuation, system availability, satellite link design.
Random Access Techniques in Satellite Communication: P-ALOHA, S-ALOHA, RALOHA, C-ALOHA.
Multiple Access Techniques in Satellite Communication FDMA: FDM-FM-FDMA, SCPC, FM-FDMA television, Companded FDM-FM-FDMA.
TDMA: TDMA frame structure, TDMA burst structure, TDMA frame efficiency, TDMA super frame structure.
Efficient Techniques: Demand Assigned Multiple Access (DAMA), Erlang B formula, Digital speech interpolation.
Satellite Spread Spectrum Communication Direct Sequence Spread Spectrum (DSSS): PN Sequence, Error rate performance of DS System in uniform and pulsed jamming. DS-CDMA: Sequence-synchronous DS-CDMA, Sequence-asynchronous DS-CDMA. Frequency Hop Spread Spectrum (FH-SS) Satellite Communication Systems, FH-CDMA, Error rate performance of FH System in uniform and pulsed jamming.
VSAT Networks: Technology and recent advancements, Mobile Satellite Networks

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the mechanism of internal elements of earth station and satellite and theoretical idea on orbital mechanics and also **analyse**	2											

	various kinds of orbitals and their satellites.												
CO2	Be able to **compute** link power budget for satellites in the presence of rain-induced attenuation, ionospheric scintillation, fading, interference and other kinds of propagation impairments.			3									
CO3	Be able to **explain** multiple access techniques and digital modulation techniques used in satellite communication and **evaluate** the effect of tone and pulsed jamming over spread spectrum technique.		3										
CO4	Be able to **explain** the principles, concepts and operation of VSAT network systems.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction**	
Class 1	Definition, history, need of satellite communication, how satellite communication works	
Class 2	Advantage and disadvantage, application, orbital elements, semi major axis, semi minor axis, mean anomaly, argument of perigee	
Class 3	Satellite orbits, Posi grade, retrograde, ascending node, descending node, Geo stationary satellite, Geo synchronous satellite	CT 1
Week 2	**Orbital Mechanics**	
Class 4	Orbital mechanics, equation of orbit, Kepler's three law of planetary motion	
Class 5	Describing the orbit of a satellite, locating the satellite in the orbit	
Class 6	Look angle determination, subsatellite point, elevation angle, azimuth angle	
Week 3	**Orbital Mechanics**	
Class 7	Solar eclipse	
Class 8	Sidereal period	

Class 9	Slant range, synodal period	
Week 4	**Satellite Link Design**	CT 2
Class 10	Introduction, Basic Transmission Theory	
Class 11	Rain Attenuation, System noise temperature and G/T ratio	
Class 12	Calculation of system noise temperature, Noise figure	
Week 5	**Satellite Link Design**	
Class 13	Noise temperature, G/T ratio for earth station and its measurement and characteristics	
Class 14	Link budget calculation	
Class 15	System availability, mean unavailability, radio-star method	
Week 6	**Multiple Access Technique**	
Class 16	DMA, FDM-FM-FDMA, Single Channel per carrier	
Class 17	TDMA, TDMA frame structure, reference burst, traffic burst, guard time	
Class 18	TDMA burst structure, carrier and clock recovery sequence, unique word, TDMA frame efficiency	
Week 7	**Demand Assignment**	Mid Term
Class 19	Erlang B formulae	
Class 20	Types of Demand Assignment	
Class 21	DAMA characteristics (demand assignment), Blocking probability	
Week 8	**ALOHA**	
Class 22	Types of ALOHA	
Class 23	Throughput calculation	
Class 24	Average packet delay vs satellite channel throughput	
Week 9	**CDMA**	
Class 25	Code generator, PN-sequence	
Class 26	Property of PN-sequence	
Class 27	Satellite spread spectrum communication	
Week 10	**CDMA**	CT 4
Class 28	Interference (unintentional and intentional interference)	
Class 29	Classification of spread spectrum (Direct sequence spread spectrum and frequency hopping)	
Class 30	Direct sequence spread spectrum system	
Week 11	**CDMA**	
Class 31	Error rate performance in uniform jamming	
Class 32	Error rate performance in pulsed jamming	
Class 33	Direct Sequence CDMA	
Week 12	**CDMA**	
Class 34	Frequency hopping spread spectrum	
Class 35	Jamming Waveform, steps for finding jamming waveform	
Class 36	Interference analysis, different types of unintentional interference	
Week 13	**VSAT Communication Network**	
Class 37	Characteristics, VSAT network system concept	
Class 38	Service of VSAT	
Class 39	Nature of traffic	
Week 14	**VSAT Communication Network**	
Class 40	Satellite channels (P-ALOHA, S-ALOHA, C-ALOHA, R-ALOHA)	
Class 41	Mobile satellite network	
Class 42	Application	

SSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous	Class Test/ Assignment	20%	CO1	C1

Assessment (40%)	1-3		CO2	C3
			CO3	C4
	Class Participation	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO1	C1
			CO2	C3
Final Exam		60%	CO1	C1
			CO2	C3
			CO3	C4
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Digital Satellite Communications by Tri T. Ha, Second Ed. McGraw-Hill.
2. Satellite Communications by Timothy Pratt, Second Ed. Wiley.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.10. EECE 444: Satellite Communication Laboratory
Level-4, Term-II (Fall)

COURSE INFORMATION

Course Code	: :EECE 444	Contact Hours	: 3.00
Course Title	: Satellite Communication Laboratory	Credit Hours	: 1.50

PRE-REQUISITE

Course Code: EECE 443
Course Title: Satellite Communications

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To help the students to explore and analysis orbital mechanics, look angles determination, orbital effects in system performance, spacecraft subsystems, transponders etc. and put theory in practice. Our mission is to expose students to design a cost-effective satellite link and evaluate the performance by calculating the SNR. It is also targeted to expose them to model and simulate parameters of antennas for satellite communication for real life applications.

OBJECTIVE

1. Be able to familiarize the students with a sound understanding of a satellite communication system successfully while transferring information from one earth station to another.
2. To acknowledge the examples of applications and trade-offs that typically occur in engineering system design and also apply the knowledge in design problems.
3. To perform MATLAB programming and Simulink design tools to model optimized antenna parameter for satellite communication.
4. Be familiarize the students to develop engineering design and report writing skills with the help of project work.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	To design different components and calculate the orbital determination and launching methods for real life applications.	PO3	P3	1		5	R, Q, LT
CO2	To develop the ability to command	PO5	P6	2	1	6	R, Q, LT

	and monitor power systems and developments of antennas and demonstrate the impacts of GPS, Navigation, NGSO constellation design for tracking and launching using MATLAB Simulink.						
CO3	To design different types of transmitter and receiver antennas to provide Uplink and Down link Frequency for real life applications.	PO5	C6	2,3	1	6	R, QT, LT
CO4	To perform as a group member and assist others during group projects and presentations.	PO10	A4				PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 443 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To design different components and calculate the orbital determination and launching methods for real life applications.			3									
CO2	To develop the ability to command and monitor power systems and developments of antennas and demonstrate the impacts of GPS, Navigation, NGSO constellation design for tracking and launching using MATLAB Simulink.					3							
CO3	To design different types of transmitter and receiver antennas to provide Uplink and Down link Frequency for real life applications.					3							
CO4	To perform as a group member and assist others during group projects and presentations.										3		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	27
Lecture	9
Experiment	18
Self-Directed Learning	51
Preparation of Lab Reports	9
Preparation of Lab-test	10
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	18

Formal Assessment Continuous Assessment Final Quiz	4 3 1
Total	82

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	To Study the Design Parameters of a Satellite and design of a digital satellite receiver.
Week-2	Analysis of a GPS Receiver and Data services in INMARSAT communication system.
Week-3	To study Ionosphere and analyzing the launching of NASA 4D into Ionosphere
Week-4	Analysis of Modulation Techniques for LEO Satellite Downlink Communications.
Week-5	To evaluate specific Attenuation, rain attenuation and total attenuation.
Week-6	Lab Quiz-1
Week-7	To Evaluate and simulate SNR in Satellite Links and calculate Carrier to noise ratio for uplink and downlink and overall.
Week-8	To obtain a plot of the relationship between the Height of the satellite i.e. Orbital Altitude and the Satellite Antenna Diameter for the parameters achieved during Link budget analysis
Week-9	To study Julian dates, generate a MATLAB code for its calculation and familiarize with the built-in Julian date functions in MATLAB.
Week-10	To simulate model and analyze antenna look angles of geostationary communications satellite by MATLAB Simulink Model.
Week-11	Practice
Week-12	Lab Test
Week-13	Lab Quiz-2
Week-14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (70%)	Lab participation and Report	25%	CO 1	P3
			CO 2	P6
			CO 3	C6
	Lab Test	30%	CO 1	P3
			CO 2	P6
			CO 3	C6
	Project and Presentation	15%	CO4	A4
Lab Quiz		30%	CO 1	P3
			CO 2	P6
			CO 3	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Digital Satellite Communications – Tri T. Ha; McGraw-Hill International.
2. Satellite Communication Mobile & Fixed Services - Michael J. Miler; Kluwer Aca Publisher.
3. Satellite Communications - T. Pratt, C. Bostian, J. Allnut; John Wiley & Sons Inc.
4. Mobile Communication satellites theory and application – Ton Logadon; McGraw-Hill Int.
5. Digital Communication System with satellite and fiber optic applications - Herald Kolimbiris.
6. Fundamentals of satellite Communication – Rao & Raja K.N; Prentice Hall of India.
7. Fundamentals of satellite Communication – Jagannathan; Prentice Hall of India.
8. Satellite Communications - Dr. D.C. Agarwal; Khanna Publishers.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.11. EECE 445: Communication Networks
Level-4, Term-I/II (Spring/ Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 445 : Communication Networks	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE 309
Course Title: Communication Theory

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To familiarize the students with the basic concept of networking. The target of the course is to enable the students to have a firm foundation on the communication network architectures and the layers of the OSI model. With an aim to provide the student with a strong base to work in the networking industry, the course is designed to cover the basics of subnetting and network security as well.

OBJECTIVE

1. To impart basic knowledge on the concepts of networking and switching and the functionalities of the internetworking devices.
2. To introduce the students with the media access protocols followed by a comparative analysis among the protocols.
3. To impart in depth knowledge on the structure and functionalities of the 7 layers of the OSI model and the relevant mechanisms.
4. To develop a student's skills on routing and hierarchy of IP addressing subnetting in order to enable the student to work in the practical field.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the concepts of network topologies and layered architecture modelling and **recall** the applications of the internetworking devices.	PO1	C1			4	T, F
CO2	Be able to **compare** the mechanisms of different media access protocols.	PO1	C3			3	T, Mid, F
CO3	Be able to **explain** in depth the functionalities of the different layers of the OSI model and **break down** the effectiveness of the network models in use.	PO3	C4	1		5	Mid, F
CO4	Be able to **evaluate** the effectiveness of the network arrangement introduced on the basis of the basic knowledge on routing and subnetting.	PO3	C5	2	2	5	F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Basic Concepts of Networking: Basic concepts of networking. Network topologies. The concept of layered architecture modelling including OSI and the TCP/IP protocol suite. Client-

server communications, ATM reference models.
Switching: Circuit, packet and virtual circuit switching technologies
Fundamentals & Link Layer: Overview of Data Communications- Networks, Building Network and its types, Overview of Internet, Protocol Layering, Physical Layer, Overview of Data and Signals, Introduction to Data Link Layer, Link layer Addressing-Error Detection, Correction and control including ARQ, flow control mechanisms including sliding windows. Link layer functionalities including frame synchronization.
Media Access & Internetworking: Elementary protocols. Sliding window protocols, error detection and corrections of HDLC.DLLL of Internet. DLLL of ATM: Multiple Access protocols. Overview of Data link Control and Media access control, Ethernet (802.3), Wireless LANs –Available Protocols, MANs, Switches, Hubs and bridges, gateways. High speed LAN, Bluetooth, Bluetooth Low Energy, Wi-Fi, 6LowPAN–Zigbee, Local area network technologies including ETHERNET, Token Rings. Multiple-access schemes such as CSMA/CD, CSMA/CA and Token-passing. MAC addressing. Switched vs. shared ETHERNETs. Performance evaluation, including throughputs and delays.
Routing: Routing, Unicast Routing, Algorithms, Protocols, Multicast Routing and its basics, Overview of Intradomain and interdomain protocols, Overview of IPv6 Addressing, Transition from IPv4 to IPv6, congestion control, internetworking.
Network layer in internet: IP protocol, IP addresses. IP addressing schemes. Subnetting.
ARP, ICMP; NI in ATM transport layer, transmission control protocol, UDP, ATM adaptation layer. Internet routing including protocols used in the Internet such as RIP, OSPF and BGP.
Transport Layer: Transport layer protocols including UDP and TCP. Ports and sockets. TCP connection establishment. Error, flow and congestion control in TCP.
Application Layer: Application Layer Paradigms, Client Server Programming, WWW and HTTP, DNS, Electronic Mail (SMTP, POP3, IMAP, MIME, FTP, TELNET), Introduction to Peer to Peer Networks, Need for Cryptography and Network Security, Firewalls.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the concepts of network topologies and layered architecture modelling and **recall** the applications of the internetworking devices.	3											
CO2	Be able to **compare** the mechanisms of different media access protocols.	3											
CO3	Be able to **explain** in depth the functionalities of the different layers of the OSI model and **break down** the effectiveness of the network models in use.			2									
CO4	Be able to **evaluate** the effectiveness of the network arrangement introduced on the basis of the basic knowledge on routing and subnetting.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning	

Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method	
COURSE SCHEDULE	

Week 1	
Class 1	Basic concepts of networking
Class 2	OSI, TCP-IP and ATM reference models
Class 3	Introduction to the layers of the OSI model
Week 2	
Class 4	Circuit, packet and virtual circuit switching technologies
Class 5	Physical Layer
Class 6	Modulation
Week 3	
Class 7	Data link layer
Class 8	Error and flow control
Class 9	Error detection and correction
Week 4	
Class 10	MAC Sub-layer
Class 11	HDLC, DLLL of Internet
Class 12	ATM
Week 5	
Class 13	Multiple Access protocols
Class 14	Random Access protocols
Class 15	Random Access protocols
Week 6	
Class 16	Network Layer
Class 17	Routing Algorithms
Class 18	Congestion control
Week 7	
Class 19	IEEE Protocols LANs and MANs
Class 20	Internetworking devices
Class 21	Wi-fi
Week 8	
Class 22	ICMP
Class 23	IP
Class 24	Subnetting
Week 9	
Class 25	Subnetting
Class 26	ATM
Class 27	TCP
Week 10	
Class 28	UDP
Class 29	DCCP, SCTP
Class 30	Application layer
Week 11	

Class 31	RIP, DHCP
Class 32	WWW, HTTP
Class 33	DNS
Week 12	
Class 34	POP, SMTP
Class 35	IMAP, FTP
Class 36	Idea about cyber security
Week 13	
Class 37	Simple and complex network management protocol
Class 38	Firewall
Class 39	Scope of research in communication network
Week 14	
Class 40	Overview of the syllabus
Class 41	Assignment
Class 42	Open discussion

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/Assignment 1-3	20%	CO1	C1
			CO2	C3
			CO4	C5
	Class Participation	5%	CO1	C1
			CO2	C3
			CO3	C4
			CO4	C5
	Class Attendance	5%		
	Mid term	10%	CO2	C3
			CO3	C4
Final Exam			CO1	C1
			CO2	C3
			CO3	C4
			CO4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Data Communications and Networking by Behrouz A. Forouzan

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.3.15. EECE 446: Communication Networks Laboratory
Level-4, Term-II (Fall)

COURSE INFORMATION

Course Code Course Title	: EECE 446 : Communication Networks Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 445
Course Title: Communication Networks

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The target of the course is to acquaint the students with different routing protocols and help them to implement different network configurations using simulating software like Cisco

Packet tracer, MATLAB and Wireshark. Teaching the students about channel coding schemes is another aim of the course.

OBJECTIVE

1.To familiarize the students with the internetworking devices and Physical Network Interface Connection.
2.To impart knowledge on IP addressing and the basic routing protocols and familiarize them with a relevant simulation software like Cisco Packet Tracer.
3.To introduce the students with the random-access protocols and assist them to simulate these.
4.To enable a student to simulate channel coding schemes using simulation software like MATLAB.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **construct** physical networks using wires and internetworking devices.	PO11	P2,A1		1		R, Q, PR
CO2	Be able to **design and justify** efficient network configurations using different routing protocols according to IEEE standards.	PO8	P4,C5	2	2	7	R, Q, ASG, T
CO3	Be able to **distinguish** between two of the types of the random-access protocols **analysing** their performances via the simulation softwares.	PO5	C4			6	R, Q, T
CO4	Be able to **reproduce** codes to **solve** problems related to channel coding schemes for real life communication network.	PO12	P3	1			R, PR,Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 445 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **construct** physical networks using wires and internetworking devices.											2	
CO2	Be able to **design and justify** efficient network configurations using different routing protocols according to IEEE standards.								2				
CO3	Be able to **distinguish** between two of the types of the random-access protocols **analysing** their performances via the simulation softwares.					3							
CO4	Be able to **reproduce** codes to **solve** problems related to channel coding schemes for real life communication network.												2

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiments	42 14 28
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	89
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	136

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	Introduction to Physical Network Interface Connection
Week 2	Familiarization with IP Addressing
Week 3	Basic Network Configuration (Static)
Week 4	VLSM (Variable-Length Subnet Mask)
Week 5	Dynamic Routing (RIP), Dynamic Host Control Protocol (DHCP)
Week 6	Introduction to Wireshark and Packet Sniffing.
Week 7	Lab Test-1
Week 8	ALOHA MAC Protocols and simulation.
Week 9	Introduction to Channel Coding and Linear Block Codes, Linear Block Coding using Modules and simulation.
Week 10	Introduction to Linear Block Codes: Cyclic Coding and simulation.
Week 11	Lab Test-2
Week 12	Lab Quiz
Week 13	Project Presentation
Week 14	Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO1	P2,A1
			CO2	C5, P4
			CO3	C4
			CO4	P3
	Labtest-1, Labtest-2	30%	CO2	C5, P4
			CO3	C4
	Project and Presentation	25%	CO4	P3
Lab Quiz		25%	CO 1	P2,A1
			CO 2	C5,P4
			CO 3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Communication System, Simon Haykin
2. Modern Digital and Analog Communication Systems, BP Lathi, Zhi Ding.

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.4 Interdisciplinary Courses

5.2.4.1 EECE 421: Control System II
Level-4, Term –I/II (Spring/ Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 421 : Control System II	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE
Course Code: EECE- 401 Course Title : Control System I
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
Control system-II is the study to understand the basic compensation using pole placement technique. It will help to know the way of deriving state equation of digital control systems. This subject will analyze in more details about the investigation of control system on both frequency domain and time domain. Additionally, it will introduce advanced control algorithm using the neural network and fuzzy control, adaptive control, H_∞Control, and nonlinear control for the application in day to day practical systems.
OBJECTIVE
1. Introduce students with the design procedure of compensator and controller from the point of view of sinusoidal frequency techniques and root locus. 2. Impart the basic knowledge of to solve the state equation of digital systems for various cases to estimate the state diagram. 3. Make the students able to analyse the control system in both the time domain and frequency domain viewpoints. 4. Impart the in-depth knowledge of modelling various control strategy such as neural network and fuzzy control, adaptive control, H_∞ Control, nonlinear control.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Method
CO1	**Design** compensator and controller from the point of view of sinusoidal frequency techniques and root locus.	PO1	C6	1		3	T, F
CO2	**Solve** the state equation of digital systems for various cases to estimate the state diagram.	PO2	C3	1		3	T, Mid, F
CO3	**Analyze** the control system in both the time domain and frequency domain viewpoints.	PO3	C4	2		3	T, Mid, F
CO4	**Model** on various control strategy such as neural network and fuzzy control, adaptive control, H_∞ Control, nonlinear control.	PO3	C3	3	3	5	ASG, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
Compensation using pole placement technique. State equations of digital systems with sample and hold, state equation of digital systems, digital simulation and approximation. Solution of discrete state equations: by Z transform, state equation and transfer function, state diagrams, state plane analysis. Stability of digital control systems. Digital simulation and digital redesign. Time domain analysis. Frequency domain analysis. Controllability and observability.

Optimal linear digital regulator design. Digital state observer. Microprocessor control. Introduction to neural network and fuzzy control, adaptive control. $H_{\propto}$ Control, nonlinear control.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Design** compensator and controller from the point of view of sinusoidal frequency techniques and root locus.	3											
CO2	**Solve** the state equation of digital systems for various cases to estimate the state diagram.		3										
CO3	**Analyze** the control system in both the time domain and frequency domain viewpoints.	3											
CO4	**Model** on various control strategy such as neural network and fuzzy control, adaptive control, $H_{\propto}$ Control, nonlinear control.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Compensator**	CT 1
Class 1	Introduction controller and compensator	
Class 2	Modeling the series and parallel compensator	
Class 3	Root locus technique to design series and parallel compensator	
Week 2	**State Equation**	
Class 4	State equations of digital systems with sample and hold.	
Class 5	State equation of digital systems.	
Class 6	Digital simulation and approximation	
Week 3	**State Equation**	
Class 7	State equation and transfer function	
Class 8	State diagrams	
Class 9	State plane analysis	
Week 4	**Z transform**	Mid Term
Class 10	Properties of transfer function	
Class 11	Concept of Poles and zeros in Z-transform	
Class 12	Inverse Z transform	
Week 5	**Digital Control System**	
Class 13	Introduction to digital control system	
Class 14	Stability of digital control systems.	
Class 15	Digital simulation and digital redesign	
Week 6	**Time Domain Analysis**	
Class 16	Introduction to Time Domain Analysis	
Class 17	Mathematical problems regarding Time Domain Analysis	
Class 18	Designing practical systems using Time Domain Analysis	
Week 7	**Frequency Domain Analysis**	CT 2
Class 19	Introduction to frequency Domain Analysis	
Class 20	Mathematical problems regarding frequency Domain Analysis	

Class 21	Designing practical systems using frequency Domain Analysis	
Week 8	**Controllability And Observability**	
Class 22	Drawbacks of transfer function model and analysis	
Class 23	Introduction and importance of Controllability and Observability	
Class 24	Gilbert's and Kalman's methods for testing Controllability and Observability	
Week 9	**Optimal Linear Digital Regulator Design**	
Class 25	Introduction to Optimal Linear Digital Regulator Design	
Class 26	Dynamic programming and optimization technique	
Class 27	Design of optimal discrete time linear-quadratic regulator	
Week 10	**Digital state observer**	CT 3
Class 28	Introduction to Digital state observer	
Class 29	Digital state observer for nonlinear system	
Class 30	Design of Digital state observer using the fractional variable-order derivative	
Week 11	**Microprocessor Control**	
Class 31	Introduction to Microprocessor control	
Class 32	Various approaches of Microprocessor control	
Class 33	Design of control system for Microprocessor control	
Week 12	**Nonlinear Control**	
Class 34	Introduction to neural network and fuzzy control	
Class 35	Adaptive control	
Class 36	$H_{\propto}$Control, nonlinear control	
Week 13	**Control System Design**	
Class 37	Different practical control system design (1) : Elementary systems	
Class 38	Different practical control system design (2) : Elementary systems	
Class 39	Different practical control system design (3) : Elementary systems	
Week 14	**Control System Design**	
Class 40	Different practical control system design (4) : Elementary systems	
Class 41	Scope of research in control system	
Class 42	Open Discussion	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C6
			CO2	C3
			CO 3	C4
	Class Participation	5%	CO 4	C3
	Class Attendance	5%	-	-
	Mid term	10%	CO 2	C3
			CO3	C4
Final Exam		60%	CO 1	C6
			CO 2	C3
			CO 3	C4
Total Marks		100%		

CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEAXT AND REFERENCE BOOKS

1. Control Systems Engineering by Norman S. Nise
2. Modern Control Engineering by Katsuhiko Ogata
3. Modern Control Systems by Richard C. Dorf
4. Linear Control System Analysis and Design. - John J. D. Azzo, Constantine H. Houpis

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.2. EECE 422: Control System II Laboratory
Level-4, Term -II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 422 : Control System II Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 421
Course Title: Control System II

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Control system-II familiarizes the students with basic knowledge of root locus to design analogue and digital compensators for optimizing the low efficient control system engineering. Thus subject tells about the basic knowledge about z-transform technique which is used to digital control system. Additionally, it communicates the in-depth theoretical knowledge of design the microprocessor and fuzzy logic control system satisfying the specification for a given practical system.

OBJECTIVE

1. Introduce the students with basic knowledge of root locus to design various types of compensators for control system engineering.
2. Impart the basic knowledge of z-transform technique to design the control system in case of digital control engineering.
3. Impart the in-depth theoretical knowledge of Design the microprocessor and fuzzy logic control system satisfying the specification for a given practical system.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding POs	Bloom's Taxonomy	CP	CA	KP	Assess ment method
CO1	**Apply** the basic knowledge of root locus to design various types of compensators for control system engineering.	PO5	C3	1		5	T, F
CO2	**Analyze** the z-transform technique to design the control system in case of digital control engineering.	PO4	C4	1		8	T, Mid, F
CO3	**Design** the microprocessor and fuzzy logic control system satisfying the specification for a given practical system.	PO9	C6	3	3		ASG, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 421 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Apply** the basic knowledge of root locus to design various types of compensators for control system engineering.					3							

CO2	**Analyze** the z-transform technique to design the control system in case of digital control engineering.				3								
CO3	**Design** the microprocessor and fuzzy logic control system satisfying the specification for a given practical system.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz	 24 6 6
Preparation of Presentation Engagement in Group Projects	5 26
Formal Assessment Continuous Assessment Final Quiz	10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week1	Introduction to the lab equipment, rules and norms of the laboratory and safety guidelines.
Week2	**Expt-01:** Study the Z-transform technique for digital control system engineering
Week3	**Expt-02:** Study on the Digital simulation and digital redesign
Week4	**Expt-03:** Designing practical systems using Time Domain Analysis
Week5	**Expt-04:** Designing practical systems using frequency Domain Analysis
Week6	**Expt-05:** Design of optimal discrete time linear-quadratic regulator
Week7	**Expt-06:** Design and implementation of digital state observer using the fractional variable-order derivative
Week8	**Expt-07:** Design of control system for Microprocessor control
Week9	**Expt-08:** Designing the control system for neural network and fuzzy control
Week10	Practice Lab
Week11	Lab Test
Week12	Viva
Week13	Quiz test
Week14	Project submission

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Participation and Report	20%	CO1	C3
			CO2	C4
			CO3	C6
	Labtest-1, Labtest-2	30%	CO1	C3

			CO2	C4
			CO 3	C6
	Project and Presentation	25%	CO3	C6
Lab Quiz		25%	CO1	C3
			CO2	C4
			CO3	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEAXT AND REFERENCE BOOKS

1. Control Systems Engineering by Norman S. Nise
2. Modern Control Engineering by Katsuhiko Ogata
3. Modern Control Systems by Richard C. Dorf

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.3. EECE 423: Numerical Methods
Level-4, Term –I/II (Spring /Fall Term)

COURSE INFORMATION

Course Code	: EECE 423	Contact Hours	:3.00
Course Title	: Numerical Methods	Credit Hours	:3.00

PRE-REQUISITE

Course Code: EECE 212
Course Name: Numerical Technique Laboratory

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To familiarize with numerical linear algebra and related numerical methods and to find solutions to complex engineering problems. These numerical methods will include finding solutions of partial and ordinary differential equation, linear and nonlinear equations, curve fitting and numerical calculus using various techniques. Emphasis is to do a comparative analysis between different numerical techniques applied for same purpose in terms of accuracy, stability, and convergence and hence to identify the most efficient and suitable numerical methods for complex engineering application.

OBJECTIVE

1. To provide students ability to obtain approximate solutions to systems of linear and nonlinear equations applying the most suitable and effective root finding numerical techniques and then apply these techniques for solving complex engineering equations.
2. To make students able to construct new data points within the range of a discrete set of known data points using interpolation formulae and creating curve that converges through scattered data points using curve fitting techniques.
3. To familiarize students with different techniques of numerical calculus to find integration and differentiation of any given data sets by either first finding interpolating function through the given data points and then performing integration/differentiation on the derived function or directly performing integration/differentiation on the data sets.
4. To enable students to solve linear or nonlinear ordinary differential equation and linear partial differential equation applying the most effective and suitable numerical techniques depending on different given values of the equations like initial value or boundary value or other conditions.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to apply numerical methods to find approximate solution of linear and nonlinear systems of equations of v complex engineering application and analyze and evaluate different methods to identify the most effective and accurate one for finding root of equations.	PO3	C3			5	T, F
CO2	Be able to generate new data points within the range of a discrete set of known data points applying interpolation formulae and creating generalized curve with highest accuracy that converges through scattered data points applying curve fitting techniques.	PO1	C6			2	Mid, F
CO3	Be able to compute integration and differentiation on any given data sets applying numerical techniques and analyze different techniques to find out the most efficient method.	PO1	C4			2	T, Mid, F
CO4	Be able to solve any differential equation of engineering application by applying established numerical methods combining different initial conditions	PO3	C5	1		5	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Motivation and errors in numerical techniques, Taylor series.
Nonlinear Equations: Iteration, bisection, false position, Newton-Raphson, Secant, Muller's and other methods.
Simultaneous linear algebraic equations: Cramer's rule, inversion of matrices, Gauss elimination, Gauss-Jordan method, factorization and Gauss-Siedel iteration methods.
Matrix Inversion and LU decomposition: Matrix norms, condition number, ill-conditioned matrices, LU decomposition using Gauss elimination, LU decomposition using Thomas algorithm, Cholesky decomposition.
Finite difference calculus: Forward, backward, divided, and central difference, difference of a polynomial. **Interpolation:** Newton's formula, Lagrange, spline, Chebyshev and inverse. Extrapolation. **Curve fitting:** Linear and polynomial regression, fitting power, exponential and trigonometric functions.
Numerical differentiation & integration: general quadrature formula, trapezoidal rule and Simpson's rule, Numerical differentiation.
Ordinary differential equations: Initial value problem, Taylor's series method, Picard's method of successive approximation, Euler's method and Runge-Kutta method, Boundary value problems.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to apply numerical methods to find approximate solution of linear and nonlinear systems of equations of complex engineering application and analyze and evaluate different methods to identify the most effective and accurate one for finding root of equations.			3									
CO2	Be able to generate new data points within the range of a discrete set of known data points applying interpolation formulae and creating generalized curve with highest accuracy that converges through scattered data points applying curve fitting techniques.	3											
CO3	Be able to compute integration and differentiation on any given data sets applying numerical techniques and analyze different techniques to find out the most efficient method.	3											
CO4	Be able to solve any differential equation of engineering application by applying established numerical methods combining different initial conditions			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	42 21 21
Formal Assessment Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	**Introduction**	
Class 1	Introduction to Numerical Techniques.	CT 1
Class 2	Motivation and errors in numerical techniques.	
Class 3	Taylor series.	

Week 2	**Nonlinear Equations**	
Class 10	Introduction to nonlinear equation solving techniques.	
Class 11	Bisection method, false position, absolute error in bisection method and a priori calculations of errors.	
Class 12	False position method, secant method, Newton-Raphson method, Muller's method.	
Week 3	**Nonlinear Equations**	
Class 7	Graphical representation of various methods	
Class 8	Convergence/divergence characteristic of various methods	
Class 9	Errors and error analysis of various methods	
Week 4	**Simultaneous linear algebraic equations**	CT 2
Class 10	Numerical Techniques for solving simultaneous linear algebraic equations.	
Class 11	Cramer’s method, Gauss elimination method.	
Class 12	Gauss elimination method, Pivoting.	
Week 5	**Simultaneous linear algebraic quations**	
Class 13	Gauss-Jordan method.	
Class 14	Factorization method.	
Class 15	Gauss-Siedel iteration method.	
Week 6	**Matrix Inversion and LU decomposition:**	
Class 16	Matrix norms, condition number, ill-conditioned mMatrix norms, condition number, ill-conditioned matrices.	
Class 17	LU decomposition using Gauss elimination.	
Class 18	LU decomposition using Thomas algorithm, Cholesky decomposition.	
Week 7	**Finite difference calculus**	Mid Tern
Class 19	Introduction to different techniques to solve differential equations numerically.	
Class 20	Forward, backward, divided, and central difference formulas.	
Class 21	Finite difference of polynomial.	
Week 8	**Interpolation**	
Class 22	Introduction to interpolation and extrapolation.	
Class 23	Newton’s formula, Lagrange, spline, Chebyshev and inverse interpolation.	
Class 24	Newton’s formula, Lagrange, spline, Chebyshev and inverse interpolation.	
Week 9	**Curve fitting**	
Class 25	Linear and polynomial regression, fitting power.	
Class 26	Linear and polynomial regression, fitting power.	
Class 27	Exponential and trigonometric functions for curve fitting.	
Week 10	**Numerical differentiation & integration**	
Class 28	Introduction to numerical differentiation & integration	
Class 29	General quadrature formula for integration.	
Class 30	Trapezoidal rule and Simpson’s rule.	
Week 11	**Numerical differentiation & integration**	CT 3
Class 31	Trapezoidal rule and Simpson’s rule.	
Class 32	Numerical differentiation, Forward, backward, divided, and central difference formulas.	
Class 33	Richardson extrapolation.	
Week 12	**Ordinary differential equations**	
Class 34	Introduction to Initial Value Problems.	
Class 35	Taylor series method, Euler's method, Modified Euler's method (predictor-corrector/Heun's method), modified Euler's method (mid-point method)	
Class 36	Runge-Kutta method, Higher order ODEs.	
Week 13	**Ordinary differential equations**	

Class 37	Introduction to Boundary Value Problems	
Class 38	Shooting method, Finite difference method for Dirichlet boundary value problems.	
Class 39	Shooting method, Finite difference method for Dirichlet boundary value problems.	
Week 14	**Ordinary differential equations**	
Class 40	Introduction to Eigen Value Problems	
Class 41	Fadeev-Leverrier method for finding characteristic polynomial, Solving Eigen value problems, Gershgorin Circle Theorem.	
Class 42	Fadeev-Leverrier method for finding characteristic polynomial, Solving Eigen value problems, Gershgorin Circle Theorem.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C3
			CO3	C4
			CO4	C5
	Class Participation	5%	CO1	C3
			CO2	C6
			CO3	C4
			CO4	C5
	Class Attendance	5%	-	-
	Mid-Term	10%	CO2	C6
			CO3	C4
Final Exam			CO1	C3
			CO2	C6
			CO3	C4
			CO4	C5
Total Marks		100%		

(CO=Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. Numerical Methods for Engineers with Programming and Software Applications (3rd Edition), Steven C. Chapra and Raymond P. Canale.
2. Numerical Methods—with Programs in BASIC FORTRAN, Pascal and C++. S. Balachandra Rao and C. K. Shantha, Revised edition, 2004.

Reference Books:

1. Numerical Analysis by Richard L. Burden and J. Douglas Faires
2. Applied Numerical Analysis, Curtis F. Gerald and Patrick O. Wheatley, Pearson Education

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.4. EECE 424: Numerical Methods Laboratory
Level-4, Term -II (Fall Term)

COURSE INFORMATION			
Course Code	: EECE 424	Contact Hours	: 3.00
Course Title	: Numerical Methods Laboratory	Credit Hours	: 1.50
PRE-REQUISITE			
None			

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize with numerical methods algorithms for solving complex engineering problems over traditional analytical solutions for accuracy, stability, and convergence adva ntages. Solving numerical analysis problems in a realistic context using engineering tools like MATLAB and C# object oriented programming is the goal of this course.

OBJECTIVE

1. To impart basic algorithms of numerical methods for engineering applications.
2. To develop the ability of engineering system modelling using first and second order differential equations.
3. To build the capability to analyze numerical problems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** basic Algorithms of numerical methods for engineering applications.	PO9	P4	1			R, LT
CO2	Be able to **model** engineering systems using first and second order differential equations, and **solve** the equations numerically.	PO5	P5	1		6	R, Q, LT
CO3	Be able to **analyze** numerical problems to **perform** both hand computation and programming applied in MATLAB and C# programming.	PO5	P6	3		6	R, Q, LT
CO4	Be able to **perform** project task on numerical analysis using MATLAB software.	PO4	P6	1,2	1,2	8	R, Q, LT

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 423 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **apply** basic algorithms of numerical methods for engineering applications.				3								
CO2	Be able to **model** engineering systems using first and second order differential equations, and **solve** the equations numerically.					2							
CO3	Be able to **analyze** numerical prob-lems to **perform** both hand computa-tion and programming applied in MATLAB and C# programming.					2							
CO4	Be able to **perform** project task on numerical analysis using MATLAB									3			

	software.												

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	14 28 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Examination	 14 1
Total	112

TEACHING METHODOLOGY

Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

COURSE SCHEDULE

Week1	Introduction to C# programming.
Week2	Solutions to Non-linear Equations: Muller's Method.
Week3	LU Decomposition.
Week4	Solutions to Linear Differential Equations.
Week5	Solutions to Linear Differential Equations.
Week6	Interpolation using Central Differences.
Week7	Lab Test - 01
Week8	Numerical Integration: Trapezoidal rule
Week9	Numerical Integration: Romburg's method.
Week10	Solving Boundary Value Problems Using Finite Difference Method (FDM)
Week11	Runge-Kutta Method for Solutions to System of Differential equations
Week12	Lab Test-2
Week13	Quiz
Week14	Viva

ASSESMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Participation and Report	20%	CO1, CO2, CO3	P4, P5, P6
	Labtest-1, Labtest-2	30%	CO1, CO2, CO3,	P4, P5, P6
	Project And Presentation	25%	CO4	P6
Lab Quiz		25%	CO 2	P5
			CO 3	P6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Numerical methods - Robert W. Hornbeck; Quantum Publishers.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.5. EECE 425: Biomedical Instrumentation
Level-4, Term –I/II (Spring/ Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 425 : Biomedical Instrumentation	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To give a brief introduction to human physiology and various instrumentations system for the measurement and analysis of physiological parameters. The target of the course is to enable the students to have a firm foundation on the mechanisms of the biomedical instruments in use with an aim to provide the student with a strong base to work in the biomedical industry.			
OBJECTIVE			
1. To impart basic knowledge on the canonical structure of biomedical instrumentation systems. 2. To introduce the students with the qualitative functions of the four primary system components (sensors, actuators, electronics interface, computation unit) 3. To impart in depth knowledge on the static and dynamic performance characteristics for instrumentation systems. 4. To develop a student's skills on the mechanisms of the existing biomedical instruments in order to enable the student to work in the practical field.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the structural evolution of the biomedical instrumentation systems.	PO1	C1			2	T, F
CO2	Be able to **distinguish** among the functions of the fundamental system components.	PO3	C2			5	T, Mid , F
CO3	Be able to **analyse** the efficiency of performance of the existing models in instrumentation systems.	PO1	C4	1		4	Mid, F
CO4	Be able to **operate** the biomedical instruments in use and **plan** for further improvement.	PO2	C6	2	1	4	F, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Human body: Cells and physiological systems, **Bioelectricity:** Genesis and characteristics. **Measurement of bio-signals:** Ethical issues, sensors, actuators, transducers, amplifiers and filters. **Electrocardiogram:** Electrocardiography, phono cardiograph, vector cardiograph, analysis and interpretation of cardiac signals, cardiac pacemakers and defibrillator. **Blood pressure:** Systolic, diastolic mean pressure, Electronics manometer, detector circuits and practical problems in pressure monitoring, **Blood flow measurement:** Plethysmography and electromagnetic flow meter. **Measurement and interpretation:** Electroencephalogram, cerebral angiograph and chronical X- ray, brain scans, electromyogram (EMG). **Tomography:** Positron emission tomography and computer tomography, magnetic resonance imaging (MRI), ultrasonogram, patient monitoring system and medical telemetry, effect of electromagnetic fields on human body.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the structural evolution of the biomedical instrumentation systems.	2											
CO2	Be able to **distinguish** among the functions of the fundamental system components.			3									
CO3	Be able to **analyse** the efficiency of performance of the existing models in instrumentation systems.	3											
CO4	Be able to **operate** the biomedical instruments in use and **plan** for further improvement.		2										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture and Discussion	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Human body**	CT 1
Class 1	Cells and physiological systems.	
Class 2	Continued	
Class 3	Continued	
Week 2	**Bioelectricity**	
Class 4	Genesis and characteristics.	
Class 5	Continued	
Class 6	Continued	
Week 3	**Measurement of bio-signals**	
Class 7	Ethical issues	
Class 8	transducers	
Class 9	amplifiers and filters	
Week 4	**Electrocardiogram**	
Class 10	Electrocardiography	
Class 11	Continued	
Class 12	phono cardiograph	
Week 5	**Electrocardiogram (contd.)**	

Class 13	vector cardiograph	
Class 14	Continued	CT 2
Class 15	analysis and interpretation of cardiac signals	
Week 6	**Electrocardiogram (contd.)**	
Class 16	Continued	
Class 17	Cardiac pacemakers and defibrillator.	
Class 18	Continued	
Week 7	**Blood pressure**	
Class 19	Systolic, diastolic mean pressure	
Class 20	Electronics manometer	
Class 21	Continued	
Week 8	**Blood pressure (contd.)**	
Class 22	detector circuits	CT 3
Class 23	practical problems in pressure monitoring	
Class 24	Continued	
Week 9	**Blood flow measurement**	
Class 25	Plethysmography	
Class 26	electromagnetic flow meter	
Class 27	Continued	
Week 10	**Measurement and interpretation**	
Class 28	Electroencephalogram	
Class 29	cerebral angiograph	
Class 30	Continued	
Week 11	**Measurement and interpretation (contd.)**	
Class 31	chronical X-ray	
Class 32	brain scans	CT 4
Class 33	Electromyogram (EMG).	
Week 12	**Tomography**	
Class 34	Positron emission tomography	
Class 35	computer tomography	
Class 36	magnetic resonance imaging (MRI)	
Week 13	**Tomography (contd.)**	
Class 37	ultrasonogram	
Class 38	patient monitoring system and medical telemetry	
Class 39	effect of electromagnetic fields on human body	
Week 14	**Revision**	
Class 40	Question answer and interactive session	
Class 41	Syllabus review	
Class 42	Scope of research on related field	

ASSESSMENT STRATEGY

<table>
<tr><td colspan="2">Components</td><td>Grading</td><td>CO</td><td>Bloom’s Taxonomy</td></tr>
<tr><td rowspan="7">Continuous Assessment (40%)</td><td rowspan="2">Class Test/ Assignment 1-3</td><td rowspan="2">20%</td><td>CO1</td><td>C1</td></tr>
<tr><td>CO2</td><td>C2</td></tr>
<tr><td rowspan="4">Class Participation</td><td rowspan="4">5%</td><td>CO1</td><td>C1</td></tr>
<tr><td>CO2</td><td>C2</td></tr>
<tr><td>CO3</td><td>C4</td></tr>
<tr><td>CO4</td><td>C6</td></tr>
<tr><td>Class Attendance</td><td>5%</td><td>-</td><td>-</td></tr>
</table>

	Mid term	10%	CO2	C2
			CO3	C4
Final Exam		60%	CO1	C1
			CO2	C2
			CO3	C4
			CO4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Biomedical Instrumentation & Measurements – Cromwell; Prentice Hall of India.
2. Biomedical Digital Signal Processing – Tompkins; Prentice Hall of India.
3. J. G. Webster, Medical Instrumentation, Application and Design, John Wiley and Sons

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.6. EECE 426: Biomedical Instrumentation Laboratory
Level-4, Term -II (Fall Term)

COURSE INFORMATION

Course Code	: EECE 426	Contact Hours	: 3.00
Course Title	: Biomedical Instrumentation Laboratory	Credit Hours	: 1.50

PRE-REQUISITE

Course Code: (EECE 425)
Course Title: Biomedical Instrumentation.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize the basics of biomedical components as well as their usage and application.

OBJECTIVE

1. To be able to learn about components used in some sophisticated lab equipment.
2. To be able to know about design and implementation of instruments.
3. To be able to learn to test the equipment on field.
4. To be able to compare the theoretical and practical orientation of instruments.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be expert in **analysing** the differences between theoretical knowledge with the practical observations.	PO5	P3	P1		6	R,Q,T
CO2	Be skillful to **Design** different instruments and theory related projects.	PO5	P7	P4		6	R,Q,T
CO3	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	P 9	A4			7	PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 425 using different hardware equipment and simulation software.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be expert in analyzing the differences between theoretical knowledge with the practical observations.					3							
CO2	Be skillful to Design different instruments and theory related projects.					2							
CO3	Developing collaborative nature by discussing and performing as a group and organize project tasks maintaining solidarity during the group projects and presentations.									2			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 12 30-
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	24 06 06 05 26
Formal Assessment Continuous Assessment Final Quiz	10 1
Total	120

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Weeks	Intended topics to be covered	Remarks
1	Introduction	
2	Design and Realize inverting and non-inverting Amplifier using Op-amp.	
3	Design and implementation of summing and average circuit using Op-amp.	
4	Design and implementation of differential amplifier using Op-amp.	
5	Design of instrumentation Amplifier.	
6	Lab Test-01	
7	Design a high pass and a low pass filter.	
8	Study the frequency response of electrode contact impedance.	
9	Study of an 8-bit Analog to Digital (A/D) converter	
10	Practice Lab	
11.	Lab Test-02	
12.	Quiz	
13.	Viva	
14.	Project Presentation	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous	Lab participation and Report	20%	CO 1	P3

Assessment (40%)			CO 2	P7
	Lab test- 1, Lab test- 2	30%	CO 1	P3
			CO 2	P7
	Project and Presentation	25%	CO 3	A4
Lab Quiz		25%	CO 1	P3
			CO 2	P7
			CO 3	A4
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				
TEXT AND REFERENCE BOOKS				
1. Biomedical Instrumentation & Measurements – Cromwell; Prentice Hall of India. 2. Biomedical Digital Signal Processing – Tompkins; Prentice Hall of India.				

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.7. EECE 429: Radar Engineering
Level-4 Term-I/II (Spring/ Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 429 : Radar Engineering	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None.			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course is designed for final year a student which focuses on adequate knowledge of radar circuit components. The students are first acquainted with the basics of radar engineering, paving the way to gain apprehension regarding the analysis of radar properties effectively and efficiently.			
OBJECTIVE			
1. To impart the thorough knowledge of basic subunits of a RADAR system with respect to their functions. 2. To enhance the skill set of students in deriving the basic radar equation and its dependence on various parameters. 3. To develop students' skills regarding Doppler Effect and its applications with respect to pulsed Doppler radar. 4. To familiarize the students clearly with the moving target indicator and to study its application. 5. To understand the effect of noise on radar signal detection.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **demonstrate** the basic principle of RADAR System.	PO1	C3	1		3	T,Mid Term, F
CO2	Be adept to **solve** the RADAR Equation and to calculate Transmitter power.	PO2	C3	1		4	Mid, ASG, F
CO3	Be proficient to **analyze** the principle of each and every block of MTI and Pulse Doppler Radar.	PO3	C4	1		5	ASG, F
CO4	Be capable to **evaluate** the Noise Figure and Noise Temperature in Radar Receivers and can describe	PO3	C5	1		5	T, F

	antennas used for Radars.						

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to radar, functional block diagrams, radar range equation, radar frequencies, pulse repetition frequency and range ambiguity, minimum detectable signal, radar cross-section of targets, detection and tracking, clutter and jamming. Doppler effect, continuous wave and frequency modulation radars, moving target indicator and phase-Doppler radars. Radar transmitter: Magnetron oscillator, klystron amplifier and traveling wave tube amplifier. Radar antenna: Antenna parameters, radiation pattern and aperture distribution. Receivers, displays and duplexers.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **demonstrate** the basic principle of RADAR System.	2											
CO2	Be adept to **solve** the RADAR Equation and to calculate Transmitter power.		2										
CO3	Be proficient to **analyze** the principle of each and every block of MTI and Pulse Doppler Radar.			3									
CO4	Be capable to **evaluate** the Noise Figure and Noise Temperature in Radar Receivers and can describe antennas used for Radars.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Test	20%	CO 1	C3
			CO 2	C3
			CO 3	C4
			CO4	C5
	Assignment	5%	CO 2	C3
			CO 3	C4
	Attendance	5%		
	Mid Term	10%	CO 1	C3
			CO2	C3
Final Term		60%	CO 1	C3
			CO 2	C3
			CO 3	C4
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Lecture	-
Experiment	-
Self-Directed Learning	
Non face to face learning	42

Revision of previous lecture at home Preparation for final examination	21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	**Introduction Nature of Radar**	**CT-1**
Class 1	Introduction Nature of Radar	
Class 2	Maximum Unambiguous Range, Radar Waveforms	
Class 3	Simple form of Radar Equation	
Week 2	**Introduction Nature of Radar**	
Class 4	Radar Block Diagram and Operation	
Class 5	Radar Frequencies and Applications.	
Class 6	Problems related to Radar Frequencies and Applications.	
Week 3	**Radar Equation**	
Class 7	Prediction of Range Performance	
Class 8	Minimum Detectable Signal	
Class 9	Receiver Noise and SNR	
Week 4	**Radar Equation**	**Mid Term**
Class 10	Integration of Radar Pulses	
Class 11	Transmitter Power, PRF and Range Ambiguities	
Class 12	System Losses (qualitative treatment), Related Problems.	
Week 5	**CW and Frequency Modulated Radar**	
Class 13	Doppler Effect, CW Radar – Block Diagram	
Class 14	Isolation between Transmitter and Receiver	
Class 15	Non-zero IF Receiver, Receiver Bandwidth Requirements	
Week 6	**FM-CW Radar**	
Class 16	FM-CW Radar	
Class 17	Range and Doppler Measurement	
Class 18	Block Diagram and Characteristics (Approaching/ Receding Targets)	
Week 7	**FM-CW Radar**	
Class 19	FM-CW altimeter, Measurement Errors	
Class 20	Multiple Frequency CW Radar	
Class 21	Information available from a radar and related mathematical problems	
Week 8	**MTI and Pulse Doppler Radar**	**CT-2**
Class 22	MTI Radar with - Power Amplifier Transmitter & Power Oscillator Transmitter	
Class 23	Delay Line Cancellers – Filter Characteristics	
Class 24	Blind Speeds, Double Cancellation, Staggered PRFs.	
Week 9	**MTI and Pulse Doppler Radar**	
Class 25	Range Gated Doppler Filters, MTI Radar Parameters	
Class 26	Limitations to MTI Performance	
Class 27	Non-coherent MTI, MTI versus Pulse Doppler Radar	
Week 10	**Tracking Radar**	
Class 28	Tracking with Radar, Sequential Lobing, Conical Scan	
Class 29	Monopulse Tracking Radar – Amplitude Comparison Monopulse	
Class 30	Phase Comparison Monopulse	
Week 11	**Tracking Radar**	**CT-3**

Class 31	Target Reflection Characteristics and Angular Accuracy	
Class 32	Tracking in Range, Acquisition and Scanning Patterns. Comparison of Trackers	
Class 33	Theoretically accuracy of radar measurements and mathematical problems	
Week 12	**Detection of Radar Signals in Noise**	
Class 34	Introduction to Detection of Radar Signals in Noise	
Class 35	Matched Filter Receiver	
Class 36	Matched Filter Receiver – Response Characteristics and Derivation	
Week 13	**Detection of Radar Signals in Noise**	
Class 37	Correlation Function and Cross-correlation Receiver	
Class 38	Efficiency of Non-matched Filters	
Class 39	Matched Filter with Non-white Noise	
Week 14	**Radar Receivers**	
Class 40	Noise Figure and Noise Temperature. Displays – types	
Class 41	Duplexers – Branch type and Balanced type, Circulators as Duplexers	
Class 42	Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Series versus Parallel Feeds, Applications, Advantages and Limitations	

REFERENCE BOOKS
1. Introduction to RADAR systems- M. Sholnik; McGraw-Hill International. 2. Principle of Radar- Tomay; Prentice Hall of India. 3. Radar design, principles, signal processing and the environment- Fred E Nathanson.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.8. EECE 430: Radar Engineering Laboratory
Level-4 Term-II (Fall)

COURSE INFORMATION			
Course Code	: EECE 430	Contact Hours	: 3.00
Course Title	: Radar Engineering Laboratory	Credit Hours	: 1.50

PRE-REQUISITE
Course Code: EECE 429 Course Title: Radar Engineering
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To help the students to explore and analysis radar components and put theory in practice. Our mission is to expose students to the working principle of radar communication and analyze its performance and applications. It is targeted to help them to verify the theoretical knowledge practically that will assist them in the long run.
OBJECTIVE
1. To impart the students in-depth knowledge about the basic concepts of fundamentals and analysis of the radar signals. 2. To familiarize the students to various radars like MTI, Doppler and tracking radars and their applications. 3. To impart the basic knowledge of design and identify accuracy of radar measurements and pulse compression techniques 4. Design and analyze radar optimal receivers and familiarize the students to develop engineering design and report writing skills with the help of project work.
COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	To design radar components and acquire	PO3	P3	1		5	R, Q, LT

	basic working principle of radar and its application for solving complex problems in real life.						
CO2	To calculate the velocity of moving objects with in-depth knowledge of Doppler effect practically.	PO5	P3	1		6	R, Q, LT
CO3	To develop the skills to analyze or modify the radiation pattern, aperture distribution and optimize it according to the necessities.	PO5	P4	2,3	1	6	R, Q, LT
CO4	To perform as a group member and assist others during group projects and presentations.	PO10	A4				PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 429 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	To design radar components and acquire basic working principle of radar and its application for solving complex problems in real life.			3									
CO2	To calculate the velocity of moving objects with in-depth knowledge of Doppler effect practically.					3							
CO3	To develop the skills to analyze or modify the radiation pattern, aperture distribution and optimize it according to the necessities.					3							
CO4	To perform as a group member and assist others during group projects and presentations.										3		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	27
Lecture	9
Experiment	18
Self-Directed Learning	51
Preparation of Lab Reports	9
Preparation of Lab-test	10
Preparation of Quiz	9
Preparation of Presentation	5
Engagement in Group Projects	18
Formal Assessment	4

Continuous Assessment Final Quiz	3 1
Total	82

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week-1	Familiarization with Radar Components and modules.
Week-2	To detect radar frequencies, pulse repetition frequency and range ambiguity.
Week-3	To study working of doppler effect.
Week-4	To study working of Doppler Radar, and measure the of the velocity of the object moving in the Radar range.
Week-5	To study the Characteristics of Reflex Klystron tube & to determine its electronic tuning range.
Week-6	Lab Test-01
Week-7	To measure the gain of a waveguide horn antenna.
Week-8	To study the phase shifter.
Week-9	To study the radiation pattern and aperture distribution.
Week-10	To study the properties of receivers, displays and duplexers
Week-11	Quiz test
Week-12	Practice Lab-02
Week-13	Lab Test-02
Week-14	Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (70%)	Lab participation and Report	25%	CO 1	P3
			CO 2	P3
			CO 3	P4
	Lab Test	30%	CO 1	P3
			CO 2	P3
			CO 3	P4
	Project and Presentation	15%	CO4	A4
Lab Quiz		30%	CO 1	P3
			CO 2	P3
			CO 3	P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Introduction to RADAR systems- M. Sholnik; McGraw-Hill International.
2. Principle of Radar- Tomay; Prentice Hall of India.
3. Radar design, principles, signal processing and the environment- Fred E Nathanson.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.9 EECE 491: Sonar and Underwater Engineering
Level-4, Term –I/II (Spring/ Fall Term)

COURSE INFORMATION

Course Code Course Title	: EECE 491 : Sonar and Underwater Engineering	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course will give an introduction to underwater acoustic theory, the sonar engineering and the use of underwater acoustics for the detection and localization of objects and for communication. The course covers the acoustic wave propagation, reflection and transmission in fluid media. The principle of designing underwater acoustic system such as electroacoustic transducers used for generating and receiving sound will enhance the in depth knowledge of sonar and underwater engineering.

OBJECTIVE

1. Introduce students with different underwater or ocean surface systems and their applications.
2. Impart the basic knowledge of technical, environmental, safety, health, and commercial issues related to the design, installation and operation of underwater or ocean surface systems.
3. Make the students able to analyse some simple solution methodologies related to design, installation and operation of underwater or ocean surface systems.
4. Impart the in depth knowledge of making a conceptual solution to complex problems in design, installation and operation of underwater or ocean surface systems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Method
CO1	**Discuss** the different underwater or ocean surface systems and their applications.	PO1	C6	1		3	T, F
CO2	**Explain** the technical, environmental, safety, health, and commercial issues related to the design, installation and operation of underwater or ocean surface systems	PO3	C5	1		5	T, Mid, F
CO3	**Analyze** some simple solution methodologies related to design, installation and operation of underwater or ocean surface systems	PO3	C4	2		5	T, Mid, F
CO4	**Evaluate** a conceptual solution to complex problems in design, installation and operation of underwater or ocean surface systems	PO3	C5	3	3	5	ASG, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Water as a media of propagation: Acoustic wave propagation. Oceanography.
Sonar introduction: Active and passive sonar equations. Noise and reverberation. Factors affecting target strength.
Sonar transducers: Towed array sonar, sonar arrays.
Sonar beams: Beam forming, beam steering. Active transmission and reception; Sonar processing gain. Doppler shift and bandwidth. Passive broadband and narrowband sonar design. Tracking and target motion analysis. Active intercept and secondary sonar. Emerging technologies. Echo sounder. Fish finder. Bathy thermography. Sonobouys. Magnetic anomaly Detectors. Soran.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Discuss** the different underwater or ocean surface systems and their applications.	3											
CO2	**Explain** the technical, environmental, safety, health, and commercial issues related to the design, installation and operation of underwater or ocean surface systems			3									
CO3	**Analyze** some simple solution methodologies related to design, installation and operation of underwater or ocean surface systems			3									
CO4	**Evaluate** a conceptual solution to complex problems in design, installation and operation of underwater or ocean surface systems			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Water as a media of propagation**	CT 1
Class 1	Introduction to Sonar and Underwater Engineering	
Class 2	Acoustic wave propagation	
Class 3	Oceanography	
Week 2	**Introduction to Sonar**	
Class 4	Sonar introduction	
Class 5	Active and passive sonar equations	
Class 6	Noise and reverberation	
Week 3	**Sonar Properties**	
Class 7	Prediction of Range Performance	
Class 8	Minimum Detectable Signal	
Class 9	Receiver Noise and SNR	
Week 4	**Sonar Equation**	CT 2
Class 10	Factors affecting target strength	
Class 11	Introduction to Sonar transducers	
Class 12	Towed array sonar	
Week 5	**Sonar Beams**	
Class 13	Sonar arrays and related mathematical problems	
Class 14	Introduction to Sonar Beams	
Class 15	Beam forming, beam steering	
Week 6	**Sonar Design**	
Class 16	Sonar processing gain	
Class 17	Doppler shift and bandwidth	
Class 18	Passive broadband and narrowband sonar design	
Week 7	**Tracking and Detection**	CT 3
Class 19	Tracking and target motion analysis	
Class 20	Active intercept of Sonar	
Class 21	Secondary sonar	
Week 8	**Sonar Technologies**	

Class 22	Emerging technologies of Sonar.	
Class 23	Mathematical Problem related Sonar Technologies	
Class 24	Designing problems	
Week 9	**Noise in Sonar**	
Class 25	Introduction to Detection of Sonar Signals in Noise	
Class 26	Introduction to Matched Filter Receiver	
Class 27	Matched Filter Receiver equations	
Week 10	**Matched Filters**	CT 4
Class 28	Response Characteristics and Derivation of Matched Filters	
Class 29	Mathematical problems related to filters	
Class 30	Design problem	
Week 11	**Tracking Accuracy**	
Class 31	Target Reflection Characteristics and Angular Accuracy	
Class 32	Seakeeping	
Class 33	Drift Loads/Motions	
Week 12	**Underwater Environment**	
Class 34	Slowly-Varying Loads/Motions	
Class 35	Ocean Environment	
Class 36	Fish finder	
Week 13	**Detectors**	
Class 37	Bathy thermography. Sonobouys	
Class 38	Magnetic anomaly Detectors	
Class 39	Soran	
Week 14	**Conclusion**	
Class 40	Revision	
Class 41	Open Discussion	
Class 42	Open Discussion	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C6
			CO2	C5
			CO 3	C4
			CO4	C5
	Class Participation	5%	CO 4	C5
	Class Attendance	5%	-	-
	Mid term	10%	CO 2	C5
			CO3	C4
Final Exam		60%	CO 1	C6
			CO 2	C5
			CO 3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEAXT AND REFERENCE BOOKS

1. Principles of Underwater Sound – Robert J. Urick; Peninsula Publishing.
2. Topics in Ocean Engineering (Vol I, II, II) – Charles I. Bretschneider.
3. Introduction to the theory of Sound Transmission – Officer C. B; McGraw Hill, NYC.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.10 EECE 492: Sonar and Underwater Engineering Laboratory
Level-4, Term -II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 492 : Sonar and Underwater Engineering Laboratory	Contact Hours Credit Hours	: 3:00 : 1.50
PRE-REQUISITE			
Course Code: EECE 491 Course Title: Sonar and Underwater Engineering			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The aim is to give a basic introduction to underwater acoustics. The course covers the acoustic wave propagation, reflection and transmission in fluid media, ray tracing and normal modes methods for solving wave equation; the principle of design underwater acoustic system such as electroacoustic transducers used for generating and receiving sound, sonar and echo sounder and the use of sonar for detection and localization of objects in the sea.			
OBJECTIVE			
1. Good knowledge on the basic principle of establishing acoustic wave equation; 2. In-depth knowledge on techniques for modelling of wave propagation in underwater 3. Detailed understanding of sonar systems for sound generation and reception, detection and localization of objects. 4. Good knowledge on basic theory and signal processing tools for underwater communication and navigation, and for acoustic remote sensing.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Model** and **Analyze** wave propagation in underwater using theoretical and numerical models	PO3	C4	1		5	R,Q,T
CO2	**Analyze** sonar systems for detection and location of objects	PO1	C4	1		4	R,Q,T
CO3	**Use** acoustic remote sensing of the seabed structure and composition, and of oceanographic conditions.	PO3	C3		1	4	R,Q,T
CO4	**Apply** mathematical and theoretical knowledge to solve practical tasks related to sonar and seismic applications and underwater acoustic communications.	PO2	C3	3	2	4	PR,Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 491 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Model** and **analyze** wave propagation in underwater using theoretical and numerical models			3									
CO2	**Analyze** sonar systems for detection and location of objects	3											

CO3	**Use** acoustic remote sensing of the seabed structure and composition, and of oceanographic conditions.			3									
CO4	**Apply** mathematical and theoretical knowledge to solve practical tasks related to sonar and seismic applications and underwater acoustic communications.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	27
Self-Directed Learning	45
Formal Assessment	02
Total	74

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Weeks	Intended topics to be covered
1.	Study of Acoustic wave propagation.
2.	Introduction to Sonar
3.	Study of Noise and reverberation of Sonar
4.	Introduction to Sonar transducers
5.	Study of Sonar beams: Beam forming, beam steering.
6.	Lab Test-01
7.	Study of Active transmission and reception
8.	Study of Doppler shift and bandwidth
9.	Study of Sonar processing gain, Doppler shift and bandwidth.
10.	Study of Active intercept and secondary sonar
11.	Quiz test
12.	Practice Lab-02
13.	Lab Test-02
14.	Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO1, CO2, CO3	C4, C4, C3
	Labtest-1,Labtest-2	30%	CO1, CO2, CO3	C4, C4, C3
	Project and Presentation	25%	CO4	C3
Lab Quiz		25%	CO1, CO2, CO3	C4, C4, C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Principles of Underwater Sound – Robert J. Urick; Peninsula Publishing.
2. Topics in Ocean Engineering (Vol I,II,II) – Charles I. Bretschneider.
3. Introduction to the theory of Sound Transmission – Officer C. B; McGraw Hill, NYC.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.11. EECE 493: Electronics Warfare
Level-4, Term-I/II (Spring/ Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 493 : Electronics Warfare	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE	
Course Code: EECE 201 Course Title: Electronics I	Course Code: EECE 429 Course Title: Radar Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of this course is to learn and understand the basic concepts of electronic warfare technologies, analyze the signals and apply the knowledge of opto-electronic, acoustic and magneto devices in real context. Various electronic warfare concepts will be introduced in order to facilitate the student with a systems level understanding of electronic warfare techniques and systems.

OBJECTIVE

1. To understand about joint electromagnetic spectrum operations.
2. To know about the electromagnetic operational environment and electromagnetic battle management.
3. To learn about the electronic warfare's relationship to irregular warfare, space operations and navigation warfare.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Be able to **describe** the basic operating principles of optoelectronics, lasers, optical fiber equipment along with other electronic warfare equipment's.	PO1	C1		P1	3	T, F
CO2	Achieving capability to **compare** various premises, procedures and results related to optoelectronic systems.	PO1	C5		P1	3	T, Mid Term Exam, F
CO3	Be competent to **analyze** the operational principle and performance of satellite communication system.	PO1	C4		P1	4	Mid Term Exam, F,ASG
CO4	Be proficient to **generate** the designing criteria of semiconductor optical devices.	PO2	C6	A1	P2	4	T, F, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Modern electronic warfare (EW) systems: Architecture, types and technology.
EW signal processing: Modern EW operation, software control of EW sets.
Role of expendables: Chaff and decoys. Comparing EW receiver capabilities.
Airborne EW: Technology evolution. Advanced EW technical approaches, EW and radar bands, anti-radiation missiles, advanced threat radars and missile systems, countering missile systems, maneuverability and speed considerations. RF and IR seekers, digital RF memory, camouflage jamming, search radar jamming, high ERP generation, directed energy weapons and stealth technology, countering stealth technology, high power microwave weapons, propagation limitations, high energy lasers and charged particle beam weapons.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the basic	3											

	operating principles of optoelectronics, lasers, optical fiber equipment along with other electronic warfare equipment's.												
CO2	Achieving capability to **compare** various premises, procedures and results related to optoelectronic systems.	3											
CO3	Be competent to **analyze** the operational principle and performance of satellite communication system.	3											
CO4	Be proficient to **generate** the designing criteria of semiconductor optical devices.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Modern electronic warfare (EW) systems**	CT 01
Class 1	warfare (EW) systems: Architecture	
Class 2	System types	
Class 3	System Technologies Familiarization	
Week 2	**Modern electronic warfare (EW) systems**	
Class 4	System Technologies principles	
Class 5	System Technologies use	
Class 6	Warfare architecture total connectivity	
Week 3	**EW signal processing**	
Class 7	Luminescence and quantum efficiency in radiation.	
Class 8	Modern EW operation	
Class 9	software control of EW sets	
Week 4	**Role of expendables**	CT 02
Class 10	Polarization and interference,	
Class 11	Chaff	
Class 12	Decoys	
Week 5	**Role of expendables**	
Class 13	Comparing EW receiver capabilities	
Class 14	Internal and external efficiency	
Class 15	Loss mechanism	

Week 6	**Airborne EW**	
Class 16	Airbrone EW familiarization	
Class 17	Technology evolution	
Class 18	Advanced EW technical approaches	
Week 7	**Radar Bands**	
Class 19	EW and radar bands	MID
Class 20	Anti-radiation missiles	
Class 21	Advanced threat radars and missile systems	
Week 8	**Missile System**	
Class 22	Countering missile systems	
Class 23	Countering missile systems	
Class 24	Maneuverability and speed	
Week 9	**RF and IR seekers**	
Class 25	Digital RF memory	
Class 26	Camouflage jamming	
Class 27	Search radar jamming	
Week 10	**High ERP generation**	
Class 28	Photo-detectors	
Class 29	Photoconductors	
Class 30	Junction photo-detectors	
Week 11	**Directed energy weapons**	CT 03
Class 31	Stealth technology	
Class 32	Countering stealth technology	
Class 33	Network configuration	
Week 12	**High power microwave weapons**	
Class 34	Avalanche photodiodes and phototransistors.	
Class 35	Interfaces require	
Class 36	Interface familiarization	
Week 13	**Propagation limitations**	
Class 37	Phase and amplitude modulation	
Class 38	Electro effect	
Class 39	Requirement descriptions	
Week 14	**High energy lasers and charged particle beam weapons.**	
Class 40	Acousto-optic effect and magneto devices.	
Class 41	Introduction to integrated	
Class 42	Review of whole syllabus	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO4	C1, C5, C6
	Class Participation	5%	CO4	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO2, CO3	C5, C4
Final Exam		60%	CO1, CO2, CO3, CO4	CO1, CO5, CO4, CO6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Electronic Defense Systems - FilippoNeri; Artech House Publishers.
2. Electronic warfare in Information Age - D. Curtis Schleher; Artech House Publishers.
3. Electronic Warfare - JPR Browne; Brassey's Lond

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.12. EECE 494: Electronics Warfare Laboratory
Level-4, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 494 : Electronics Warfare Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
Course Code: EECE 493 Course Title: Electronics Warfare			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The aim of this laboratory course is to learn and get familiarized with the basics of different electronic warfare devices and their architecture by performing hand-held experiments and also obtain practical understanding of EW technologies.			
OBJECTIVE			
1. To understand the construction and basic principle of different EW devices. 2. To get acquainted with EW signal processing by adopting software implementation of different EW sets. 3. To achieve capability to compare between different EW receivers and visualize EW spectrum and radar bands. 4. To get familiarized with different high power optoelectronic, acousto-optic and magneto devices.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Achieving ability to **construct** different devices with respect to theoretical knowledge.	PO4	P5		P1	3	PR, Pr R,
CO2	Becoming proficient in **interpreting** the behaviour of different frequency bands for EW applications.	PO6	C2			7	R, Q,T
CO3	Attaining knowledge to **follow** basic knowledge of EW signal processing to **design** an EW spectrum receiver.	PO5	P7	A2	P2	6	R, Q, T
CO4	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	PO10	A4	7			PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 493 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Achieving ability to **construct** different devices with respect to				3								

	theoretical knowledge.												
CO2	Becoming proficient in **interpreting** the behaviour of different frequency bands for EW applications.						2						
CO3	Attaining knowledge to **follow** basic knowledge of EW signal processing to **design** an EW spectrum receiver.					3							
CO4	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.										3		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 6 6 5 26
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	120

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introductory Session on familiarization of basic electronic warfare technologies, laboratory norms and safety measures.
Week 2	Analyze and disassemble various frequency bands to figure out the working principle of radio portions.
Week 3	Design a radio-controlled improvised explosive device (IED).
Week 4	Design jammer circuits to defeat openers across the entire band and lay out them in PCB.
Week 5	Design jammer circuits to defeat openers across the entire band and lay out them in PCB.
Week 6	Review & Practice Lab-1
Week 7	Lab Test-1
Week 8	Design and test a monopole antenna for the jammer.
Week 9	Build and bench test of the mock IED, antenna, and jammer.
Week 10	Study the RF propagation involved for the jamming scenario.
Week 11	Review & Practice Lab-2
Week 12	Lab Test-2
Week 13	Lab Quiz Test
Week 14	Project Presentation

ASSESSMENT STRATEGY

<table>
<tr><td colspan="2">Components</td><td>Grading</td><td>CO</td><td>Bloom's Taxonomy</td></tr>
<tr><td rowspan="8">Continuous Assessment (40%)</td><td rowspan="3">Lab participation and Report</td><td rowspan="3">20%</td><td>CO1</td><td>P5</td></tr>
<tr><td>CO2</td><td>C2</td></tr>
<tr><td>CO3</td><td>P7</td></tr>
<tr><td rowspan="3">Labtest-1,Labtest-2</td><td rowspan="3">30%</td><td>CO1</td><td>P5</td></tr>
<tr><td>CO2</td><td>C2</td></tr>
<tr><td>CO3</td><td>P7</td></tr>
<tr><td rowspan="2">Project and Presentation</td><td rowspan="2">25%</td><td>CO4</td><td>A4</td></tr>
<tr><td>CO1</td><td>P5</td></tr>
<tr><td colspan="2" rowspan="3">Lab Quiz Test</td><td rowspan="3">25%</td><td>CO1</td><td>P5</td></tr>
<tr><td>CO2</td><td>C2</td></tr>
<tr><td>CO3</td><td>P7</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td><td colspan="2"></td></tr>
</table>

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Electronic Defense Systems - FilippoNeri; Artech House Publishers.
2. Electronic warfare in Information Age - D. Curtis Schleher; Artech House Publishers.
3. Electronic Warfare - JPR Browne; Brassey's Lon

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.13. EECE 495: Avionics Engineering
Level-4, Term –I/II (Spring/Fall Term)

COURSE INFORMATION

Course Code Course Title	: EECE 495 : Avionics Engineering	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of this course is to familiarize students with advanced contents of avionics engineering. It is designed with the leading-edge contents of hyperbolic system of navigation, global positioning system (GPS). Students will be able to learn traffic alert collision avoidance and flight management systems for aeronautical applications.

OBJECTIVE

1. To provide a fundamental knowledge on modern design and working principles of radar, guidance and navigation for air vehicles.
2. To impart the mathematical concepts of radar, navigation by NDB, VOR, GPS and inertial navigation approaches and guidance laws.
3. To understand the technological trends of future aircraft navigation and guidance systems designs.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to use the concept of navigation, radio direction finding, automatic direction finder and radio compass.	PO1	C3	1		4	T
CO2	Be proficient in analysing mathematical concepts of radar,	PO3	C6	1	1	5	F, ASG, Pr

	navigation by NDB, VOR, GPS and inertial navigation approaches and be able to design the solution of complex avionics engineering problem using guidance laws.						
CO3	Be competent to understand the working principle of doppler navigation, beam configuration and capable to analyse the trends of aircraft navigation.	PO1	C3			4	Mid

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: VHF and UHF radio, methods of navigation, radio direction finding, automation direction finder, radio compass, VHF omni directional range, distance measuring equipment (DME), DME beacon, TACAN.
Hyperbolic system of navigation: Loran-C Instrument Landing System (ILS), localizer, glide slope indicator and marker beacon. Microwave Landing system (MLS), Doppler Navigation, Inertial Navigation
Global positioning system (GPS): GPS segment satellite constellation, navigation technique, GPS signal structure, navigation data, application of GPS, differential GPS and augmentation of GPS.
Traffic Alert Collision Avoidance System: Introduction, basic operating principle, block diagram and system description, controls and display.
Flight Management System: Introduction, basic operating principle, block diagram and system description, controls and display.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to use the concept of navigation, radio direction finding, automatic direction finder and radio compass.	3											
CO2	Be proficient in analysing mathematical concepts of radar, navigation and able to design the solution of complex avionics engineering problem.			2									
CO3	Be competent to understand the working principle of doppler navigation, beam configuration and capable to analyse the trends of aircraft navigation.	2											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	48
Self-Directed Learning	94
Formal Assessment	05
Total	147

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE		
Week 1	**Introduction/Radio Navigation**	CT 1
Class 1	Introduction	
Class 2	Four Methods of Navigation	
Class 3	Loop Antenna and its equation, Coordinate transformation- Direction cosine matrix	
Week 2	**Radio Navigation**	
Class 4	Cause of 180 degrees ambiguity in Loop antenna	
Class 5	How to overcome 180 degrees ambiguity in Loop antenna	
Class 6	Errors in direction finding and functioning of Radio Altimeter	
Week 3	**Radio Ranges**	
Class 7	Working principle of VHF Omni-directional Range (VOR)	
Class 8	Frequency Spectrum and Wave Equations	
Class 9	Errors and limitations of VOR	
Week 4	**Distance Measuring Equipment**	CT 2
Class 10	Timing Modes, Concept of RADAR mile	
Class 11	Signal Equation of a Gaussian Pulse	
Class 12	Frequency Spectrum and Wave Equations	
Week 5	**Distance Measuring Equipment**	
Class 13	DME operation, Mathematical Relations	
Class 14	DME operation, Mathematical Relations (Cond.)	
Class 15	Modes of operation	
Week 6	**Instrument Landing System**	
Class 16	Components of ILS (Ground and Airborne)	
Class 17	Localizer Equations	
Class 18	Indication Systems	
Week 7	**Instrument Landing System**	CT 3
Class 19	Beam Pattern Geometry of Localizer Transmitter	
Class 20	Beam Pattern Geometry of Localizer Transmitter (Cond.)	
Class 21	Beam Pattern Geometry of Glide Slope Transmitter (Cond.)	
Week 8	**Instrument Landing System**	
Class 22	Development and concept of Microwave Landing System	
Class 23	Development and concept of Microwave Landing System (Cond.)	
Class 24	Development and concept of Microwave Landing System (Cond.)	
Week 9	**Global positioning system (GPS)**	
Class 25	GPS segment, satellite constellation	
Class 26	Navigation technique, GPS signal structure, navigation data	
Class 27	Application of GPS, differential GPS and augmentation of GPS.	
Week 10	**Inertial Navigation**	Mid Term
Class 28	Principle of operation	
Class 29	Microwave Landing System (MLS)	
Class 30	Microwave Landing System (MLS) (Cond.)	
Week 11	**Doppler Navigation**	
Class 31	Beam Configuration	
Class 32	Frequency Spectrum	
Class 33	Components of Doppler RADAR and mathematical problems	
Week 12	**Secondary RADAR**	
Class 34	Concept of Secondary RADAR and Technical Parameters	
Class 35	Modes of Secondary RADAR (A, C, S Signal Format)	
Class 36	Types of transmission & ATC-RBS Interrogation Reply Pulse	
Week 13	**Traffic Alert and Collision Avoidance System**	

Class 37	Introduction and basic operating principle	
Class 38	Block diagram and system description	
Class 39	Controls and display	
Week 14	**Flight Management System (FMS)**	
Class 40	Introduction and basic operating principle	
Class 41	Block diagram and system description	
Class 42	Control and display	

ASSESSMENT STRATEGY				
Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test & Assignment 1-3	20%	CO 1	C3
			CO 2	C6
	Class Participation	5%	CO 2	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO3	C3
Final Exam		60%	CO 2	C6
Total Marks		100%		
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)				

TEXT AND REFERENCE BOOKS

1. Avionics Fundamentals- Jeppesen; Highflyn.
2. Principles of Avionics - Albert Helfrick; Avionics Communication.
3. Digital Avionics Systems Principles and Practice - R. Spitzer; The Blackburn Press.
4. Avionics Navigation Systems – Myron Kayton; Wiley-Interscience.
5. Elements of Electronic Navigation- N S Nagaraja; McGraw-Hill

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.4.14. EECE 496: Avionics Engineering Laboratory
Level-4, Term -II (Fall Term)

COURSE INFORMATION			
Course Code: **Course Title:**	: EECE 496 : Avionics Engineering Laboratory	Contact Hours Credit Hours	: 3.00 : 1.5

PRE-REQUISITE

Course Code: EECE 495
Course Title: Avionics Engineering

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To teach and familiarize the students with the basics of avionics engineering and to apply the knowledge of communication, navigation and guidance systems practically.

OBJECTIVE

1. Be able to impart fundamental knowledge of the various guidance techniques and their properties.
2. Be able to make the students capable of measuring position and altitude of an aircraft.
3. Be able to apprise the students with current and planned implementations and applications of navigation instruments and their working mechanism.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able **Understand** the fundamental of aircraft communication and	PO2	C2,P1,A1			3	R,Q,T

	controlling equipment by practical demonstration.						
CO2	Be able to **analyze** the data obtained from navigation, guidance, communication and control systems by plotting graphs and simulation.	PO5	C4,P4,A2		1	6	R,Q,T
CO3	Be able to **Compare** the performance and capability of different avionics systems by practical demonstration and simulation.	PO6	C5,P5,A3			7	Pr, R,Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 495 using different hardware equipment and simulation software

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able **Understand** the fundamental of aircraft communication and controlling equipment by practical demonstration.		3										
CO2	Be able to **analyze** the data obtained from navigation, guidance, communication and control systems by plotting graphs and simulation.					3							
CO3	Be able to **Compare** the performance and capability of different avionics systems by practical demonstration and simulation.						3						

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 7 6
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Presentation	 6 6 7 6 18
Formal Assessment Continuous Assessment Final Quiz	 6 1
Total	63

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Design Based Method

COURSE SCHEDULE

Week 1	Introduction to the lab equipment's and safety measures
Week 2	Familiarization with DME operation and its terminologies using a DME trainer set.

Week 3	Familiarization with ILS operation and ILS components Testing using an ILS Trainer set.
Week 4	Familiarization with Radio Altimeter and simulating a return signal through a test set.
Week 5	Review
Week 6	Lab Test-1
Week 7	Familiarization with autopilot operation and its terminologies and autopilot Testing using a Trainer set.
Week 8	Detection of stationary targets using parabolic antenna and study the influence of Sensitivity Time Control (STC) on display.
Week 9	Detection of moving targets using parabolic antenna and estimation of beam- width.
Week 10	Review
Week 11	Lab Test-2
Week 12	Lab Quiz
Week 13	Presentation on Assigned Problems
Week 14	Presentation on Assigned Problems

ASSESSMENT METHOD

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	C2, P1, A1
			CO 2	C4, P1, A1
			CO 3	C5, P4, A2
	Labtest-1, Labtest-2	30%	CO 1	C2, P1, A1
			CO 2	C4, P1, A1
			CO 3	C5, P4, A2
	Project and Presentation	25%	CO3	C5, P4, A2
Lab Quiz		25%	CO 1	C2, P1, A1
			CO 2	C4, P1, A1
			CO 3	C5, P4, A2
Total Marks		100%		

TEXT AND REFERENCE BOOKS

1. Avionics Fundamentals- Jeppesen; Highflyn.
2. Principles of Avionics - Albert Helfrick; Avionics Communication.
3. Digital Avionics Systems Principles and Practice - R. Spitzer; The Blackburn Press.
4. Antennas and Wave Propagation- 4th Edition, John D Kraus, Ronald J Marhefka.
5. Avionics Navigation Systems – Myron Kayton; Wiley-Interscience.
6. Elements of Electronic Navigation- N S Nagaraja; McGraw-Hill

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.15 EECE 497: Biomedical Signal Processing
Level-4, Term –I/II (Spring/ Fall Term)

COURSE INFORMATION			
Course Code	: EECE 497	Contact Hours	: 3.00
Course Title	: Biomedical Signal Processing	Credit Hours	: 3.00

PRE-REQUISITE	
Course Code: EECE 301 Course Title: Continuous Signal and Linear System	Course Code: EECE 311 Course Title: Digital Signal Processing I

CURRICULUM STRUCTURE
Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
The aim of the course is to develop the mind of the student in reaching a sound understanding of advanced topics in biomedical signal processing. It focuses on the leading-edge topics in biomedical signal processing such as digital filters, frequency analysis of signals, numerical processing techniques of biomedical signals, machine learning and applications of biomedical signals in real-life power technical problems.
OBJECTIVE
1. To impart the concepts of biomedical signal characteristics and learn about their frequency response. 2. To be skilled in designing filters and machine learning algorithm. 3. Be able to understand the numerical processing techniques and utilize them in engineering design.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to use the concept of digital signals and illustrate the idea in biomedical signal processing.	PO1	C3	1		4	T, F
CO2	Be proficient in **analysing** different biomedical signal characteristics and be able to **design** the practical filters.	PO10	C6	1	1		F, ASG, Pr
CO3	Capable of understanding different numerical techniques and machine learning algorithm and **apply** those techniques to solve the practical design problems.	PO9	C3				F, ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Systems and Digital Filters: Non-stationary, non-linear, non-Gaussian, Linear shift invariant system, Finite and infinite impulse response, auto regressive and moving average filters.

Frequency Analysis of Signals: Discrete Fourier transform and z-transform, Magnitude and phase response, Poles and zeros Stability, Convolution theorem, Linear versus circular convolution, Overlap-save implementation of linear convolution, Windowing, Discrete versus continuous time signals Sampling theorem, Pre-filtering, Down-sampling.

Numerical and Processing Techniques of Signals: Probability distribution and density function of 1D random, Conditional distribution and additive random variables, Normal distribution and the central limit theorem, Moments and Cumulants, Characteristic function, Gaussian, Poison, and Laplacian, Multivariate distributions, Covariance, Multivariate Gaussian, Product and convolutions of Gaussians, Conditional Gaussian (Shurr complement). Statistical independence, factorization, Bayes rule, prior, posterior, Probabilistic in ference, Markov and Wiener process Correlation, drift and variance, Probabilistic estimation, Maximum Likelihood, Maximum a-posteriori estimation (MAP).

Machine Learning: Linear discriminants - detection of motor activity from MEG Logistic regression, ROC curve, Test versus training set performance.

Applications of Biomedical Signals: Harmonic analysis - estimation of heart rate in ECG, Heart rate monitoring, Pitch detection, Auto-regressive model - estimation of the spectrum of 'thoughts' in EEG, Linear prediction, Spectral estimation, Matched and Wiener filter - filtering in ultrasound, Independent components analysis - analysis of MEG signals, Wavelets, PCA, ICA.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)

		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to use the concept of digital signals and illustrate the idea in biomedical signal processing.	3											
CO2	Be proficient in **analysing** different biomedical signal characteristics and be able to **design** the practical filters.			2							3		
CO3	Capable of understanding different numerical techniques and machine learning algorithms and **applying** those techniques to solve the practical design problems.	2								3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	48
Self-Directed Learning	94
Formal Assessment	05
Total	147

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Systems and Digital Signals**	CT 1
Class 1	Basic elements of a signal processing system	
Class 2	Advantages and classification of systems	
Class 3	Advantages and classification of systems (Contd.)	
Week 2	**Introduction to Systems and Digital Signals (Contd.)**	
Class 4	Introduction of digital filters: FIR and IIR filters	
Class 5	Characteristics of digital filters	
Class 6	Designing of FIR filters with window method	
Week 3	**Introduction to Systems and Digital Signals (Contd.)**	
Class 7	Designing of FIR filters with Frequency Sampling method	
Class 8	Designing of IIR filters with bi-linear Z-transform method	
Class 9	Designing of IIR filters with Least Square method	
Week 4	**Frequency Analysis of Signals**	
Class 10	Discrete Fourier transform and z-transform,	
Class 11	Magnitude and phase response, Poles and zeros Stability, Convolution theorem,	
Class 12	Pole location and time domain behaviour for causal signals	
Week 5	**Frequency Analysis of Signals (Contd.)**	CT 2
Class 13	Windowing, Discrete versus continuous time signals Sampling theorem,	
Class 14	Pre-filtering, Down-sampling	
Class 15	Linear versus circular convolution, Overlap-save implementation of linear convolution,	
Week 6	**Numerical and Processing Techniques of Signals (Contd.)**	
Class 16	Probability distribution and density function of 1D random	
Class 17	Conditional distribution and additive random variables	
Class 18	Normal distribution and the central limit theorem	
Week 7	**Numerical and Processing Techniques of Signals (Contd.)**	

Class 19	Moments and Cumulants, Characteristic function	
Class 20	Markov and Wiener process, Maximum a-posteriori estimation (MAP)	
Class 21	Gaussian, Poison, and Laplacian, Multivariate distributions	
Week 8	**Numerical and Processing Techniques of Signals (Contd.)**	Mid Term
Class 22	Covariance, Multivariate Gaussian	
Class 23	Product and convolutions of Gaussians	
Class 24	Conditional Gaussian (Shurr complement)	
Week 9	**Numerical and Processing Techniques of Signals (Contd.)**	
Class 25	Statistical independence, factorization,	
Class 26	Bayes rule, prior, posterior, Probabilistic inference	
Class 27	Correlation, drift and variance, Probabilistic estimation, Maximum Likelihood,	
Week 10	**Machine Learning**	
Class 28	Introduction to machine learning	
Class 29	Validations of test and train set data, Algorithms of machine learning	
Class 30	Logistic regression Algorithm and Linear Discriminant Algorithm	CT 3
Week 11	**Machine Learning (Contd.)**	
Class 31	Performance analysis of Machine learning	
Class 32	MSE, RMSE, Confusion matrix, optimal epochs	
Class 33	Detection of motor activity from MEG and ROC curve test	
Week 12	**Applications of Biomedical Signals**	
Class 34	Harmonic analysis - estimation of heart rate in ECG	
Class 35	Heart rate monitoring and Pitch detection	
Class 36	Auto-regressive model - estimation of the spectrum of 'thoughts' in EEG,	
Week 13	**Applications of Biomedical Signals (Contd.)**	
Class 37	Linear prediction and Spectral estimation	
Class 38	Matched and Wiener filter - filtering in ultrasound	
Class 39	Independent components analysis - analysis of MEG signals	
Week 14	**Applications of Biomedical Signals (Contd.)**	
Class 40	Wavelets, PCA and ICA.	
Class 41	Miscellaneous applications and current research work	
Class 42	Open Discussion	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessme nt (40%)	Class Test & Assignment 1-3	20%	CO 1	C2, C3
			CO 2	C6
			CO 3	C3
	Class Participation	5%	CO 2	C6
	Class Attendance	5%	-	-
	Mid term	10%	CO1	C2
Final Exam		60%	CO 2	C6
			CO 3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Eugene N. Bruce, Biomedical Signal Processing and Signal Modeling
2. Steven Kay, Fundamentals of Statistical Signal Processing, Prentice Hall, 1998
3. Monson H. Hayes, Statistical Digital Signal Processing and Modeling
4. Iranpour, R. and Chacon, P., Basic Stochastic Processes: The Mark Kac Lectures.

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.4.16 EECE 498: Biomedical Signal Processing Laboratory
Level-4, Term -II (Fall Term)

COURSE INFORMATION			
Course Code Course title	: EECE 498 : Biomedical Signal Processing Laboratory	Contact Hours Credit Hours	: 3.00 : 1.5

PRE-REQUISITE

Course Code: EECE 497
Course Title: Biomedical Signal Processing

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To teach and familiarize the students with the basic of bio-medical signal processing and analysis using MATLAB

OBJECTIVE

1. Be able to impart fundamental practical knowledge of signal processing techniques like sampling and quantization
2. Be able to make the students capable of time, frequency and Z-domain analysis of a signal.
3. Be able to apprise the students with the practical design of digital filters.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** the understanding of sampling, quantization, encoding techniques in the way of digitization of real-life signals.	PO1	C3, P3, A2	1		4	R,Q,T
CO2	Be able to **analyze** the analog and the digital signal both in time and in frequency domain.	PO2	C4,P4, A3	1		4	R,Q,T
CO3	Be able to **compute** Fourier series coefficients, Fourier transforms, Z-transforms, Laplace transforms of different analog, digital, continuous or discrete time signals.	PO9	C3	1			R,Q,T
CO4	Be able to **design** digital filters.	PO10	C6	2	2,3		PR, R,Q,T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 497 using different hardware equipment and simulation software

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **apply** the understanding of sampling, quantization, encoding techniques in the way of digitization of real-life signals.	3											
CO2	Be able to **analyze** the analog and the digital signal both in time and in frequency domain.		3										
CO3	Be able to **compute** Fourier series coefficients, Fourier transforms, Z-									3			

	transforms, Laplace transforms of different analog, digital, continuous or discrete time signals.												
CO4	Be able to **design** digital filters.										3		

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 10 10
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Presentation	 10 10 10 6 18
Formal Assessment Continuous Assessment Final Quiz	 6 1
Total	81

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Design Based Method

COURSE SCHEDULE

Week 1	Study of Sampling, Quantization and Encoding: Part – I (Uniform Quantization)
Week 2	Study of Sampling, Quantization and Encoding: Part – II (Non-uniform Quantization)
Week 3	Time Domain Analysis of Discrete Time Signals and Systems: Part – I (Response of LTI Systems: Convolution)
Week 4	Time Domain Analysis of Discrete Time Signals and Systems: Part – II (Difference Equations and Correlation)
Week 5	Z – Transform and Its Application: Part – I(Z and Inverse Z – Transform, Pole-Zero Plot and ROC)
Week 6	Z – Transform and Its Application: Part – II(Higher Order Stability Testing)
Week 7	Lab Test – I
Week 8	Frequency Domain Analysis of DT Signals and Systems: Part – I (DTFS, DTFT, DFT)
Week 9	Frequency Domain Analysis of DT Signals and Systems: Part – II (DFT)
Week 10	Frequency Domain Analysis of DT Signals and Systems: Part – II (Circular Convolution, Correlation, Modulation)
Week 11	FIR Filter Design
Week 12	Lab Test – II
Week 13	Project Submission
Week 14	Quiz test

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	C3, P3, A2
			CO 2	C4, P4, A3
			CO 3	C3
			CO4	C6
	Labtest-1, Labtest-2	30%	CO 1	C3, P3, A2
			CO 2	C4, P4, A3
			CO 3	C3

			CO 4	C6
	Project and Presentation	25%	CO4	C6
Lab Quiz		25%	CO 1	C3, P3, A2
			CO 2	C4, P4, A3
			CO 3	C3
			CO 4	C6
Total Marks		100%		

TEXT AND REFERENCE BOOKS

1. Eugene N. Bruce, Biomedical Signal Processing and Signal Modeling
2. Steven Kay, Fundamentals of Statistical Signal Processing
3. Monson H. Hayes, Statistical Digital Signal Processing and Modeling
4. Iranpour, R. and Chacon, P., Basic Stochastic Processes: The Mark Kac Lectures.
5. Digital Signal Processing: Principles, Algorithms and Applications – Proakis & Manolakis.
6. Digital Signal Processing using MATLAB – Ingle & Proakis.

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

5.2.4.17 CSE 491: Introduction to Embedded Systems
Level-4, Term –I/II (Spring/ Fall Term)

COURSE INFORMATION

Course Code	: CSE 491	Contact Hours	: 3.00
Course Title	: Introduction to Embedded Systems	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: CSE-109 Course Title: Computer Programming	Course Code: CSE-371 Course Title: Microprocessors and Interfacing

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To teach and familiarize the students with CPUs and its architectures, acquaint them with in depth knowledge on Python3 programming language. It is also targeted to provide them basic understanding on microcontrollers and introduction to Raspberry pi along with its application. Finally getting them first-hand experience on modern embedded systems and IoT to solve real life engineering problems.

OBJECTIVE

1. To familiarize the students about the basic architecture of CPUs’, microcontrollers and IoT devices.
2. To enhance students’ skill on building algorithms and program flow controls with python3.
3. To acquaint the students with the different working principle of classical and modern embedded systems and their use in the field of IoT.
4. To introduce the students with Linux OS and its functionalities.
5. To emphasize students’ ability on identifying and solving real life engineering-problems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom’s Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the mechanism of the internal blocks in various computers along with their basic architectures, instructions set and **illustrate** their differences.	PO1	C4			3	T, Mid, F
CO2	Be able to **develop** in depth knowledge in python3 language and	PO5	C5			6	T, Mid, F

	their implementation.						
CO3	Be able to **explain** IoT based systems, their application and incorporate them with the idea of IoT.	PO3	C2			5	T, F
CO4	Be able to **design** system based on their interfacing with microcontrollers and Raspberry pi and **solve** real-life engineering problems.	PO3	C1			5	F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Microcontroller and Raspberry pi: Introduction to Arduino (ATmega328p), Real life problem solving and system design with microcontrollers. Difference and relation between microprocessor and microcontroller. Application in production line and industrial automation. Working with Raspberry Pi, Installing OS and Designing Systems using Raspberry pi.

Python Concepts, Data Structures and Classes: Basics of the Python programming language for programming on the Raspberry Pi

Cloud server data storage and data access.

IoT: Internet of Things Promises, Definition, Scope, Sensors for IoT, Structure of IoT, IoT Map Device, Integrated IoT Sensors, Description & Characteristics**..**

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the mechanism of the internal blocks in various computers along with their basic architectures, instructions set and **illustrate** their differences.	2											
CO2	Be able to **develop** in depth knowledge in python3 language and their implementation.					3							
CO3	Be able to **explain** IoT based systems, their application and incorporate them with the idea of IoT.			3									
CO4	Be able to **design** system based on their interfacing with microcontrollers and Raspberry pi and **solve** real-life engineering problems.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment	 2

Final Examination	3
Total	131

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method
COURSE SCHEDULE

Week 1	**Central Processing Units (CPUs')**	CT 1
Class 1	Introduction to the Course content and Evaluation Process.	
Class 2	Introduction to Microcontrollers	
Class 3	Functional Block Diagram.	
Week 2	**Central Processing Units (CPUs')**	
Class 4	Memory Mapping	
Class 5	Addressing Modes	
Class 6	Register Mode	
Week 3	**Central Processing Units (CPUs')**	
Class 7	Indexed Mode	
Class 8	Introduction to functions	
Class 9	Interrupts	
Week 4	**Introduction to python**	CT 2
Class 10	Interpreter, Program Execution, Statements, Expressions	
Class 11	Program Execution, Statements, Expressions (contd.)	
Class 12	Statements, Expressions (contd.)	
Week 5	**Introduction to python**	
Class 13	Flow Controls	
Class 14	Flow Controls (contd.)	
Class 15	Flow Controls (contd.)	
Week 6	**Atmega Microcontroller**	
Class 16	Introduction to Arduino (ATmega328p)	
Class 17	Functionalities and architecture of Atmega.	
Class 18	I/O interfacing with Arduino.	
Week 7	**Atmega Microcontroller**	Mid Term
Class 19	Real life problem solving and system design with microcontrollers.	
Class 20	Difference and relation between microprocessor and microcontroller.	
Class 21	Application in production line and industrial automation.	
Week 8	**Raspberry pi**	
Class 22	Installing OS and Designing Systems using Raspberry pi	
Class 23	Getting introduced to Linux OS, Basic Linux commands and uses.	
Class 24	Interface sensor and Actuator with Raspberry Pi.	
Week 9	**IoT**	
Class 25	Internet of Things Promises, Definition, Scope	
Class 26	Sensors for IoT, Structure of IoT, IoT Map Device,	
Class 27	Integrated IoT Sensors, Description & Characteristics	
Week 10	**IoT**	CT 3
Class 28	Polytronics Systems, Description & Characteristics,	
Class 29	IoT Generation Roadmap.	
Class 30	Revision and discussion on scope of research.	
Week 11	**Introduction to Embedded Concepts**	
Class 31	Introduction to embedded systems, Application Areas, Categories of embedded systems	
Class 32	Overview of embedded system architecture, Specialties of embedded systems	
Class 33	recent trends in embedded systems, Architecture of embedded systems	

Week 12	Introduction to Embedded Concepts	
Class 34	Hardware architecture, Software architecture, Application Software, Communication Software.	
Class 35	Embedded Systems Categorization, Types of Embedded Systems	
Class 36	Features of Embedded System	
Week 13	**IoT Technologies for Embedded Computing**	
Class 37	Introduction, Properties of Devices and Applications	
Class 38	Hardware and Software Architecture of IoT	
Class 39	Efficiency at different stages	
Week 14	**SMART SENSORS**	
Class 40	Introduction, Primary Sensors ,Excitation, Amplification, Data Communication	
Class 41	Filters , Converters , Compensation, Information Coding/Processing	
Class 42	Standards for Smart Sensor Interface,The Automation.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C4
			CO2	C5
			CO3	C2
			CO4	C1
	Class Participation	5%		
	Class Attendance	5%		
	Mid term	10%	CO1	C4
			CO2	C5
Final Exam		60%	CO1	C4
			CO2	C5
			CO3	C2
			CO4	C1
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Microprocessors and Interfacing by Douglas V. Hall
2**.** Steven F.Barret, Daniel J Pack, ―Microcontroller Programming and Interfacing: Texas instruments MSP430‖, Morgan & Claypool Publishers, ISBN: 9781608457137
3**.** Mark Lutz, "Learning Python", O'Reilly Media, 5th Edition, 2016.
4. Dr. G Girardin, A. Bonnabel, Dr. E. Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024', Yole Development Copyrights ,2014
5. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.4.18 CSE 492: Introduction to Embedded Systems Laboratory
Level-4, Term-I (Spring)

COURSE INFORMATION

Course Code Course Title	: CSE 492 : Introduction to Embedded Systems laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: CSE 491
Course Title: Introduction to Embedded Systems.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
To teach and familiarize the with in depth knowledge on Python3 programming language. It is also targeted to provide them basic understanding on microcontrollers and their programming language. Introduction to Raspberry pi and Linux OS. Finally getting them first-hand experience on modern embedded systems and IoT with microcontrollers and sensors.

OBJECTIVE
1. To enhance students' skill on building algorithms and program flow controls with python3. 2. To acquaint the students with the different application of classical and modern microcontroller and IoT devices. 4. To introduce the students with Linux OS and its functionalities. 5. To emphasize students' ability on identifying and solving real life engineering-problems.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Be able to **apply** Python coding in solving mathematical and word problems.	PO4	P3			8	PR, Pr R,Q
CO2	Be proficient to **demonstrate** skills on Linux OS in Raspberry pi 3.	PO2	P3			4	R,Q,T
CO3	Be able to **implement** microcontrollers infield and **evaluate** their performance with sensors.	PO2	C5			3	R,Q,T
CO4	Be able to **discuss** and **perform** as a group and **assist** other group members during group projects and presentations.	PO10	A1, P5	1			PR,Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
In this course, students will perform experiments to practically verify the theories and concepts learned in CSE 491 using different hardware equipment and simulation software

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **apply** Python in solving mathematical and word problems.				2								
CO2	Be proficient to **demonstrate** skills on Linux OS in Raspberry pi 3.		2										
CO3	Be able to **implement** microco-ntrollers in field and **evaluate** their performance with sensors.		2										
CO4	Be able to **discuss** and **perform** as a group and **assist** other group members during group projects and presentations.										2		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports	 24

Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	6 6 5 26
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	120

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Familiarization with different microcontrollers.
Week 2	Control statements and program flow controls.
Week 3	Basic experiments with Atmega: - Blink, Digital Read Serial, Fade, and Read Analog Voltage.
Week 4	Temperature Sensor Interfacing, Bluetooth Interfacing. Motor driver Interfacing, LCD Interfacing (HD44780)
Week 5	Experiments with Atmega: Digital-Button, Digital Input Pullup, Blink Without Delay.
Week 6	Lab Test - I
Week 7	Implementation of IoT using Raspberry Pi & Python Programming: - LCD Interfacing, Motor driver Interfacing , Camera interface
Week 8	Implementation of IoT using Raspberry Pi & Python Programming: contd.
Week 9	Arduino coding and i/o operations.
Week 10	Arduino application. (Ultrasonic sensor, temperature sensor, LDR, motor shield)
Week 11	Arduino application. (Ultrasonic sensor, temperature sensor, LDR, motor shield)
Week 12	Lab Test - II
Week 13	Quiz and Viva
Week 14	Project Presenttion

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1, CO 2	P3
			CO 3, CO4	C5, P5
	Labtest-1, Labtest-2	30%	CO 1, CO 2	P3
			CO 3, CO4	C5, P5
	Project and Presentation	25%	CO 1, CO5	P3, A1, P5
Lab Quiz		25%	CO 1, CO 2	C3, P3
			CO 3, CO 4	C5, P5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEAXT AND REFERENCE BOOKS

1. Microprocessors and Interfacing by Douglas V. Hall
2. Steven F.Barret, Daniel J Pack, ―Microcontroller Programming and Interfacing: Texas instruments MSP430‖, Morgan & Claypool Publishers, ISBN: 9781608457137
3. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development, 2014

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

CHAPTER 6

COURSE OFFERED BY EECE DEPARTMENT TO THE STUDENTS OF OTHER DEPARTMENTS

Courses Offered to Other Departments in Term-I (Spring)

Ser	Offered to	Course Code	Course Title	Cr Hr	Level
1	CSE	EECE 163	Electrical Circuit Analysis	3	1
2	CSE	EECE 164	Electrical Circuit Analysis Sessional	0.75	1
3	CSE	EECE 269	Electrical Drivers and Instrumentation	3	2
4	CSE	EECE 270	Electrical Drives and Instrumentation Sessional	0.75	2
5	ME	EECE 159	Fundamentals of Electrical Engineering	3	1
6	NAME	EECE 382	Marine Electrical and Electronics Sessional	1.5	3
7	NSE	EECE 119	Fundamentals of Electrical Circuit Analysis	3	1
8	NSE	EECE 120	Fundamentals of Electrical Circuit Analysis Sessional	0.75	1
9	BME	EECE 191	Principles of Electrical Engineering	3	1
10	BME	EECE 192	Principles of Electrical Engineering Sessional	1.5	1
11	BME	EECE 291	Electronic Circuits and Devices	3	2
12	BME	EECE 292	Electronic Circuits and Devices Sessional	1.5	2
13	BME	EECE 391	Digital Electronics	3	3
14	BME	EECE 392	Digital Electronics Sessional	1.5	3
15	IPE	EECE 271	Electrical Machines and Electronics	3	2
16	IPE	EECE 272	Electrical Machines and Electronics Sessional	0.75	2
17	AE	EECE 161	Electrical Circuit Analysis I	3	1
18	AE	EECE 162	Electrical Circuit Analysis I Sessional	1.5	1
19	EWCE	EECE 167	Basic Electrical Technology	3	1

Courses Offered to Other Departments in Term-II (Fall)

Ser	Offered to	Course Code	Course Title	Cr Hr	Level
1	CSE	EECE 169	Electronic Devices and Circuits	3	1
2	CSE	EECE 170	Electronic Devices and Circuits Sessional	0.75	1
3	CSE	EECE 279	Digital Electronics and Pulse Technique	3	2
4	CSE	EECE 280	Digital Electronics and Pulse Technique Laboratory	0.75	2
5	CE	EECE 165	Basic Electrical Technology	3	1
6	ME	EECE 173	Electrical and Electronics Technology	3	1
7	ME	EECE 174	Electrical and Electronics Technology Sessional	1.5	1
8	NAME	EECE 281	Marine Electrical and Electronics	4	2
9	NSE	EECE 221	Electrical and Electronics Technology	3	2
10	NSE	EECE 222	Electrical and Electronics Technology Laboratory	1.5	2
11	PME	EECE 261	Fundamentals of Electrical and Electronic Engineering	3	2
12	PME	EECE 262	Electrical and Electronic Engineering Lab	1.5	2
13	IPE	EECE 171	Basic Electrical and Electronic Circuit	3	1
14	IPE	EECE 172	Basic Electrical and Electronic Circuits Sessional	0.75	1
15	Arch	EECE 3251	Building Services III: Electrical Equipment	2	3

6.1. Department of Computer Science and Engineering (CSE)

6.1.1. EECE 163: Electrical Circuit Analysis
Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code	: EECE 163	Lecture Contact Hours	: 3.00
Course Title	: Electrical Circuit Analysis	Credit Hours	: 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The foundational course on electrical circuits is a basis of making freshmen engineering students well familiarize about the arena of DC and AC circuits. The course is aimed towards the methods of electric circuit analysis and evaluating their responses which can be very well achieved by the understanding of circuit laws, techniques and theorems for both AC and DC excitations. Investigation of first and second order DC circuits is vital in understanding circuit elements like capacitors and inductors used in daily life. A hands-on flavour of the poly phase circuits will enhance the practical knowledge, which addresses the issue of faults and power in the transmission lines. Although the course may seem somewhat rudimentary in its design, it imprints the groundwork for engineers who may pursue advanced course on electrical engineering.

OBJECTIVE

1. **Create** a foundation of basic electrical engineering and circuits.
2. **Familiarize** students with basic circuit laws (Ohm, Kirchhoff), techniques (Mesh, Nodal), concepts (Superposition, Source Transformation) and theorems (Thevenin, Norton).
3. **Develop** the understanding of AC steady state response of single-phase circuits and power in AC circuits.
4. **Introduce** students to poly-phase circuits as a practical arena of AC Circuits.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Capable to **interpret** circuit laws and **apply** their corresponding technique to find circuit quantities; also **justify selection** particular circuit concept(s) and theorem(s) for simplifying complex circuits.	PO1	C5	P1	-	3	T, F
CO2	Competent in **analyse** 1st and 2nd-order circuits and **evaluate** the responses both in the presence and absence of dc circuits.	PO1	C4	P1		2,3	T, MT
CO3	Manage to **outline** sinusoids and phasors in **explaining** circuit parameters and **analysing** AC power.	PO1	C2			1	F, MT
CO4	Able to **understand** the current voltage relation of 3 phase circuits for different configure-tions and **reproduce** knowledge of AC power to **analyze** real life power consumptions of transmission lines.	PO3	C2	P1		5	F, ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Fundamental electrical concepts and measuring units; Direct current (dc): Current, voltage, resistance, power and energy; Series/Parallel Circuits; Methods of network analysis and Network Theorems; Capacitors, Inductors and introduction to magnetic circuits. Alternating current (ac): Instantaneous current, voltage and power for various combinations of R, L and C circuits; Effective current and voltage, average power; Phasor representation of sinusoidal quantities;

Sinusoidal Single-Phase Circuit Analysis; Introduction to three phase circuits; Power factor and power equation (Δ and Y circuits).

CO-PO MAPPING

N .	Course Outcome	PROGRAM OU COMES (PO)											
		1		3	4	5	6	7	8	9	1	11	12
CO1	Capable to **interpret** circuit laws and **apply** their corresponding technique to find circuit quantities (Voltage and Current); also **justify selection** particular circuit concept(s) and theorem(s) for simplifying complex circuits.	3											
CO2	Competent in **analyze** first-order and second-order circuits and **evaluate** the responses both in the presence and Absence of DC circuits.	2											
CO3	Manage to **outline** sinusoids and phasors in **explaining** circuit parameters and **analysing** AC power.	2											
CO4	Able to **understand** the current voltage relation of 3 phase circuits for different configurations and **reproduce** knowledge of AC power to **analyze** real life power consumptions of Transmission lines.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	84
Formal Assessment	05
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week	Lecture	Topics	Assessment Methods
Week 1	Lecture 1	Charge and Current, Voltage, Power and Energy	CT 1
	Lecture 2	Circuit Elements, Relevant Practice Problems	
	Lecture 3	Ohm's Law; Nodes, Branches and Loops; Kirchhoff's Laws	
Week 2	Lecture 1	Series Resistors and Voltage Division, Parallel Resistors and Current Division, Wye-Delta Transformations	
	Lecture 2	Nodal Analysis, Nodal Analysis in Circuits with Supernodes	
	Lecture 3	Mesh Analysis, Mesh Analysis in Circuits with Supermesh	
Week 3	Lecture 1	Nodal and Mesh Analysis problems	
	Lecture 2	Superposition Theorem	CT 2
	Lecture 3	Practice Problems Relevant to Superposition Theorem	

Week 4	Lecture 1	Thevenin's Theorem	
	Lecture 2	Practice Problems Relevant to Thevenin's Theorem	
	Lecture 3	Norton's Theorem	
Week 5	Lecture 1	Practice Problems Relevant to Norton's Theorem	
	Lecture 2	Electrical Properties of Capacitors, Series and Parallel Capacitors	
	Lecture 3	Electrical Properties of Inductors, Series and Parallel Inductors	
Week 6	Lecture 1	Source Free RC Circuits	
	Lecture 2	Source Free RL Circuits	
	Lecture 3	Source Free RLC Circuits	
Week 7	Lecture 1	Step Response of a RC Circuit	MID TERM
	Lecture 2	Step Response of a RL Circuit	
	Lecture 3	Step Response of a RLC Circuit	
Week 8	Lecture 1	Introduction time varying sinusoid excitations	
	Lecture 2	Concept of phasor and complex impedance / admittance	
	Lecture 3	Analysis of series and parallel circuits	
Week 9	Lecture 1	Network reduction; voltage and current division	
	Lecture 2	Basic idea about Source transformation	
	Lecture 3	Introduction to Instantaneous power and Average power	
Week 10	Lecture 1	Power factor, complex power, power triangle, maximum average power	
	Lecture 2	AC power measurement and power conservation.	
	Lecture 3	Tie-set and Cut- set schedules	
Week 11	Lecture 1	Formulation of equilibrium equations in matrix form	
	Lecture 2	Solution of resistive networks	
	Lecture 3	Maximum power transfer theorems for variable resistance load	
Week 12	Lecture 1	Variable impedance load– Statement and applications	CT 3 or ASG+Pr
	Lecture 2	Introduction: Graph of a network, Concept of tree and co-tree, incidence matrix	
	Lecture 3	Balanced Poly phase Circuits	
Week 13	Lecture 1	Voltage current relations and power measurement.	
	Lecture 2	Unbalanced poly phase circuit	
	Lecture 3	Power measurement and faults analysis	
Week 14	Lecture 1	Assorted problems on poly phase circuits	
	Lecture 2	Practical Applications of Electrical Circuit analysis	
	Lecture 3	Summary, Review and Open discussion	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Test 1-3	20%	CO1	C5
			CO2	C4
	Class Participation	5%	CO4	C2
	Class Attendance	5%	-	-
	Mid term	10%	CO2, CO3	C2, C4
Final Exam		60%	CO1	C5
			CO3	C2
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective

Domain)
TEXT AND REFERENCE BOOKS
1. Fundamentals of Electric Circuit by C. K. Alexander & M. N. Sadiku 2. Introductory Circuit Analysis by R. L. Boylestad 3. Alternating Current Circuits by G. S. Corcoran & R. F. Kerchner 4. Electric Circuits by James William Nilsson

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.1.2. EECE 164: Electrical Circuit Analysis Sessional

Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 164 : Electrical Circuit Analysis Sessional	Lecture Contact Hours Credit Hours	: 1.50 : 0.75
PRE-REQUISITE			
Course Code: EECE 163 Course Title: Electrical Circuit Analysis			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course of electrical engineering discipline aims to familiarize the students with implementation of basic electrical circuits in hardware domain. Designed for fresher students, experiments of this laboratory course will enable them to assemble beginner-level circuits to experimentally verify some fundamental circuit laws and theorems (KVL, KCL, Thevenin, Norton). This course also familiarizes the students with hardware implementation of AC circuits and measurement of ac quantities by oscilloscope. Finally, this course is targeted to introduce the students with hardware projects that will provide them with the first hand on experience about application of electrical engineering in real life and simulation of electrical circuits in a widely used simulation software (Proteus).			
OBJECTIVE			
1. To enable the students to apply the fundamental circuit laws (KVL, KCL, Ohm's law) in the hardware domain. 2. To develop students' skills to simplify complex electrical circuits into simpler circuits by Thevenin and Norton's theorem and verify them in hardware. 3. To teach the students the basic operation of the oscilloscope to measure AC quantities (magnitude and phase). 4. To impart the students the skills of analogue filter design by RLC circuit. 5. To familiarize the students with implementation of hardware electrical projects and a circuit simulation software (Proteus)			

COURSE OUTCOMES& GENERIC SKILLS

No.	Course Learning Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **assemble** electrical circuits that can **verify** fundamental electrical laws (KVL, KCL and Ohm's Law)	PO9	P5, A3	1			R, Q, T
CO2	Be adept to **set up** circuits to **justify** Thevenin's law and Norton's law in electrical circuits.	PO10	P5, A3	1			R, Q, T
CO3	Be adept to **produce** desired ac	PO5	P6	1		6	R, Q, T

	waves and **measure** amplitude and phase of ac waves in oscilloscope, **design** analogue RLC filter that can produce desired frequency response.						
CO4	Be able to develop collaborating nature by **completing** a simple project in both software and hardware and **performing** group activities.	PO9	P7, A4	2	1		PR, R, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT-Mid Term Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 163 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **assemble** electrical circuits that can **verify** fundamental electrical laws (KVL, KCL and Ohm's Law)									3			
CO2	Be adept to **set up** circuits to **justify** Thevenin's law and Norton's law in electrical circuits.										3		
CO3	Be adept to **produce** desired ac waves and **measure** amplitude and phase of ac waves in oscilloscope, **design** analogue RLC filter that can produce desired frequency response.					3							
CO4	Be able to develop collaborating nature by **completing** a simple project in both software and hardware and **performing** group activities.									3			

(3 – High, 2- Medium, 1-low)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 7 14 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz	 6 6 5 6
Engagement in Group Projects	10
Formal Assessment Continuous Assessment	 6

Final Examination	1
Total	61

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Class	Topic
1	Construction and operation of simple electrical circuits
2	Verification of KVL and KCL
3	Verification of Superposition Theorem and Thevenin's Theorem
4	Familiarization with alternating current (ac) waves
5	Study of R-L-C series circuit
6	Different types of filters and its characteristics with different input frequency
7	Lab test, Quiz and Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (75%)	Lab participation and Report	20%	CO1	P5, A3
			CO2	P5, A3
			CO3	P6
			CO4	P7, A4
	Labtest-1 ,Labtest-2	30%	CO1	P5, A3
			CO2	P5, A3
			CO3	P6
			CO4	P7, A4
	Project and Presentation	25%	CO4	P7, A4
Lab Quiz		25%	CO1	P5, A3
			CO2	P5, A3
			CO3	P6
			CO4	P7, A4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Fundamentals of Electric Circuit by C. K. Alexander & M. N. Sadiku
2. Introductory Circuit Analysis by R. L. Boylsted
3. Alternating Current Circuits by G. S. Corcoran & R. F. Kerchner
4. Electric Circuits by James William Nilsson Inc.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.1.3. EECE 169: Electronic Devices and Circuits
Level-1, Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 169	Lecture Contact Hours	: 3.00
Course Title	: Electronic Devices and Circuits	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 163
Course Title: Electrical Circuit Analysis

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This subject is classified under the applied technology group and is strongly intended to teach the students the concepts, principles and working of basic electronic components and their implementations on circuits. It is targeted to provide a basic foundation for technology areas like electronics devices, communication systems, industrial electronics as well as instrumentation, control systems and various electronic circuit design.

OBJECTIVE

1. To be able to understand the basics of electronic devices like diode, Transistor, MOSFET etc and their applications.
2. To be able to differentiate between the working principal of different electronic components.
3. To become skilled at designing different electronic circuits like rectifier, amplifiers etc.
4. To apply theoretical knowledge for solving complex mathematical problems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Be able to **explain** the basic operation of diodes, BJT, MOSFET, JFET, Op-Amp, oscillators, TRIAC, DIAC and their characteristics to solve engineering problems.	PO1	C2			1,3	T, MT
CO2	Be adept to **compare** the characteristics of different types of diodes, transistors, OP-Amp and oscillators.	PO1	C3			1	T, MT, F
CO3	Be capable to **solve** various mathematical problems to meet specific design criteria.	PO3	C3			5	F, ASC
CO4	Be capable to **apply** the knowledge of semiconductor diodes, BJT, MOSFET, JFET, Op-Amp etc to solve real life engineering problems such as rectification, switching and amplification	PO3	C5			5	F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to semiconductors: p type and n type semiconductors, p-n junction diode characteristics.
Diode applications: Half and full wave rectifiers, clipping and clamping circuits, regulated power supply using Zener diode.
Bipolar Junction Transistor (BJT): Principle of operation, I-V characteristics, transistor circuit configurations (CE, CB, CC), BJT biasing, load lines, BJTs at low frequencies, hybrid model- h parameters, simplified hybrid model, small signal analysis of single and multi-stage amplifiers, frequency response of BJT amplifiers.
Field Effect Transistor (FET): Principle of operation of JFET and MOSFET, depletion and enhancement type NMOS and PMOS, biasing of FETs, low and high frequency models of FETs, switching circuits using FETs, introduction to CMOS.
Operational Amplifiers (OP-AMPS): Linear applications of OPAMPs, gain, input and output

impedances; active filters, frequency response and noise.
Introduction to oscillators SCR, TRIAC, DIAC and UJT: Characteristics and applications, Introduction to IC fabrication processes.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **explain** the basic operation of diodes, BJT, MOSFET, JFET, Op-Amp, oscillators, TRIAC, DIAC and their characteristics to solve engineering problems.	3											
CO2	Be adept to **compare** the characteristics of different types of diodes, transistors, OP-Amp and oscillators.	3											
CO3	Be capable to **solve** various mathematical problems to meet specific design criteria.			3									
CO4	Be capable to **apply** the knowledge of semiconductor diodes, BJT, MOSFET, JFET, Op-Amp etc to solve real life engineering problems such as rectification, switching and amplification.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Self-Directed Learning Non-face-to-face learning Revision Assessment Preparations	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week	Lecture	Topics	Assessment Methods
1	Class 1	Basic ideas and example about Electronics	CT 1
	Class 2	comparison between electronic and electrical equipment and their application	
	Class 3	Introduction to semiconductor devices and its classifications	

2	Class 4	P-type and N-type materials and doping	
	Class 5	Semiconductor diode and its band diagram	
	Class 6	Biasing of semiconductor diodes	
3	Class 7	I-V characteristics of diode and equivalent circuit of diodes, Shockley's equation	
	Class 8	Zener diode and related math	
	Class 9	Applications of diode	
4	Class 10	Diode rectifiers	CT 2
	Class 11	Ripple factor and related mathematical problems.	
	Class 12	Clipper circuit and related problems	
5	Class 13	Clamper circuit and related problems	
	Class 14	Diodes in voltage multiplier circuit	
	Class 15	Voltage doubler, Tripler and quadrupler circuit	
6	Class 16	Introduction to BJT and construction	
	Class 17	Working principle, operating regions of BJT	
	Class 18	BJT configurations and characteristics curves	
7	Class 19	BJT Biasing circuits, BJT as an amplifier, biasing the BJT for discrete circuits	
	Class 20	Small signal equivalent circuit models	
	Class 21	BJT as a switch and mathematical problems	
8	Class 22	Introduction to FET and comparative studies between BJT and FET	MT
	Class 23	Construction and operation of JFET	
	Class 24	Mathematical problems related to JFET	
9	Class 25	Small signal analysis of JFET	
	Class 26	Mathematical problems	
	Class 27	Mathematical problems	
10	Class 28	Introduction to MOSFET, Construction and operating principle	
	Class 29	Types and Characteristics curve of MOSFET	
	Class 30	Biasing of MOSFET and related problems	
11	Class 31	Threshold voltage, Body effect, current-voltage characteristics of enhancement MOSFET	
	Class 32	Single-stage MOSFET, multi stage MOSFET and application of MOSFET as switch.	
	Class 33	Introduction to CMOS circuits	
12	Class 34	Basics of Operational Amplifier.	CT-3
	Class 35	Different types of operational amplifier and introduction to Filters	
	Class 36	Mathematical problems related to op-amp	
13	Class 37	Basic Principle of oscillation	
	Class 38	Different type of oscillators	
	Class 39	Mathematical problems	
14	Class 40	Concepts of negative feedback	
	Class 41	Characteristics and applications of SCR, TRIAC, DIAC and UJT	
	Class 42	Review class	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous	Test 1-3	20%	CO1	C2

Assessment (40%)			CO2	C3
	Class Participation	5%		
	Class Attendance	5%		
	Mid term	10%	CO1	C2
			CO2	C3
Final Exam		60%	CO2	C3
			CO3	C3
			CO4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Electronic Devices and Circuit Theory -Robert L. Boylestad and Louis Nashelsky
2. Micro Electronics Circuits-Adel S. Sedra & Keneth C. Smith-Oxford University Press
3. Operation Amplifiers and Linear Integrated Circuits-Robert F. Coughlin-Prentice Hall of India Private Limited

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.1.4. EECE 170: Electronic Devices and Circuits Sessional
Level-1, Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 170	Contact Hours	: 1.50
Course Title	: Electronic Devices and Circuits Sessional	Credit Hours	: 0.75

PRE-REQUISITE

Course Code: EECE 169
Course Title: Electronic Devices and Circuits

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Electronics Devices and Circuits Sessional course is designed to familiarize the students with some basic electronic components and to examine the characteristics and working of these components in electronic devices and circuits by hand-held experiments and computer aided simulation tool. After being acquainted with these basic components, students will be able to apply the achieved knowledge to implement electronic devices to perform different mathematical operations and to design oscillator circuits for practical purpose.

OBJECTIVE

1. To enable the students to implement circuits using different electronic components like diode, BJT and JFET and analyze working principles and input/output characteristics of these components.
2. To provide the students ability to implement electronic circuits like rectifier, OP-AMP circuits to perform different mathematical operations and oscillator circuits for applications in real life engineering.
3. To introduce the students with the use of circuit simulation software PSpice Schematics in analyzing electronic circuits and thereby enrich their skills in designing various complex electronic circuits.
4. To augment student's creative thinking, communication and project management skills through projects and presentations.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to analyze the characteristics of various types of active and passive electronic components by constructing simple circuits using these elements.	PO5	P2			6	R, Q, T
CO2	Be able to construct basic electronic devices to perform different mathematical operations and construct oscillator circuits.	PO5	P4			6	R, Q, T
CO3	Be able to construct an electronic device for application in real life adapting the desired requirements.	PO9	P5	1			PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 169 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO 1	Be able to analyze the characteristics of various types of active and passive electronic components by constructing simple circuits using this element.					3							
CO 2	Be able to construct basic electronic devices to perform different mathematical operations and construct oscillator circuits.					3							
CO 3	Be able to **construct** an electronic device for application in real life **adapting** the desired requirements using both hardware and simulation tools.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 14 28
Self-Directed Learning Preparation of Lab Reports	 30
Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	4 5 5 24
Formal Assessment	

Continuous Assessment Final Quiz	10 1
Total	121

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Study of Diode Characteristics using Hardware implementation and simulation in PSpice Schematics
Week 2	Implementation of Diode Rectifier Circuits and study their rectification characteristics using Hardware implementation and simulation in PSpice Schematics.
Week 3	Construction of n-p-n CE (common emitter) and CB (common base) transistor and determine their input and output characteristics using Hardware implementation and simulation in PSpice Schematic.
Week 4	Study of Characteristics of Junction Field Effect Transistor (JFET) using Hardware implementation and simulation in PSpice Schematic.
Week 5	Mathematical operations using OP-AMP (Adder and Subtractor) using hardware implementation and simulation in PSpice Schematic.
Week 6	Mathematical operations using OP-AMP (Integrator and Differentiator) using hardware implementation and simulation in PSpice Schematic.
Week 7	Lab Test, lab quiz and viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	P2
			CO 2	P4
	Labtest-1, Labtest-2	30%	CO 1	P2
			CO 2	P4
	Project and Presentation	25%	CO3	P5
Lab Quiz		25%	CO 1	P2
			CO 2	P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electronic Devices and Circuit Theory -Robert L. Boylestad and Louis Nashelsky
2. Micro Electronics Circuits-Adel S. Sedra & Keneth C. Smith-Oxford University Press
3. Operation Amplifiers and Linear Integrated Circuits-Robert F. Coughlin-Prentice Hall of India Private Limited

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.1.5. EECE 269: Electrical Drivers and Instrumentation
Level-2, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 269 : Electrical Drivers and Instrumentation	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE 163 Course Title: Electrical Circuit Analysis			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To familiarize students with electrical energy conversion devices and deliver fundamental knowledge on electrical measurement and instrumentation systems. The course is designed with the contents of electrical machines construction, operating principles, characteristics and applications. Students will also be able to learn different electrical measurement and instrumentation techniques, data conditioning and telemetry devices for engineering applications			
OBJECTIVE			
1. To appraise the operating principle and constructional details of transformer, motor, generator. 2. To develop understanding on practical use of energy conversion devices. 3. To impart the knowledge of electrical measurement system components and measurement methods. 4. To develop the ability to analyse measurement data and determine performance metrics.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be proficient to **describe** the operating principles of generator, motor and transformer and be able to **demonstrate** the practical application.	PO1	C2	1	1	3	T, F
CO2	Be capable to **understand** the basics of electrical measurement systems and **explain** their characteristics and different measurement methods.	PO1	C2, A2			3	F ASG,Pr
CO3	Be adept in **analyzing** measurement data and performance of measurement systems using modern tools.	PO5	C2			6	Mid Term

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Three phase circuits, alternators and transformers, principles & operation of DC Machines, synchronous, induction, universal and stepper motors, thyristor and microprocessor-based speed control of motors.

Instrumentation amplifiers: Differential, logarithmic, and chopper amplifiers, frequency and voltage measurements using digital techniques, recorders and display devices, spectrum analyzers and logic analyzers, data acquisition and interfacing to microprocessor-based systems.

Transducers: Terminology, types of transducers, principles and applications of photovoltaic, piezoelectric, thermoelectric, variable resistance and opto-electronics transducers. Noise reduction in instrumentation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient to **describe** the operating principles of generator, motor and transformer and be able to **demonstrate** the practical application.	2											
CO2	Be capable to **understand** the basics of electrical measurement systems and **explain** their characteristics and different measurement methods.	3											
CO3	Be adept in **analyzing** measurement data and performance of measurement systems using modern tools					3							

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	48
Self-Directed Learning	94
Formal Assessment	05
Total	147

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**DC Generator**	
Class 1	Overview of Electrical Energy conversion	
Class 2	Introduction to DC generator and its principle of operation	
Class 3	Commutation principle and slip rings	
Week 2	**DC Generator**	
Class 4	Construction of DC generator and different parts	
Class 5	Lap winding and wave winding and its comparison	
Class 6	Emf equation of DC generator and related mathematical problems	
Week 3	**DC Motor**	
Class 7	Construction and operating principle of DC motor	
Class 8	Flemings right hand rule and left-hand rule, conversion of energy	CT 1
Class 9	Differences between DC generator and DC motor	
Week 4	**DC Motor**	
Class 10	Back emf and related equations for DC motor	
Class 11	Speed control, Torque –speed characteristics of different types DC motors.	
Class 12	Related mathematical problems of DC motor	
Week 5	**Transformer**	
Class 13	Introduction to Transformer and its principle of operations	CT 2

Class 14	Types of transformer and ideal characteristics	
Class 15	Equivalent circuit of Transformer	
Week 6	**Transformer**	
Class 16	Vector diagrams of transformer under different conditions	
Class 17	Mathematical problems of Transformer	
Class 18	Losses in transformer and their explanations	
Week 7	**Synchronous Generator**	MID
Class 19	Synchronous Generator: Operating principle	
Class 20	Excitation systems of Synchronous Generator	
Class 21	equivalent circuit of synchronous Generator	
Week 8	**Instruments & Measurement overview**	
Class 22	Introduction on Measurement and instrumentation	
Class 23	Basic requirements, significance and methods of measurement.	
Class 24	Functional elements of a generalized measurement system and classification of instruments.	
Week 9	**Transducers**	
Class 25	Transducers: Introduction, advantage of using Electrical Transducers	
Class 26	Resistance, Inductance and Capacitive transducer	
Class 27	Hall effect transducer and Optical transducer.	
Week 10	**Transducers**	
Class 28	Thermocouple, Resistance Temperature Detector and Thermistor.	
Class 29	Thermal Imaging- Applications, Measurement of Strain	
Class 30	Measurement of Force (piezoelectric sensors) and Torque.	
Week 11	**Noise Performance Analysis**	
Class 31	Noise in a measurement system: Typical source of noise in a measurement system.	
Class 32	Types of noise in measurement system- Electromagnetic Interference, Inductive and Capacitive coupling.	
Class 33	Techniques for compensation of noise: Shielding, Filtering and Ground isolation.	
Week 12	**Signal Conditioning**	CT 3
Class 34	Overview of signal conditioning: Noise elimination and compensation, Amplification, Linearization.	
Class 35	Different methods in use: A\D and D\A conversion for suitable output devices and data acquisition.	
Class 36	A\D converters: Basics, techniques- parallel/flash, single slope (ramp), successive approximation, sample and hold circuit	
Week13	**Instrumentation Amplifiers**	
Class 37	Different instrumentation amplifier, Operation amplifiers	
Class 38	Application of amplifiers, filters for signal conditioning	
Class 39	Data Acquisition system: Microprocessor and embedded system applications.	
Week 14	**Data Transmission, Telemetry and Data Presentation**	
Class 40	Current, Voltage and Frequency telemetry. Telemetry Applications	
Class 41	Various types of display devices and their interfacing and applications	
Class 42	Practical measurement system analysis and Review	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment	Class Test & Assignment 1-3	20%	CO 1	C3
			CO 2	C6

(40%)	Class Participation	5%	CO 2	C6
	Class Attendance	5%		
	Mid term	10%	CO3	C3
Final Exam		60%	CO 1	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electrical Machinery Fundamentals- Stephen J Chapman
2. A Textbook of Electrical Technology - B.L Theraja
3. A Course in Electrical and Electronic Measurements and Instrumentation by A. K. Sawhney
4. Electronic Instruments and Instrumentation Technology', by M. M. S. Anand

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.1.6. EECE 270: Electrical Drives and Instrumentation Sessional
Level-2, Term-I (Spring)

COURSE INFORMATION

Course Code	: EECE-270	Contact Hours	: 1.50
Course Title	: Electrical Drives and Instrumentation Sessional	Credit Hours	: 0.75

PRE-REQUISITE

Course Code: EECE 269
Course Title: Electrical Drives and Instrumentation.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To help the students to explore various DC and AC machines and put theory in practice. Our mission is to expose students to the constructions of electrical machines and analyze their performance. This course is targeted to verify the properties of generator, motor etc. and relate them with their theoretical knowledge. Our aim is to give the students the basic idea of how these machines fit in large context. This course is also designed to give the students the basic idea of electronic instrumentation system.

OBJECTIVE

1. Be able to familiarize the students with the basic electrical machines like transformer, dc generator, dc motor, alternator etc.
2. Be able to calculate various parameters of machines like voltage regulation, efficiency etc., observe their behaviour under various load conditions and compare them.
3. To impart the basic knowledge of electrical control system and instrumentation.
4. To impart practical knowledge on electrical machine crafting and develop collaborative learning skill.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **compute** the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and **justify** these characteristics under various loading condition.	PO9	P3		1		R, Q, LT
CO2	Be able to **identify** the	PO5	P4	1	1	6	R, Q, LT

	characteristics of electrical machines like dc generator, dc motor, alternator, etc.						
CO3	Be able to **apply** the basic idea of control system through the controlling of water level and water flow by feedback transducer.	PO9	P4	1	1		R, Q, LT
CO4	Be able to **perform** project task and **design** electrical machine **adapting** to requirement.	PO10	P6	1	1,3,5		T, PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 269 using different hardware equipment and simulation software

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **compute** the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and **justify** these characteristics under various loading condition.									3			
CO2	Be able to **identify** the characteristics of electrical machines like dc generator, dc motor, alternator etc.					2							
CO3	Be able to **apply** the basic idea of control system through the controlling of water level and water flow by feedback transducer.									3			
CO4	Be able to **perform** project task and **design** electrical machine **adapting** to requirement.										2		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	7
Lecture	14
Practical	21
Self-Directed Learning	
Preparation of Lab Reports	6
Preparation of Lab Test	5
Preparation of presentation	5
Preparation of Quiz	6
Engagement in Group Projects	10
Formal Assessment	

Continuous Assessment Final Examination	6 1
Total	60

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method.

COURSE SCHEDULE

Class 1	Expt-01: Computing the regulation of the Transformer in Various Loads.
Class 2	Expt-02: Study the properties of DC self and separately excited shunt generator.
Class 3	Expt-03: Identifying the characteristics of DC shunt motor & calculating the efficiency.
Class 4	Expt-04: Study the properties of Three-Phase Alternator in various loads.
Class 5	Expt-05: Flow rate control of water by feedback transducer
Class 6	Expt-06: Water level control by feedback transducer.
Class 7	Lab Test, Quiz, Project Presentation and viva

ASSESMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Participation and Report	20%	CO1	P3
			CO2	P4
			CO 3	P4
	Labtest	30%	CO1	P3
			CO2	P4
			CO 3	P4
	Project and Presentation	25%	CO4	P6
Lab Quiz		25%	CO 1	P3
			CO 2	P4
			CO 3	P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electrical Machinery Fundamentals- Stephen J Chapman.
2. Electrical machinery and Transformer – Irving L. Kosow.
3. Electrical machines- Samarjit Ghosh.
4. A Textbook of Electrical Technology - B.L Theraja.
5. Direct and Alternating Current Machinery – Jack Rosenblatt & Friedman

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.1.7. EECE 279: Digital Electronics and Pulse Technique
Level-2, Term-II (Fall)

COURSE INFORMATION

Course Code Course Title	: EECE 279 : Digital Electronics and Pulse Technique	Contact Hours Credit Hours	:3.00 :3.00

PRE-REQUISITE

Course Code: EECE 169
Course Title: Electronic Devices and Circuits

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize the basic logic gates as well as to be able to design various combinational and sequential circuits using logic gates.

OBJECTIVE

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronic circuits.
2. To prepare students to perform the analysis and design of various combinational and sequential circuits using gates.

COURSE OUTCOMES& GENERIC SKILLS

No.	Course Learning Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
1.	Identify the structure of various number systems and **interpret** its application in digital design.	PO1	C2			3	T,ASG,F
2.	**Design** various combinational and sequential circuits.	PO3	C6	2		5	T,MT,ASG, F
3.	**Analyze** the memory elements, state table and state diagrams of the sequential circuit.	PO3	C4			5	MT,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term)

COURSE CONTENT

Introduction to number systems and codes.
Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, binational logic design, minimization of combinational logic.
Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin and power dissipation. Power optimization of basic gates and combinational logic circuits.
Modular combinational circuit design: Pass transistor, pass gates, multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements and ALU design. Programmable logic devices: Logic arrays, field programmable logic arrays and programmable read only memory. Sequential circuits: Different types of latches, flip-flops and their design using ASM approach, timing analysis and power optimization of sequential circuits. Modular sequential logic circuit design: shift registers, counters and their applications.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
1.	Identify the structure of various number systems and **interprets** application in digital design.	3											
2.	**Design** various combinational and sequential circuits.			2									
3.	**Analyze** the memory elements, state table and state diagrams of the sequential circuit.			2									

(3 – High, 2- Medium, 1-low)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42

Lecture Practical / Tutorial / Studio Student-Centred Learning	- -
Self-Directed Learning Non-face-to-face learning Revision Assessment Preparations	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week	Lecture	Topics	Assessment Methods
1	1	Number base conversion	CT-1
1	2	Complements and related problems	
1	3	Binary codes	
2	4	Basic theories and properties of Boolean Algebra	
2	5	Canonical and standard forms	
2	6	Mathematical problems on Boolean Algebra	
3	7	Simplification of Boolean functions through Map method	
3	8	Product of Sums simplification	
3	9	NAND and NOR implementation	
4	10	Simplification with Don't Care conditions	CT-2
4	11	The Tabulation method of simplification	
4	12	Related mathematical problem solving	
5	13	Introduction to Combinational Logic	
5	14	Discussion on Design procedure	
5	15	Adders and subtractors	
6	16	Code conversion	
6	17	Boolean function implementations	
6	18	Exclusive-OR AND equivalence functions	
7	19	Parity generation and checking	MID
7	20	Combinational logic with MSI and LSI	
7	21	Coder/decoder and multiplexer/ de-multiplexer design.	
8	22	Modular combinational circuit design: Pass transistor, pass gates	
8	23	Multiplexer, demultiplexer and their implementation in CMOS	
8	24	Decoder, encoder, comparators, binary arithmetic elements and ALU design	
9	25	Programmable logic devices: Logic arrays	
9	26	Field programmable logic arrays	
9	27	Programmable read only memory	
10	28	Sequential circuits: Different types of latches	CT-3
10	29	Flip-flops: master-slave, D, JK, T	
10	30	Design of flip-flops using ASM approach	
11	31	Timing analysis	
11	32	Power optimization of sequential circuits	

11	33	Modular sequential logic circuit design: shift registers	
12	34	Parallel I/O shift registers	
12	35	Series I/O shift registers	
12	36	Universal shift register	
13	37	Counters: Introduction	
13	38	Asynchronous counters: up and down	
13	39	Synchronous counters: up and down	
14	40	BCD counters and other modulo counters	
14	41	Ring counter, Johnson counter	
14	42	Applications of registers and counters	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Test 1-3	20%	CO1	C1,C2
			CO2	C6
	Assignment	5%	CO1	C1,C2
			CO2	C6
	Attendance	5%		
	Mid term	10%	CO2	C6
			CO3	C4
Final Exam		60%	CO1	C1,C2
			CO2	C6
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Digital Logic and Computer Design- M Morris Mano; Prentice Hall of India Private Ltd.
2. Digital Fundamentals –Thomas L Floyd; Prentice Hall International, Inc.
3. Pulse, Digital and Switching waveforms - Jacob Millman& Herbert Taub; Tata McGraw-Hill.
4. Fundamentals of Digital Logic with Verilog Design by Stephen Brown and Zvonko Vranesik

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

6.1.8. EECE 280: Digital Electronics and Pulse Technique Laboratory
Level-2, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 280 : Digital Electronics and Pulse Technique Laboratory	Contact Hours Credit Hours	: 1.50 : 0.75

PRE-REQUISITE

Course Code: EECE 279
Course Title: Digital Electronics and Pulse Technique

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Being one of the fundamental requirements for electrical engineering students of Level-3, the course emphasizes on a good understanding of basic concepts about digital logic circuits. Besides, it helps to form a firm grasp of the modern design approach that relies on computer-aided design (CAD) tools. It exploits areas like Boolean algebra, combinational circuits, sequential circuits and memory elements. The students are first taught about the number system and logic gates before introduction to digital IC technology. This paves the way of exposure to CAD tools like Schematic Capture and Verilog constructs which are useful for the design of logic circuits. It will be followed by implementation of Verilog code in the FPGA board. The aim of the course is to familiarize students with modern design methodology to illustrate how digital design is carried out in practice today.

OBJECTIVE

1. To acquaint the students with the fundamental concepts in classical manual digital design.
2. To familiarize the students clearly with the way in which digital circuits are designed today using CAD tools like Schematic Capture and Verilog HDL.
3. To develop students' analytical skills to build complex digital circuits and impart the knowledge about 'Green Technology' to integrate it in their projects.
4. To enhance the skill set of students in designing various memory devices such as flip flops, registers and counters followed by implementation in FPGA boards.
5. To develop communication and project management skills in the students through presentation and project.

COURSE OUTCOMES &GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **follow** instructions on building of combinational and sequential circuits using basic logic gates and compute simulation using CAD tools.	PO9	P3				R, Q, T
CO2	Be adept to apply basic Boolean laws and K-map to **reproduce** a simplified and efficient version of large scale complex circuits meeting the specified requirements using minimum hardware.	PO10	P3	1,3			R, Q, T
CO3	Be proficient to deconstruct a device and **demonstrate** skills to troubleshoot a digital circuit.	PO5	A3			6	R, Q, T
CO4	Be capable to **construct** different types of digital electronic circuits with or without memory elements for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.	PO10	P7	1,4			PR, Pr,Q

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 279 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **follow** instructions on building of combinational and sequential circuits using basic logic gates and compute simulation using CAD tools.									3			
CO2	Be adept to apply basic Boolean laws and K-map to **reproduce** a simplified and efficient version of large scale complex circuits comprehending the specified requirements using minimum hardware.										1		
CO3	Be proficient to deconstruct a device and **demonstrate** skills to troubleshoot a digital circuit.					3							
CO4	Be capable to **construct** different types of digital electronic circuits with or without memory elements for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.										2		

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	27 9 18
Self-Directed Learning Preparation of Lab Reports	54 9
Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	12 10 5 18
Formal Assessment Continuous Assessment Final Quiz	 3 1
Total	73

COURSE SCHEDULE

Week 1	Design and simulation of half adder, full adder, ripple adder, half subtractor, full subtractor and multiplier, 4-to-1 multiplexer, 16-to-1 multiplexer, 4-to-1 multiplexer using two 2-to-1 multiplexer, crossbar switch and demultiplexers using basic logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.

Week 2	Design and simulation of 4-to-2 encoder, priority encoder, 2-to-4 decoder, 3-to-8 decoder using two 2-to-4 decoders, 4-to-16 decoder built using a decoder tree, 4-to-1 multiplexer built using a decoder using logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 3	Design of BCD to seven-segment decoder circuit using logic gates and simulation of BCD to seven-segment decoder and multilevel modules (using adder, 7 segment display) using Schematic Capture and Verilog.
Week 4	Design and simulation of Latch, S-R FF, J-K FF, D FF, T FF, Master Slave FF using logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 5	Design and simulation of Up Counter, Down Counter (Synchronous and Asynchronous with and without Enable and Clear pins), Ring Counter, BCD Counter using logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 6	Design and simulation of Shift Register and Parallel Access Shift Register using logic gates, Schematic Capture and Verilog followed by implementation in FPGA board.
Week 7	Lab Test, Lab Quiz, Project Presentation, Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Participation and Report	20%	CO1	P3
			CO2	P3
			CO 3	A3
			CO4	P7
	Labtest	30%	CO1	P3
			CO2	P3
			CO 3	A3
			CO4	P7
	Project and Presentation	25%	CO4	P7
Lab Quiz		25%	CO 1	P3
			CO 2	P3
			CO 3	A3
			CO4	P7
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Fundamentals of Digital Logic with Verilog Design, Stephen Brown & Zvonko Vranesic.
2. Ronald J Tocci, Digital Systems, Pearson Education, 10th edition 2009.
3. Digital Design, Moris Mano, Prentice Hall of India, 3rd edition, 2002.

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

6.2. Dept of Civil Engineering (CE)

6.2.1. EECE 165: Basic Electrical Technology
Level-1, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 165 : Basic Electrical Technology	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To introduce the students with the fundamental concepts of DC and AC circuits, relevant components and theorems. The course is designed to give a brief introduction on the basics of network analysis of electrical and electronic circuits, electronic devices and electrical machines. It aims to build a strong foundation on electrical wiring system with a view to enabling the students to work efficiently in practical field and design efficient layouts for electrical wiring.			
OBJECTIVE			
1. To familiarize the students with the basics of DC and AC circuit analysis. 2. To impart knowledge on the working principle and applications of some common yet frequently used electronic devices. 3. To introduce the students with the electrical machines that are in use enabling them to analyse the characteristics of the machines changing relevant parameters. 4. To ensure that the students have the necessary knowledge of Electrical Wiring system to work efficiently in practical field.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to apply the concepts of DC and AC circuit analysis for solving relevant problems and analyse potential solutions using the network theorems.	PO1	C4	1		3	T, F, ASG
CO2	Be able to describe the functions of the common electronic devices and solve problems related to electronic circuits.	PO1	C3	1		3	T, Mid Term Exam, F
CO3	Be able to explain the working principles of the most commonly used electrical machines.	PO1	C2			3	Mid Term Exam, F, ASG
CO4	Able to understand the current voltage relation of 3 phase circuits for different configure-tions and reproduce knowledge of AC power to analyze real life power consumptions of transmission lines.	PO3	C2	P1		5	F, PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Measurement of electrical quantities: Current, voltage, resistance,
Measuring instruments: Ammeter, voltmeter, watt meter and multimeter,
Laws of Electric Circuit: Ohm's law, Kirchhoff's voltage and current laws, Series, parallel equivalent circuit and Delta-wye transformation.
Electrical networks analysis: Branch and loop currents, node and mesh current analysis, Super position, Thevenin's and Norton's theorem,
AC circuit analysis: Instantaneous current, voltage and power, effective current and voltage, average power.
Introduction to Electronics devices with simple application: Diodes, Rectifiers.
Familiarization with different types of electrical machines: DC generators and motors, alternators, AC motors, transformers. Working principles of transformers and induction motors.
Electrical Wiring: Rules and Regulations, wiring for residential, industrial, commercial buildings, cost estimation for electrical wiring, illumination.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **apply** the concepts of DC and AC circuit analysis for solving relevant problems and **analyse** potential solutions using the network theorems.	3											
CO2	Be able to **describe** the functions of the common electronic devices and **solve** problems related to electronic circuits.	3											
CO3	Be able to **explain** the working principles of the most commonly used electrical machines.	2											
CO4	Be able to **recall** the rules and regulations of electrical wiring system and **design** efficient layouts for the wiring system of residential, commercial and industrial buildings.			2									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture and Discussion	42
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Topics**	**Assessment Method**
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage.	
Class 2	Power and energy, Active elements, Passive elements, Independent and Dependent source	
Class 3	Ohm's law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh	
Week 2		
Class 4	Series-parallel connection	CT-1
Class 5	KCL, KVL, Analysis of equivalent resistance of electrical circuit	
Class 6	Analysis of voltage, current and power	
Week 3		
Class 7	Y to Δ conversion derivation	
Class 8	Analysis of electrical circuits with Y-Δ connection	
Class 9	Ammeter, Voltmeter, Wattmeter and Multimeter	
Week 4		
Class 1	Su er node analysis	
Class 11	Various mathematical problems solving nodal analysis	
Class 12	Mesh Analysis	
Week 5		
Class 13	Network Theorems	
Class 14	Network Theorems	
Class 15	Magnetic Circuits	
Week 6		Midterm
Class 16	Introduction to AC, Reactive circuit components	
Class 17	Network theorems for AC circuit analysis	
Class 18	Network theorems for AC circuit analysis	
Week 7		
Class 19	Average and RMS values of current, voltage and power	
Class 20	Instantaneous Current, voltage and power for RC and RL circuits	
Class 21	Instantaneous Current, voltage and power for RLC circuits	
Week 8		
Class 22	Diode (Working principle)	
Class 23	Diode (Applications and mathematical problems)	
Class 24	Transistor	
Week 9		CT-2
Class 25	Transformer	
Class 26	DC generator	
Class 27	DC generator, DC motor	
Week 10		
Class 28	DC motor	
Class 29	Induction Motor	
Class 30	Alternator	
Week 11		
Class 31	Introduction to electrical wiring	
Class 32	Rules and Regulations for electrical wiring	CT-3

Class 33	Electrical wiring for residential buildings	
Week 12		
Class 34	Electrical wiring for residential buildings	
Class 35	Electrical wiring for industrial buildings	
Class 36	Electrical wiring for industrial buildings	
Week 13		
Class 37	Electrical wiring for commercial buildings	
Class 38	Electrical wiring for commercial buildings	
Class 39	Cost estimation for electrical wiring of a building	
Week 14		
Class 40	Cost estimation for electrical wiring of a building	
Class 41	Introduction to illumination, Illumination for different types of building	
Class 42	Revision	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C4
			CO2	C3
			CO3	C2
	Class Participation	5%	CO1	C4
			CO2	C3
			CO3	C2
			CO4	C2
	Class Attendance	5%		
	Mid term	10%	CO2	C3
			CO3	C2
Final Exam		60%	CO1	C4
			CO2	C3
			CO3	C2
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.
3. A Textbook of Electrical Technology- B.L. Theraja and A.K. Theraja
4. Electrical Wiring, Estimating and Costing - S.L. Uppal; Khanna Publishers
5. Fundamentals of Electric Circuits – Charles Alexander and Mathew Sadiku

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

6.3. Dept of Mechanical Engineering (ME)

6.3.1. EECE 159: Fundamentals of Electrical Engineering
Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 159 : Fundamentals of Electrical Engineering	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To learn and familiarize with the basic laws, principles and phenomena in the area of electrical engineering and apply the acquired knowledge and skills in specialist courses and application fields.			
OBJECTIVE			
1. To impart the understanding of basic electrical quantities, standardized units and measuring instruments. **2.** To disseminate the knowledge of different electrical network theorems and apply those theorems in solving complex circuit networks. **3.** To make understand the basics of magnetic circuits and application of these basic concepts in different electromagnetic machineries like motors, generators, transformers etc. **4.** To promulgate the basics of alternating current concepts and circuits solving techniques. **5.** To introduce with the single phase and balanced poly-phase circuits and their physical applications with real life analysis and problem solving.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** different electrical quantities and **explain** techniques and instruments to measure them.	PO1	C2			1	T, F
CO2	Be able to **apply** different circuit laws and theorems to **solve** electrical network related problems by **designing** circuits in a cost effective manner.	PO3	C3			5	T, Mid Term Exam, F
CO3	Be able to **explain** alternating current concepts and **apply** the circuit laws and theorems for single phase circuit problems and to **contrast** them with those applied in DC circuits.	PO1	C4	1		3	Mid Term Exam, F, ASG
CO4	Be able to **analyse** practical three phase circuit problems and **compute** power calculations.	PO1	C4			3	F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Laws of Electric Circuit: Ohm’s law, Kirchhoff’s voltage and current laws. Delta-wye transformation.
Electrical Networks: Network analysis methods of branch and loop currents, method of node and mesh analysis, Thevenin’s and Norton’s theorems.
Magnetism Concepts: Magnetic field, right hand rule, magnetic flux density, Biot-Savart law, B-H curve, Hysteresis loss, Eddy current and Eddy current loss, total core loss, Introduction to magnetic circuits.
Electromagnetic Forces: Forces upon a current carrying conductor and charges particle moving in a magnetic field, electromagnetic torque, electric motor.
Electromagnetic Induction and EMF: Lenz’s law, BLV rule, elementary ac generator.
AC Currents: General concepts and definitions, instantaneous current, voltage and power; R, L, C, RL, RC, and RLC branches. Effective and average value, form factor, crest factor, real and reactive power.
AC Circuits (Steady State Analysis): Impedance in polar and Cartesian forms. Sinusoidal single phase circuit analysis. Impedance in series, parallel branches, series parallel circuits. Network analysis: Thevenin’s theorem, Norton’s Theorem.
Balanced poly phase circuits: Three phase, four wire system of generated EMFs, three phase three wire systems, balanced Y loads and balanced delta loads. Power in balanced systems and power factor. Balanced three phase circuit analysis and power measurement.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **define** different electrical quantities and **explain** techniques and instruments to measure them.	3											
CO2	Be able to **apply** different circuit laws and theorems to **solve** electrical network related problems by **designing** circuits in a cost effective manner..			2									
CO3	Be able to **explain** alternating current concepts and **apply** the circuit laws and theorems for single phase circuit problems and to **contrast** them with those applied in DC circuits.	3											
CO4	Be able to **analyse** practical three phase circuit problems and **compute** power calculations.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio	 42 -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home	 42 21
Preparation for final examination	21
Formal Assessment	

Continuous Assessment Final Examination	2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Electrical Circuit Laws**	CT 1
Class 1	Ohm's law, Kirchhoff's voltage and current laws.	
Class 2	Series and paralleling of resistors, power and energy equations.	
Class 3	Delta-wye transformations.	
Week 2	**Electrical Networks Analysis**	
Class 4	Network analysis methods of branch currents.	
Class 5	Network analysis methods of loop currents.	
Class 6	Electrical network problem solving on nodal and mesh analysis.	
Week 3	**Circuit Theorems**	
Class 7	Introduction to the circuit laws and concept of linear and non-linear circuit.	
Class 8	Thevenin's theorems and problem solving.	
Class 9	Thevenin's theorems and problem solving.	
Week 4	**Circuit Theorems**	CT 2
Class 10	Norton's theorem and problem solving.	
Class 11	Norton's theorem and problem solving.	
Class 12	Maximum power transfer theorem and related problem solving.	
Week 5	**Magnetism Concepts**	
Class 13	Biot-Savart law, Magnetic field intensity and Magnetic flux	
Class 14	Ferromagnetic materials - Theory and Characteristics.	
Class 15	B-H curve, Hysteresis loss, Eddy current and Eddy current loss	
Week 6	**Magnetically Coupled Circuits**	
Class 16	Introduction to magnetic circuits.	
Class 17	The dot rule for solving magnetically coupled circuit related problems.	
Class 18	Mutual inductance and energy calculations in magnetic circuit.	
Week 7	**Electromagnetic forces**	Mid Term
Class 19	Forces upon a current carrying conductor and charges particle moving in a magnetic field, the concept of electromagnetic torque.	
Class 20	Electromagnetic induction and EMF: Lenz's law, BLV rule.	
Class 21	Elementary ac generator and induction motor.	
Week 8	**Alternating Current Concepts**	
Class 22	General concepts and definitions, instantaneous current, voltage and power, phasors.	
Class 23	Impedance: R, L, C, RL Branches.	
Class 24	Impedance: RC and RLC branches.	
Week 9	**Alternating Current Circuit: Steady State Analysis**	
Class 25	Effective value, Average value, Form factor.	
Class 26	Single phase circuit analysis: basic circuit laws and impedance.	
Class 27	Single phase circuit analysis: basic circuit laws and impedance.	
Week 10	**Alternating Current Circuit: Steady State Analysis**	CT 3
Class 28	Concept of complex power, real power and reactive power.	
Class 29	Single phase circuit analysis: Real Power and Reactive Power calculations.	

Class 30	Single phase circuit analysis: Real Power and Reactive Power calculations.	
Week 11	**AC Network Analysis**	
Class 31	Impedance in series, parallel branches	
Class 32	Thevenin’s theorem in AC circuits and problem solving.	
Class 33	Norton’s theorem in AC circuits and problem solving.	
Week 12	**Balanced Poly-Phase System**	
Class 34	Balanced three phase voltages and phasors.	
Class 35	Concept of line and phase current/voltage quantities and relations between them.	
Class 36	Three phase four wire/three wire systems.	
Week 13	**Balanced Poly-Phase Circuits**	
Class 37	Balanced wye- wye and delta-delta connection.	
Class 38	Balanced wye-delta and delta-wye connection.	
Class 39	Power in balanced systems and power factor calculation.	
Week 14	**Balanced Three Phase Circuit Analysis**	
Class 40	Balanced three phase circuit analysis and power measurement calculations.	
Class 41	Balanced three phase circuit analysis and power measurement calculations.	
Class 42	Open Discussion	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C3
	Class Participation	5%	CO4	C4
	Class Attendance	5%		
	Mid term	10%	CO2	C3
			CO3	C4
Final Exam 60%			CO1	C2
			CO2	C3
			CO3	C4
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Introductory Circuit Analysis – R. L. Boylestad.
2. Fundamentals of Electrical Circuits – Matthew Sadiku, Charles Alexander.
3. Alternating Current Circuits – Russel M Kerchner and George F Corcoran.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.3.2. EECE 173: Electrical and Electronics Technology
Level-1, Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 173	Contact Hours	: 3.00
Course Title	: Electrical and Electronics Technology	Credit Hours	: 3.00

<table>
<tr><th colspan="8">PRE-REQUISITE</th></tr>
<tr><td colspan="8">Course Code: EECE 159
Course Title: Fundamentals of Electrical Engineering</td></tr>
<tr><th colspan="8">CURRICULUM STRUCTURE</th></tr>
<tr><td colspan="8">Outcome Based Education (OBE)</td></tr>
<tr><th colspan="8">SYNOPSIS/RATIONALE</th></tr>
<tr><td colspan="8">Electrical and Electronics Technology is a basic course to acquire knowledge on electro mechanical energy conversion by electrical machines, their constructions, operating principles, characteristics and applications. It is targeted to develop a strong foundation in the basic operating principle, constructions, characteristic features, applications etc. of AC electrical machinery like synchronous generator, synchronous motor and three phase induction motors. It is targeted to provide a basic foundation for technology areas like electronics devices (rectifiers, voltage regulators and amplifiers), as well as instrumentation and various electronic circuit design.</td></tr>
<tr><th colspan="8">OBJECTIVE</th></tr>
<tr><td colspan="8">1. To convey basic knowledge of electromagnetic induction in different electrical machineries.
2. To appraise the operating principle and constructional details of electrical machines like transformer, motor, generator.
3. To develop a strong foundation on AC electrical machines (synchronous machines, induction machines etc.) with a special focus on operating principle, identification of parts and accessories, constructional features, types etc.
4. Be able to investigate and analyze characteristic features of such machines like modelling of equivalent circuit, estimations of regulations and efficiency, input and output relationships.
5. Achieving ability to familiarize the students with the working principle of semiconductor devices (Diodes, BJTs, SCRs etc.) as electronic circuit elements and ICs.
6. To impart the knowledge of the basics of electrical and electronic measurement system components along with different methods of measurement.</td></tr>
<tr><th colspan="8">COURSE OUTCOMES& GENERIC SKILLS</th></tr>
<tr><td>No.</td><td>Course Outcomes</td><td>Corresponding PO</td><td>Bloom’s Taxonomy</td><td>KP</td><td>CP</td><td>CA</td><td>Assessment Methods</td></tr>
<tr><td>CO1</td><td>Attaining proficiency in describing the physics of electromagnetic induction and constructions and operating principles of different Electrical Machines to infer the fundamental ideas about common energy conversion devices.</td><td>PO1</td><td>C2</td><td>3</td><td></td><td></td><td>T, F</td></tr>
<tr><td>CO2</td><td>Gaining ability to develop equivalent circuits, compare vector diagrams and torque speed characteristics of different electrical machineries.</td><td>PO1</td><td>C4</td><td>3</td><td>1</td><td></td><td>T, MidTerm, F</td></tr>
<tr><td>CO3</td><td>Be capable to interpret and analyse the design features and evaluate the characteristics of synchronous machines, induction motors etc.</td><td>PO2</td><td>C5</td><td>3</td><td>1</td><td></td><td>Mid Term Exam, F</td></tr>
</table>

CO4	Be able to **recall** and **infer** the physics of semiconductor devices and the operation of different electronic devices and measurement equipment for strengthening fundamental idea about basic electronics.	PO1	C2	3	1		MidTerm, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Single phase transformer: Equivalent circuit and laboratory testing; Introduction to three phase transformers, Testing procedure of three phase transformer.
DC generators: Principles, types, performances and characteristics.
DC Motors: Principles, types, performances and characteristics. Speed control and starters of motors, applications of DC motors for industrial purpose.
AC Machines: Principles of three phase induction motor and equivalent circuits. Introduction to synchronous machines and fractional horse power motors, selection of electrical machines for industrial applications.
Electronics: Introduction, characteristics of semiconductor diodes and transistors, equivalent circuits, self-biasing circuits, emitter follower amplifiers, push pull amplifier. Introduction to silicon controlled rectifier and its application. Oscilloscope.
Transducers: Strain, temperature, pressure, speed and torque measurement.
Microcontroller: Introduction to microcontroller, basic architecture, pin diagram, applications of microcontroller for industrial controlling purpose and automation purpose.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Attaining proficiency in **describing** the physics of electromagnetic induction and constructions and operating principles of different Electrical Machines to **infer** the fundamental ideas about common energy conversion devices.	3											
CO2	Gaining ability to **develop** equivalent circuits**, compare** vector diagrams and torque speed characteristics of different electrical machineries.	3											
CO3	Be capable to **interpret** and **analyse** the design features and **evaluate** the characteristics of synchronous machines, induction motors etc.		3										
CO4	Be able to **recall** and **infer** thephysics of semiconductor devices andthe operation of different electronic components for strengthening fundamental idea about basic electronics.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 56 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 56 28 28
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	173

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE		
Week 1	**DC Generator**	CT 1
Class 1	Basic idea about energy conversion, conversion by electrical machines	
Class 2	Introduction to DC generator and its principle of operation	
Class 3	Commutation principle and slip rings, Types, construction of DC generator and its different parts, Emf equation and related mathematical problems.	
Week 2	**DC Generator and DC Motor**	
Class 4	Mathematical problems of series-shunt configurations	
Class 5	Losses in DC generator and efficiency calculation, Power stages, maximum efficiency, Mathematical problems.	
Class 6	Introduction to DC motor, Construction and operating principle.	
Week 3	**DC Motor**	
Class 7	Equivalent circuits of DC motor, Back emf and related equations for DC motor.	
Class 8	Torque –speed characteristics of DC motor, Different types of motor and their operating principles. Losses in DC motor,	
Class 9	Loss related mathematical problems. Different types of motors' characteristics, DC Motor Starter Circuit Analysis.	
Week 4	**Transformer**	CT 2
Class 10	Introduction to Transformer and its principle of operations, types of transformer and ideal characteristics, Equivalent circuit of Transformer.	
Class 11	Vector diagrams of transformer under different conditions, Mathematical problems. Losses in transformer and their explanations,	
Class 12	Efficiency calculation and condition for maximum efficiency and mathematical problems. Regulation of transformer and Parallel operation of transformer.	
Week 5	**Synchronous Motor**	
Class 13	Principle of operation, construction, method of starting. Power flow within a synchronous motor, motor losses.	

Class 14	Equivalent circuit and vector diagrams of synchronous motor, power developed by a synchronous motor and related problems.	
Class 15	Power factor adjustment, synchronous capacitor and power factor correction.	
Week 6	**Three Phase Induction Motor**	
Class 16	General principle, advantage, disadvantage, Construction, types of rotor, squirrel cage rotor and phase wound rotor.	
Class 17	Rotating magnetic field, slip, slip frequency and related problems.	
Class 18	Relation between torque and rotor power factor, starting torque and condition for maximum starting torque.	
Week 7	**Three Phase Induction Motor**	Mid Term
Class 19	Starting torque of a squirrel cage motor, effect of change in supply voltage on starting torque, rotor emf and reactance under running condition.	
Class 20	Power stages in an induction motor, losses, torque developed	
Class 21	Review Class.	
Week 8	**Introduction to Electronics and Semiconductor diodes**	
Class 22	Basic idea about Electronics, Introduction to semiconductor devices and its classifications. P-type and N-type materials and doping, Semiconductor diode and its band diagram.	
Class 23	Biasing of semiconductor diodes.	
Class 24	I-V characteristics of diode and equivalent circuit of diodes, Shockley's equation and related mathematical problems.	
Week 9	**Diode Rectifier and Introduction to Bipolar Junction Transistor**	
Class 25	Diode rectifiers, Ripple factor and related mathematical problems.	
Class 26	Introduction to BJT. Working principle and operating regions of BJT.	
Class 27	CB, CE and CC configurations and characteristics curves.	
Week 10	**Introduction to Bipolar Junction Transistor**	CT 4
Class 28	Mathematical problems related to different configurations using BJT.	
Class 29	Mathematical problems related to different configurations using BJT	
Class 30	BJT as an amplifier.	
Week 11	**Silicon Controlled Rectifier (SCR)**	
Class 31	Introduction to Silicon Controlled Rectifier.	
Class 32	Principle of operation, Equivalent circuit, I-V characteristics curve.	
Class 33	Two transistor model of SCR. Application of SCR in controlled rectifier.	
Week 12	**Silicon Controlled Rectifier (SCR) and Transducers**	
Class 34	Application of SCR in Inverter.	
Class 35	Application of SCR in AC-AC Controller.	
Class 36	Introduction on Measurement System, Basic requirements, Significance and Methods of measurement. Elements of generalized measurement system.	
Week13	**Transducers**	
Class 37	Functional elements of an instrument, Applications. Transducers: Introduction, advantage of using Electrical Transducers	
Class 38	Measurement of Strain, Force (piezoelectric sensors) and Torque. Strain gauge basic operating principle, applications. Mathematical Problems.	
Class 39	Thermocouple, Resistance Temperature Detector and Thermistor.	
Week 14	**Data Acquisition and microcontroller**	
Class 40	Data acquisition system in instrumentation, Digital data acquisition system, Analog data acquisition system.	
Class 41	Introduction to microcontroller, basic architecture of microcontroller,	

	applications of microcontroller in instrumentation	
Class 42	Applications of microcontroller for industrial automations, design problems.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C2, C4
	Class Participation	5%	-	-
	Class Attendance	5%		
	Mid term	10%	CO2, CO3, CO4	C2, C4, C5
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C5
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Electrical Machinery Fundamental - Stephan J. Chapman; McGraw-Hill.
2. A Text Book of Electrical Technology (AC, DC Machines) – B.L Theraja & A.K. Theraja; S. Chand & Company Ltd.
3. Electrical Machines - Nagrath and Kothari; McGraw-Hill.
4. Electronic Devices & Circuit theory- Robert L. Boylestad.
5. Micro Electronics Circuits – Adel S. Sedra & Keneth C. Smith; Oxford University Press.
6. Power Electronics (Circuits, devices & Application) - MD. H. Rashid; Prentice Hall of India.
7. Introduction to Embedded Systems Using ANSI C and the Arduino Development Environment
(Synthesis Lectures on Digital Circuits and Systems) - David Russell

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

6.3.3. EECE 174: Electrical and Electronics Technology Sessional
Level-1, Term-II (Fall)

COURSE INFORMATION

Course Code Course Title	: EECE 174 : Electrical and Electronics Technology Sessional	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

1. EECE 159 Fundamentals of Electrical Engineering
2. EECE 173 Electrical and Electronics Technology

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Electrical Engineering lab is designed to impart into the students the basic concepts of electrical engineering encompassing the practical implementations of DC and AC circuits. At the beginning of this course, students will get to know the projection of fundamental DC circuit using the basic equipment along with the observation of the basic theorems as well as the AC circuit concepts will be experimented accompanying the showcase of various types of filter and their characteristics. In the following part of the lab, some basic electronics experiment using diode and transistor will be done. In the last part of the course, the students will be familiarized with various electrical machines like DC and Ac motor and generator.

OBJECTIVE

1. To introduce the students to basic DC circuit laws and solving of complex circuits using basic circuit theorems
2. To impart into the students with the AC circuit hardware construction and operation.
3. To familiarize the students with different type of filter construction and their characteristics.
4. To give in depth knowledge on the basic electronics circuit using diode and transistor.
5. To introduce the students to different type of Dc and AC motor and generators.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Achieving the quality to construct DC, AC and electric circuits and justify the basic laws as well as to modify the complex circuits into simple circuits.	PO9	A4				R, Q, T
CO2	Attaining the competency to reproduce the basic filters and to explain their characteristics.	PO10	P3				R, Q, T
CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component	PO9	A3	P1			R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 159 and EECE 173 using different hardware equipment and simulation software.

CO-PO Mapping

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Achieving the quality to construct DC, AC and electric circuits and justify the basic laws as well as to modify the complex circuits into simple circuits.									2			
CO2	Attaining the competency to reproduce the basic filters and to explain their characteristics.										2		
CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component									2			

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 6 6 5 26
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Week 1	Exp 1: Verification of KVL and KCL
Week 2	Exp 2: Verification of Thevenin's Theorem
Week 3	Exp 3: Familiarization with alternating current (ac) waves and study of RLC series circuit
Week 4	Exp 4: Different types of filters and its characteristics with different input frequency
Week 5	Exp 5: Study the diode characteristics and rectifier circuit
Week 6	Exp 6: Study of N-P-N CB (Common base) and CE (Common emitter) transistor characteristics
Week 7	Exp 7: Regulation of the Transformer in Various Loads
Week 8	Exp 8: Study the properties of Three-Phase Alternator in various loads
Week 9	Exp 9: Study the properties of DC Shunt Motor.
Week 10	Exp 10: Study the properties of DC Separately Excited and Self-Excited Shunt Generator.
Week 11	Exp 11: Study the properties of Squirrel-Cage Induction Motor.
Week 12	Basics of PIC 16F877A, Arduino and Raspberry pi 3
Week 13	Lab test + Viva
Week 14	Quiz+Presentation

ASSESSMENT STRATEGY

Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Lab participation and Report	20%	CO1	A4
			CO2	P3
			CO3	A3
	Labtest-1, Labtest-2	40%	CO1	A4
			CO2	P3
			CO3	A3
Lab Quiz		40%	CO1	A4
			CO2	P3
			CO3	A3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS
1. Basic Electrical and Electronics Engineering by Sabyasachi Bhattacharya 2. Fundamentals of Electrical Circuits –Alexander and Sadiku 3. Introductory Circuit Analysis by R. L. Boylstad 4. A Text Book of Electrical Technology (AC, DC Machines) – B.L Theraja & A.K. Theraja 5. Electronic Devices & Circuit theory- Robert L. Boylestad.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.4. Naval Architecture and Marine Engineering (NAME)

6.4.1. EECE 281: Marine Electrical and Electronics
Level-2, Term-II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 281 : Marine Electrical and Electronics	Lecture Contact Hours Credit Hours	: 4.00 : 4.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Compulsory theoretical course based on application of electrical and electronic technology in marine field.			
OBJECTIVE			
1.Be familiarized with electrical technology, able to investigate and analyse electrical circuits and get introduced with power generation and distribution system, relevant SOLAS regulation applicable for ship and marine establishments. 2.To develop a basic foundation on electrical machines with a special focus on operating principle, identification of parts and accessories, constructional features, types, characteristics features, efficiency and loss measurement, application and maintenance etc. 3.To have a basic understanding on electronic components and its applications in marine electronics 4.To develop a broad idea on navigational aid equipment such as Radar, Gyro compass, echo sounder, speed log etc.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Be able to describe** basic theories of electric circuits, analyse electrical circuits and its application in electrical equipment, identify power generation and distribution system with relevant SOLAS regulation applicable for ship and marine establishments	PO1	C3	1		3	T/ ASG, F

CO2	**Be capable to describe** basic theories of electrical machines and explain principle of operation, constructional features and **evaluate** the characteristics and find out their efficiency and losses, applications and maintenance etc.	PO1	C1	1		3	T/ ASG, MT, F
CO3	Be able to **explain** theories of electronic components and identify its applications in marine electronics sector.	PO3	C3	2		5	T/ ASG, F
CO4	Be capable to **explain** the principles of navigational aid equipment such as Radar, Gyro compass, echo sounder, speed log, GPS etc and communication equipment used on board ships.	PO1	C3	1		3	T/ ASG, Pr, MT, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

DC and AC circuit analysis: Kirchhoff's law, Thevenin theorem, Norton theorem, Node Pair voltage theorem etc.
Three phase induction motors: Basic Theory, Principle of operation, Types, construction, Equivalent circuit, Starting, speed control, Maintenance, applications.
Single phase induction motors: Basic Theory, Principle of operation, Equivalent circuit, types, starting, Maintenance, applications.
AC generators: Basic Theory, Principle of operation, Construction, excitation system, generator on load, voltage regulation, synchronization, Maintenance and applications.
Synchronous motor: Principle of operation, Starting, application, maintenance Steering system.
Diodes, BJTs, diode and BJT circuits, IC, MOSFET and SCR as power switching devices.
Controlled rectifiers and inverters.
Radar and wireless equipment: Principle, block diagram, different parameters, Maintenance.
Navigational and Electronic navigational aids (GPS, Gyro compass. Echo sounder, speed log, LORAN, RDF and Decca Chain).
Power generation and distribution (PGT) system.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Be able to describe** basic theories of electric circuits, analyse electrical circuits and its application in electrical equipment, identify power generation and distribution system with relevant SOLAS regulation applicable for ship and marine establishments	3											
CO2	**Be capable to describe** basic theories of electrical machines and explain principle of operation, constructional features and **evaluate** the	3											

	characteristics and find out their efficiency and losses, applications and maintenance etc.												
CO3	Be able to **explain** theories of electronic components and identify its applications in marine electronics sector.			2									
CO4	Be capable to explain the principles of navigational aid equipment such as Radar, Gyro compass, echo sounder, speed log, GPS etc and communication equipment used on board ships.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 56 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 28 28
Formal Assessment Continuous Assessment Final Examination	 3 3
Total	160

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	DC Circuit analysis	
Class 1	Nodal analysis and examples	CT1
Class 2	Super node with examples, Basic circuit theorems	
Class 3	Thevenin's theorem with examples	
Class 4	Norton's theorem with examples	
Week 2	**Alternator**	
Class 5	Synchronous Generator: Operating principle,	
Class 6	Losses in Alternator	
Class 7	equivalent circuit of synchronous Generator, Excitation systems of Synchronous Generator	
Class 8	Emf equation of synchronous generator, Mathematical problems	
Week 3	**Alternator (Cont..)**	
Class 9	synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations	
Class 10	Vector diagram under different loads	
Class 11	factors affecting voltage regulation	
Class 12	Load sharing and parallel operation	

Week 4	**Induction Motor**	CT 2
Class 13	Three phase induction motor: principle	
Class 14	Rotating magnetic field	
Class 15	Construction of squirrel cage IM, equivalent circuit	
Class 16	vector diagram, torque-speed characteristics	
Week 5	**Induction Motor (Cont..)**	
Class 17	no-load test, blocked rotor test	
Class 18	starting and braking, speed control	
Class 19	Single phase induction motor: Types of operation	
Class 20	starting and torque speed characteristics	
Week 6	**Synchronous Motor**	
Class 21	Synchronous motor: Operation	
Class 22	Vector diagrams of synchronous motor	
Class 23	effect of loading under different excitation condition.	
Class 24	Starting method of synchronous motor	
Week 7	**Synchronous Motor (Cont..)**	CT 3
Class 25	effect of changing excitation, Armature reactions	
Class 26	Variations of power factor with armature reactions, Mathematical Problems.	
Class 27	Maximum load angle	
Class 28	Mathematical Problems	
Week 8	**Diode**	
Class 29	Introduction to semiconductor devices and its classifications	
Class 30	P-type and N-type materials and doping, Semiconductor diode and its band diagram	
Class 31	Biasing of semiconductor diodes, I-V characteristics of diode and equivalent circuit of diodes	
Class 32	Zener diode and related maths of zener diode,	
Week 9	**Diode (Cont..)**	
Class 33	Applications of diode, HWR and FWR using diode	
Class 34	Diode bridge rectifier and Centre tapped transformer rectifier, Clipper circuit and related problems	
Class 35	Clamper circuit and related problems	
Class 36	Ripple factor and related mathematical problems	
Week 10	**BJT**	CT 4
Class 37	Introduction to BJT and construction, Principle and operation of BJT	
Class 38	Operating regions of BJT and its different configurations	
Class 39	CB and CE configurations and characteristics curves	
Class 40	Mathematical problems related to CB and CC configurations.	
Week 11	**MOSFET**	
Class 41	Introduction to MOSFET, Construction and operating principle of MOSFET	
Class 42	Types of MOSFET, Construction and operating principle of depletion type and enhancement type MOSFET	
Class 43	Biasing of MOSFET and related problems, Characteristics curve of MOSFET	
Class 44	threshold voltage, Body effect, current- voltage characteristics of an enhancement MOSFET	
Week 12	**SCR**	
Class 45	Introduction to power semiconductors witches, Introduction to triggering devices	

Class 46	Introduction to SCR and IGBT, Controlled single phase and three-phase Rectifiers	
Class 47	Introduction to AC voltage controllers	
Class 48	Introduction to Single and three phase Choppers, Working principle of Single and three phase Choppers	
Week 13	**Radar and wireless equipment**	
Class 49	Principle, block diagram, different parameters	
Class 50	Maintenance Navigational and Electronic navigational aids	
Class 51	GPS, Gyro compass	
Class 52	Echo sounder, speedlog	
Week 14	**Radar and wireless equipment (Cont..)**	
Class 53	Introduction to LORAN	
Class 54	RDF and Decca Chain	
Class 55	Power generation and distribution (PGT) system	
Class 56	Review class	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C3
			CO 2	C1
			CO 3	C3
			CO 4	C3
	Class Participation	5%	CO 4	C3
	Class Attendance	5%		
	Mid term	10%	CO 2	C1
			CO 4	C3
Final Exam		60%	CO 1	C3
			CO 2	C1
			CO 3	C3
			CO 4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electric Machinery Fundamentals- Stephen J. Chapman;
2. A Text book of Electrical Technology (V-I and II) - B.L. Theraja and A. K. Theraja;
3. Electronic Devices & Circuit theory-Robert L. Boylestad.
4. Principles of Electronics : V.K. Mehta
5. Introductory Circuit Analysis – Robert Boylestad

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.4.2. EECE 382: Marine Electrical and Electronics Sessional
Level-3, Term-I (Spring Term)

COURSE INFORMATION			
Course Code	: EECE 382	**Contact Hours**	3.00
Course Title	: Marine Electrical and Electronics Sessional	**Credit Hours**	1.5

PRE-REQUISITE	
Course Code:	EECE 281
Course Title:	Electrical and Electronic Technology for Marine Application

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To help the students to explore various DC and AC machines and to teach about the concepts, principles and working of basic electronic devices and circuits by hand-held experiments. Our mission is to expose students to the constructions of electrical machines and basic electronic circuit to analyze their performance. This course is targeted to verify the properties of generator, motor, diode, BJT, MOSFET and relate them with their theoretical knowledge.

OBJECTIVE

1. Be able to calculate various parameters of machines like voltage regulation, efficiency etc., observe their behaviour under various load conditions and compare them.

2. To enable the students to be familiarized and implement different semiconductor diode circuits (e.g. rectifier**,** regulator), their output characteristics and their practical implication in real life.

3. To familiarize the students with input and output characteristics of different BJTs, FETs and also the operation of each device in terms of junction bias voltage and charge carrier movement.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Method
CO1	**Compare** the starting and operating characteristics of various electrical machines	PO5	C1	1	1	6	R, Q, T
CO2	**Interpret** input and output characteristics of different electronic component for specified requirements using both simulating tools and hardware.	PO5	P7	1,2		6	R,Q,T
CO3	**Organize** project tasks maintaining solidarity during the group projects and presentations.	PO10	A4		1		PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 281 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Compare** the starting and operating characteristics of various electrical machines					3							
CO2	**Interpret** input and output characteristics of different electronic component for specified requirements using both simulating tools and hardware.					3							
CO3	**Organize** project tasks maintaining solidarity during the group projects and presentations.										3		

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 6 6 5 26
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week1	Introduction to the lab equipment, rules and norms of the laboratory
Week2	Expt-01: Computing the regulation of the Transformer in Various Loads.
Week3	Expt-02: Study the properties of Three-Phase Alternator in various loads
Week4	Expt-03: Study the properties of Three Phase Induction motor.
Week5	Expt-04: Study the properties of Capacitor-Start & Run Motor.
Week6	Expt-05: Study the properties of synchronous motor.
Week7	Expt-06: Study the characteristics of diode.
Week8	Expt-07: Study of diode rectifier circuits.
Week9	Expt-08: Study of the characteristics of SCR.
Week10	Expt-09: Study of common base bipolar junction transistor characteristics.
Week11	Practice Lab
Week12	Lab Test + Viva
Week13	Quiz test
Week14	Project submission

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Participation and Report	20%	CO1	C1
			CO2	P7
	Labtest-1, Labtest-2	30%	CO1	C1
			CO2	P7
	Project and Presentation	25%	CO3	A4
Lab Quiz		25%	CO1	C1
			CO2	P7
Total Marks		100%		

(CO= Course Outcome, C = Cognitive, P = Psychomotor, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electric Machinery Fundamentals- Stephen J. Chapman
2. Text book of Electrical Technology (V-II) - B.L. Theraja and A. K. Theraja
3. Electronic Devices & Circuit Theory-Robert L. Boylestad.
Principles of Electronics : V.K. Mehta

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.5. Nuclear Science and Engineering (NSE)

6.5.1. EECE 119: Fundamentals of Electrical Circuit Analysis
Level-1, Term-I (Spring Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 119 : Fundamentals of Electrical Circuit Analysis	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To learn and familiarize the basics of electric and magnetic circuit as well as the analysis of DC and AC circuit.			
OBJECTIVE			
1. Familiarize students with basic Circuit laws (Ohm, Kirchhoff), techniques (Mesh, Nodal), concepts (Superposition, Source Transformation) and theorems (Thevenin, Norton). 2. Introduce the definition and derivation of AC power (Average power, Instantaneous power) along with other power concepts (Power factor, Complex power, maximum average power transfer). 3. Impart knowledge of AC power conservation and measurements to be applied in practical field. 4. Impart in depth knowledge of balanced and unbalanced 3 phase circuits, their analysis and configurations (Y, Δ). 5. Articulate the concepts of magnetically coupled circuits (mutual inductance, dot convention) three phase and poly phase circuits			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the basic circuit laws	PO1	C2	-	-	3	T, F, Q
CO2	**Apply** the circuit theorems to **Solve** the AC and DC circuits	PO2	C3	-		3	T, MT, F
CO3	**Analyse** the magnetic circuits and three phase circuits	PO1	C4	1		2,3	MT, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Laws of electric circuit: Ohm's Law, Kirchhoff's voltage and current laws, delta-wye transformation.
Electrical networks: network analysis methods of branch and loop currents, method of node pair voltages, Thevenin's and Norton's theorems.
Magnetic concepts and units: magnetic field, right hand rule, magnetic flux density, Biot-Savart law, magnetic field intensity, measurement of magnetic flux, energy of magnetic field, characteristic of ferromagnetic materials, theory of ferromagnetism, B-H curve, hysteresis loss, eddy current and eddy current loss, total core loss. Introduction to magnetic circuits.

Electromagnetic forces: forces upon a current carrying conductor and charged particles moving in a magnetic field. Electromagnetic torque; electric motor. Electromagnetic induction and emf; Lenz's law, Blv rule, elementary a.c. generator.
General concepts and definitions: Instantaneous current, voltage and power, R, L, C, RL, RC and RLC branches.
Effective current and voltage: average values, form factor, crest factor, power real and reactive. Introduction to vector algebra. Impedance in polar and Cartesian forms. Sinusoidal single phase circuit analysis. Impedance in series, parallel branches, series-parallel circuits. Network analysis – Thevenin's theorem.
Balanced poly phase circuits: three phase, four wire system of generated emfs, three phase, three wire systems, balanced wye loads, balanced delta loads, power in balanced systems, power factor. Balanced three phase circuit analysis and power measurement.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the basic circuit laws	3											
CO2	**Apply** the circuit theorems to **solve** the AC and DC circuits		2										
CO3	**Analyse** the magnetic circuits and three phase circuits	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	105
Formal Assessment	06
Total	153

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Weeks	Topics	Remarks
Week-1	**Laws of electric circuit:** Ohm's Law, Kirchhoff's voltage and current laws, delta-wye transformation.	**Class Test 1, Final Exam**
Week-2	**Laws of electric circuit:** Ohm's Law, Kirchhoff's voltage and current laws, delta-wye transformation (2)	
Week-3	Electrical networks: network analysis methods of branch and loop currents	
Week-4	**Electrical networks:** network analysis methods of branch and loop currents	**Class Test 2, Final Exam**
Week-5	Method of node pair voltages, Thevenin's and Norton's theorems.	
Week-6	**Magnetic concepts and units:** magnetic field, right hand rule, magnetic flux density,	
Week-7	Biot-Savart law, magnetic field intensity, measurement of magnetic flux, energy of magnetic field, characteristic of ferromagnetic materials, theory of ferromagnetism	
Week-8	B-H curve, hysteresis loss, eddy current and eddy current loss, total core loss. Introduction to magnetic circuits.	**Mid Term, Final Exam**
Week-9	**Electromagnetic forces:** forces upon a current carrying conductor and charged particles moving in a magnetic field.	
Week-10	Electromagnetic torque; electric motor. Electromagnetic induction	

	and emf; Lenz's law, Blv rule, elementary a.c. generator.	
Week-11	**General concepts and definitions:** Instantaneous current, voltage and power, R, L, C, RL, RC and RLC branches.	**Class Test 3, Final Exam**
Week-12	**Effective current and voltage:** average values, form factor, crest factor, power real and reactive. Introduction to vector algebra. Impedance in polar and Cartesian forms. Sinusoidal single phase circuit analysis. Impedance in series, parallel branches, series-parallel circuits. Network analysis – Thevenin's theorem.	
Week-13	**Balanced poly phase circuits:** three phase, four wire system of generated emfs,	
Week-14	three phase, three wire systems, balanced wye loads, balanced delta loads, power in balanced systems, power factor. Balanced three phase circuit analysis and power measurement.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment (1-3)	20%	CO1	C2
			CO2	C3
			CO3	C4
	Class Participation	5%	CO1	C2
	Class Attendance	5%		
	Mid term	10%	CO3	C4
Final Exam		60%	CO1	C2
			CO2	C3
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson;
3. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
4. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
5. Introduction to Electrical Engineering – Robert P. Ward
6. Fundamentals of Electric Circuits – Charles Alexander and Mathew Sadiku.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.5.2. EECE 120: Fundamentals of Electrical Circuit Analysis Sessional
Level-1, Term-I (Spring Term)

COURSE INFORMATION

Course Code Course Title	: EECE 120 : Fundamentals of Electrical Circuit Analysis Sessional	Lecture Contact Hours Credit Hours	: 1.50 : 0.75

PRE-REQUISITE

Course Code: EECE 119
Course Title: Fundamentals of Electrical Circuit Analysis

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course of electrical engineering discipline aims to familiarize the students with implementation of basic electrical circuits in hardware domain. Designed for fresher students, experiments of this laboratory course will enable them to assemble beginner-level circuits to experimentally verify some fundamental circuit laws and theorems (KVL, KCL, Thevenin, Norton). This course also familiarizes the students with hardware implementation of AC circuits and measurement of ac quantities by oscilloscope. Moreover, this course will introduce the students with fundamental electrical machines (Motor, Generator) practically. Finally, this course is targeted to introduce the students with hardware projects that will provide them with the first hand on experience about application of electrical engineering in real life and simulation of electrical circuits in a widely used simulation software (Proteus).

OBJECTIVE

1. To enable the students to apply the fundamental circuit laws (KVL, KCL, Ohm's law) in hardware domain.
2. To develop students' skills to simplify complex electrical circuits into simpler circuits by Thevenin and Norton's theorem and verify them in hardware.
3. To teach the students the basic operation of oscilloscope to measure AC quantities (magnitude and phase).
4. To impart the students the skills of analogue filter design by RLC circuit.
5. To introduce the students with fundamental electrical machines (Motor, Generator)
5. To familiarize the students with implementation of hardware electrical projects and a circuit simulation software (Proteus)

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **assemble** electrical circuits that can **verify** fundamental electrical laws (KVL, KCL and Ohm's Law, Thevenin's law and Norton's law)	PO9	P5, A3	1			R, Q, T
CO2	Achieve ability to **design** analogue RLC filters, **produce** desired ac waves and **measure** amplitude and phase of ac waves in oscilloscope.	PO10	P6	1			R, Q, T
CO3	Be able to **operate** fundamental electrical machines (Motor, Generator).	PO9	P4	1			R, Q, T
CO4	Be able to develop collaborating nature by **completing** a simple project in both software and hardware and **performing** group activities.	PO5	P7, A4	2	1	6	PR, R, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile,T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

COURSE CONTENT

In this course students will get a hands-on experience about electrical circuits. They will observe the uses of electrical circuits practically. They will find out different values of elements practically and match the results with theoretical values.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **assemble** electrical									3			

	circuits that can **verify** fundamental electrical laws (KVL, KCL and Ohm's Law, Thevenin's law and Norton's law)												
CO2	Achieve ability to **produce** desired ac waves and **measure** amplitude and phase of ac waves in oscilloscope.										3		
CO3	Be able to **operate** fundamental electrical machines (Motor, Generator).									3			
CO4	Be able to develop collaborating nature by **completing** a simple project in both software and hardware and **performing** group activities.					3							

(3 – High, 2- Medium, 1-low)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Practical / Tutorial / Studio	14
Student-Centred Learning	21
Self-Directed Learning	
Preparation of Lab Reports	9
Preparation of Lab Test	4
Preparation of presentation	5
Preparation of Quiz	5
Engagement in Group Projects	10
Formal Assessment	
Continuous Assessment	14
Final Examination	1
Total	90

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week	Topic
1	Construction and operation of simple electrical circuits
2	Verification of KVL and KCL
3	Verification of Superposition Theorem and Thevenin's theorem
4	Familiarization with alternating current (ac) waves
5	Study of R-L-C series circuit
6	Lab Test-02
7	Quiz+ Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (75%)	Lab participation and Report	20%	CO1	P5, A3
			CO2	P6
			CO3	P4
	Labtest-1 ,Labtest-2	30%	CO1	P6
			CO2	P4
			CO3	P7, A4
	Project and Presentation	25%	CO4	P7, A4
Lab Quiz		25%	CO1	P5, A3
			CO2	P5, A3
			CO3	P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Fundamentals of Electric Circuits – Matthew Sadiku, Charles Alexander
3. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson
4. Alternating Current Circuits- Russell M Kerchner and George F Corcoran

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.5.3. EECE 221: Electrical and Electronics Technology
Level-2, Term-II (Fall Term)

COURSE INFORMATION

Course Code	: EECE 221	Lecture Contact Hours	: 3.00
Course Title	: Electrical and Electronics Technology	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 119

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To develop a strong foundation in the basic operating principle, constructions, characteristic features, applications etc. of AC electrical machinery like synchronous generator, synchronous motor and three phase and single-phase induction motors and special motors. The emphasis has been given on both physical insight and analytical techniques. The subject material covered here will provide the basis for understanding many real-world electric machinery applications as well as the foundation for advanced courses in electric machinery design and control. To teach the students the concepts, principles and working of basic electronic circuits (Diodes, BJTs). It is targeted to provide a basic foundation for technology areas like electronics devices (rectifiers, voltage regulators and amplifiers), industrial electronics as well as instrumentation, control systems and various electronic circuit design. Finally, this course is designed to develop a designing capability involving real life practical problems.

OBJECTIVE

1. To impart basic knowledge on the physics of semiconductor along with the types, specification and standard values of passive and active components of electronic circuits.
2. To develop a strong foundation on AC electrical machines (synchronous machines, induction machines, universal machines etc) with a special focus on operating principle, identification of parts and accessories, constructional features, types etc

3. To familiarize with basic electronic circuits (rectifiers, voltage regulators and amplifiers), their working principles, design criteria and system components.
4. To develop a broad idea on application of machines in practical industrial and domestic field.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the fundamental operation, basic construction and classification of different AC and DC machines	PO1	C2			3	T, F
CO2	**Interpret** and **analyze** the performance characteristics of different electrical machines e.g. transformers, DC and AC machines	PO1	C4			3	T, F
CO3	**Analyze** basic electronic circuits considering existing system models to explore practical complex engineering problems.	PO3	C4			5	MT, F
CO4	**Design** various electronic circuits using both passive and active components to solve the real-life engineering problems.	PO3	C6	1		5	ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT-Mid Term Exam)

COURSE CONTENT

Transformer: Principles, types, performances and characteristics and Introduction to Auto Transformer
DC generators: Principles, types, performances and characteristics.
DC Motors: Principles, types, performances and characteristics. Speed control and starters of motors, Permanent Magnet Brushless dc (BLDC) Motor Drives
AC Machines: Principles of three phase induction motor and equivalent circuits. Introduction to synchronous machines.
Electronics: Introduction, characteristics of semiconductor diodes, Diode Applications, Characteristics of BJT and their DC Biasing and Introduction to FET, MOSFET, IGBT, SCR

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the fundamental operation, basic construction and classification of different AC and DC machines	3											
CO2	**Interpret** and **analyze** the performance characteristics of different electrical machines e.g. transformers, DC and AC machines	3											

CO3	**Analyze** basic electronic circuits considering existing system models to explore practical complex engineering problems.			3									
CO4	D**esign** various electronic circuits using both passive and active components to solve the real-life engineering problems.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	84
Revision	21
Formal Assessment	
Continuous Assessment	2
Mid-Term	1
Final Examination	3
Total	153

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	Transformer: Principles, types, Auto Transformer
Week 2	Transformer: Performances and characteristics.
Week 3	DC generators: Principles, types
Week 4	DC generators: Performances and characteristics.
Week 5	DC Motors: Principles, types: Magnet Brushless dc (BLDC) Motor Drives
Week 6	DC Motors: Performances and characteristics
Week 7	DC Motors: Speed control and starters of motors.
Week 8	AC Machines: Principles of three phase induction motor and equivalent circuits
Week 9	AC Machines: Introduction to synchronous machines and fractional horse power motors.
Week 10	AC Machines: Introduction to synchronous machines and fractional horse power motors
Week 11	Electronics: Characteristics of semiconductor diodes
Week 12	Electronics: Diode Applications
Week 13	Characteristics of BJT and Introduction to FET, SCR, IGBT
Week 14	DC Biasing of BJT

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous	Class Test/	20%	CO1	C2

Assessment (40%)	Assignment 1-3		CO2	C4
			CO3	C4
	Class Participation	5%	-	-
	Class Attendance	5%		
	Mid term	10%	CO3	C4
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C4
			CO4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electrical Machinery Fundamental - Stephan J. Chapman; McGraw-Hill.
2. A Text Book of Electrical Technology (AC, DC Machines) – B.L Theraja & A.K. Theraja;
3. Electrical Machines - Nagrath and Kothan; McGraw-Hill.
4. Electronic Devices & Circuit theory-Robert L. Boylestad.
5. Micro Electronics Circuits – Adel S. Sedra & Keneth C. Smith; Oxford University Press.
6. Power Electronics (Circuits, devices & Application) - MD. H. Rashid; Prentice Hall of India.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.5.4. EECE 222: Electrical and Electronics Technology Laboratory
Level-2, Term-II (Fall Term)

COURSE INFORMATION

Course Code Course Title	: EECE 222 : Electrical and Electronics Technology Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 221
Course Title: Electrical and Electronics Technology

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize with the instrumentation and control systems by theoretical analysis and experiments. The course is designed to provide a practical - hands on introduction to electronics with a focus on measurement and signals. The aim is to provide students with the practical knowledge necessary to work in a modern science or engineering setting and to instil a degree of comfort and familiarity with electronics that will be useful in designing experiments, building simple circuits, and understanding the behaviour of complex circuits that will be helpful in the long run in Nuclear Science and Engineering.

OBJECTIVE

1.To enable the students to explain the basic electrical measurement tools and techniques to employ circuit laws and theorems of electrical circuit analysis into real-life electrical problems.
2.To make students proficient in working with basic circuit simulation software (e.g. PSpice/Multisim) for analyzing electrical circuits and numerical software (e.g. MATLAB) for solving electrical circuits and help study and analyze the data obtained for performance evaluation.
3. To impart into students the quality of optimizing circuit characteristics by varying circuit parameters using simulating tools and familiarize with the sample case data to face comparatively new scenarios in real life application fields.

COURSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the basic operation principle of practical electrical and electronic equipment and their characteristics along with **selection** of different types of methods of measurement for different measurement scenarios.	PO1	P1, A3			3	R,Q,T
CO2	Be able to **analyze** synthesis of data and information with the help of modern technologies and tools: study, design and implementation, and **compute** performance analysis of practical measurement systems and simulation in software suites.	PO5	C4			6	R,Q,T, Pr
CO3	Be able to **evaluate**, debug and improve the operation of a measurement system to **adapt** to new, unexpected situations in practical instruments.	PO4	C5, P6	P2		8	R,Q,T, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 221 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the basic operation principle of practical electrical and electronic equipment and their characteristics along with **selection** of different types of methods of measurement for different measurement scenarios.		1										
CO2	Be able to **analyze** synthesis of data and information with the help of modern technologies and tools: study, design and implementation, and **compute** performance analysis of practical measurement systems and simulation in software suites individually or in group projects.					3							

CO3	Be able to **evaluate**, debug and improve the operation of a measurement system to **adapt** to new, unexpected situations in practical instruments.				2								

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Experiment	14
Self-Directed Learning	
Preparation of Lab Reports	7
Preparation of Lab-test	6
Preparation of Quiz	7
Preparation of Presentation	6
Engagement in Group Projects	21
Formal Assessment	
Continuous Assessment	6
Final Quiz	1
Total	75

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Design Based Method

COURSE SCHEDULE

Weeks	Topics
Week 1	Exp 1: Regulation of the Transformer in Various Loads
Week 2	Exp 2: Study the properties of Three-Phase Alternator in various loads
Week 3	Exp 3: Study the properties of DC Shunt Motor.
Week 4	Exp 4: Study the properties of DC Separately Excited and Self-Excited Shunt Generator.
Week 5	Exp 5: Study the properties of Squirrel-Cage Induction Motor.
Week 6	Exp 6: Study the properties of synchronous motor.
Week 7	Labtest-1
Week 8	Exp 7: Study the diode characteristics and rectifier circuit
Week 9	Exp 8: Study of N-P-N CE (Common emitter) transistor characteristics
Week 10	Exp 9: Study of N-P-N CB (Common base) transistor characteristics
Week 11	Study of Characteristics of Field Effect Transistor (FET) and its Application in CMOS Inverter
Week 12	Performance Analysis of Common Source (CS) and Common Drain (CD) JFET Small Signal Amplifier
Week 13	Lab test 2 + Viva
Week 14	Quiz+ Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO1	P1, A3
			CO2	C4
			CO3	C5, P6
	Labtest-1, Labtest-2	30%	CO1	P1, A3

			CO2	C4
			CO3	C5, P6
	Project and Presentation	25%	CO3	C5, P6
Lab Quiz		25%	CO1	P1, A3
			CO2	C4
			CO3	C5, P6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electric Machines and Transformers – Irving L. Kosow.
2. Electrical Machines Fundamentals – Stephan J. Chapman.
3. A Text Book of Electrical Technology (AC, DC Machines) –B L Theraja, A. K. Theraja.
4. Electronic Devices and Circuit Theries – R. L. Boylsted.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.6. Biomedical Engineering (BME)

6.6.1. EECE 191: Fundamentals of Electrical Engineering
Level-1, Term-I (Spring Term)

COURSE INFORMATION

Course Code	: EECE 191	Contact Hours	: 3.00
Course Title	: Fundamentals of Electrical Engineering	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome-Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize the basics of electrical circuit components, analysis of DC and AC circuits and the basics of electrical machines. The course covers the following modules: DC and AC circuits, DC Generator, DC Motor, AC Machines, and Transformer.

OBJECTIVE

1. To understand the basics of AC and DC circuits.
2. To apply different laws of circuit theorems for solving various engineering problems.
3. To explain the behavior of different electrical machines.
4. To analyze different circuit-related complex engineering problems efficiently.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	PO	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the basics of AC and DC circuits	C2	PO1	1	-	3	T, F
CO2	Be able to **apply** different laws of circuit theorems for solving various engineering problems.	C3	PO2	1,3	-	3	T, F
CO3	Be able to **understand** the behavior of different electrical machines.	C2	PO1	1	-	1	MT, F
CO4	Be able to **analyze** different circuit-related complex engineering problems efficiently.	C4	PO2	1,3	-	3	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Fundamentals of electrical circuit: Ohm's Law, Kirchhoff's voltage and current laws, Delta-wye transformation, Basic concept on AC and DC circuits, RL, RC, RLC-based AC circuit, Impedance in series, parallel branches, series-parallel circuits, Resonance in AC circuits, Transient response of capacitor and inductor circuits. Electrical networks: Network analysis methods of branch and loop currents, Nodal circuit analysis, Thevenin's, and Norton's theorems. Effective current and voltage: Average values, Form factor, Crest factor, Concept of real and reactive power. Introduction to phasor algebra: Impedance in polar and Cartesian forms, Sinusoidal single-phase circuit analysis, Impedance measuring by vector diagram. Balanced polyphase circuits: Three-phase four-wire and three-phase three-wire system of electrical load, balanced wye loads, balanced delta loads, power in balanced systems, power factor. Balanced three-phase circuit analysis, and power measurement. DC Generator: Working principle, types, performances, and characteristics. DC Motor: Working principle, types, performances, speed control, starters and characteristics, AC Machines: Three-phase induction motor principles, equivalent circuit, single-phase induction motor principle, Principles of AC generator. Transformer: Principles of singe and three-phase transformer, Equivalent circuit of single-phase transformer, Different losses of transformers, Instrument Transformer, Applications of the transformer in AC system. Technical specifications of different electrical machines.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **understand** the basics of AC and DC circuits	3											
CO2	Be able to **apply** different laws of circuit theorems for solving various engineering problems.		3										
CO3	Be able to **understand** the behavior of different electrical machines.	3											
CO4	Be able to **analyze** different circuit related complex engineering problems efficiently.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous and (or) subsequent lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Topic	Assessment
Week 1	**Fundamentals of Electrical Circuit**	**CT – 1, Final**
Lecture 1	Ohm's Law, Kirchhoff's voltage and current laws, Series-Parallel circuits	
Lecture 2	Voltage and current division, Delta-wye transformation	
Lecture 3	Basic concept on AC and DC circuits, RL, RC and RLC-based AC circuit	
Week 2	**Fundamentals of Electrical Circuits (Cont...)**	
Lecture 4	Impedance in series and parallel branches,	
Lecture 5	Concept of resistance, reactance, inductance, capacitance, susceptance, admittance, and impedance	
Lecture 6	Finding impedance of series-parallel AC circuits	
Week 3	**Fundamentals of Electrical Circuits (Cont...)**	
Lecture 7	Resonance in AC circuits	
Lecture 8	Transient response of capacitor and inductor circuits	
Lecture 9	Sinusoidal-steady-state response	
Week 4	**Electrical Network Analysis**	**CT – 2, Final**
Lecture 10	Network analysis methods of branch and loop currents	
Lecture 11	Nodal circuit analysis, Mesh Circuit Analysis	
Lecture 12	Superposition Theorem	
Week 5	**Electrical Network Analysis and Effective Current and Voltage**	
Lecture 13	Thevenin's and Norton's theorems	
Lecture 14	Features of AC signal, Average values, RMS value, Form factor, Crest factor, and relevant mathematical problem	
Lecture 15	Concept of real and reactive power and relevant mathematical problems	
Week 6	**Introduction to Phasor Algebra**	
Lecture 16	Impedance in polar and Cartesian forms	
Lecture 17	Sinusoidal single-phase circuit analysis	
Lecture 18	Impedance measuring by vector diagram.	
Week 7	**Balanced Poly Phase Circuits**	
Lecture 19	Three-phase four-wire and three-phase three-wire system of electrical load	
Lecture 20	Balanced wye loads, balanced delta loads	
Lecture 21	Power in balanced systems	
	Midterm Break	
Week 8	**Balanced Poly Phase Circuits (Continue)**	**Midterm, Final**
Lecture 22	Power factor measurement of single and 3 phase systems,	
Lecture 23	Balanced three-phase circuit analysis and Power measurement	
Lecture 24	Some related mathematical problem solving	
Week 9	**DC Generator**	
Lecture 25	Working principles of DC generator	
Lecture 26	Basic components and types of DC generator	
Lecture 27	Performances and Characteristics, applications of DC generator	
Week 10	**DC Motor**	
Lecture 28	Working principle of DC motor	
Lecture 29	Basic components and types of DC motor	

Lecture 30	Performances and characteristics, speed control of DC motor	
Week 11	**DC Motor (Cont…) and AC Machines**	**CT – 3, Final**
Lecture 31	Different starters of DC motor	
Lecture 32	Applications of DC motor	
Lecture 33	Principles of three-phase induction motor and its equivalent circuit	
Week 12	**AC Machines**	
Lecture 34	Principles of Single phase induction motor and its equivalent circuit	
Lecture 35	Principles of AC generator	
Lecture 36	Principles of Synchronous Motor and its application	
Week 13	**Transformer**	**FINAL**
Lecture 37	Principles of singe and three-phase transformer	
Lecture 38	Equivalent circuit of single-phase transformer	
Lecture 39	Different loses and efficiencies of transformers and relevant mathematical problems	
Week 14	**Transformer (Cont...)**	
Lecture 40	Instrument transformers	
Lecture 41	Applications of various machines in the Biomedical Engineering Field	
Lecture 42	Familiarization with Technical specifications of different electrical machines.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO3	C2
			CO4	C4
	Class Participation	5%	CO3	C2
	Class Attendance	5%		
	Mid term	10%	CO2	C3
Final Exam		60%	CO 1	C2
			CO 2	C3
			CO 3	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain)

TEXT AND REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.
3. A Textbook of Electrical Technology - B.L Theraja
4. Electrical Machinery Fundamentals- Stephen J Chapman

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.6.2. EECE 192: Fundamentals of Electrical Engineering Sessional
Level-1, Term-I(Spring Term)

COURSE INFORMATION

Course Code Course Title	: EECE 192 : Fundamentals of Electrical Engineering Sessional	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

EECE 191

CURRICULUM STRUCTURE
Outcome-Based Education (OBE)
SYNOPSIS/RATIONALE
To learn and familiarize the basics of electrical circuit components, analysis of DC and AC circuits and the basics of electrical machines. DC and AC circuits, DC Generator, DC Motor, AC Machines, and Transformer module will be covered by this course.
OBJECTIVE
This course aims to practically implement the concepts of AC and DC circuits and learn the principle and applications of different electrical machines.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** different laws of circuit theorems for solving various engineering problems.	PO9	C3	1			T, Q, R
CO2	Be able to **understand** the behavior of different electrical machines.	PO10	C2	1, 3			T, Q, R
CO3	Be able to **analyze** different circuit-related complex engineering problems efficiently.	PO9	C4	1			T, Q, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 191 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **apply** different laws of circuit theorems for solving various engineering problems.									3			
CO2	Be able to **understand** the behavior of different electrical machines.										3		
CO3	Be able to **analyze** different circuit-related complex engineering problems efficiently.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Practical / Tutorial / Studio	35
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	-
Revision of the previous and (or) subsequent lecture at home	15
Preparation for the final examination	10

Formal Assessment Continuous Assessment Lab Test Quiz Viva	 1 1 0.75 0.25
Total	70

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Lecture Topics
1	Construction and operation of simple electrical circuits
2	Verification of KVL and KCL
3	Verification of Superposition Theorem
4	Verification of Thevenin's and Norton's theorem
5	Familiarization with alternating current (ac) waves and study of R-L-C series circuit.
6	Series Resonance and Parallel Resonance
7	Experiment on the principles and properties of DC Generator
8	Experiment on the principles and properties of DC Motor
9	Experiment on the principles and properties of Alternator
10	Experiment on the principles and properties of Transformer
11	Familiarization with the technical specifications of various Electrical Machines
12	Review class
13	Lab Test
14	Quiz and Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Report	20%	CO1, CO2, CO3	C3, C2, C4
	Class Participation	20%	CO1, CO2, CO3	C3, C2, C4
Final Exam (60%)	Lab Test	20%	CO1, CO2, CO3	C3, C2, C4
	Quiz	30%	CO1, CO2, CO3	C3, C2, C4
	Viva	10%	CO1, CO2, CO3	C3, C2, C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Fundamentals of Electric Circuits- Alexander & Sadiku.
2. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
3. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.
4. A Textbook of Electrical Technology - B.L Theraja
5. Electrical Machinery Fundamentals- Stephen J Chapman

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.6.3. EECE 291: Electronic Circuits and Devices
Level-2, Term-I(Spring Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 291 : Electronic Circuits and Devices	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
EECE 191: Fundamentals of Electrical Technology			
CURRICULUM STRUCTURE			
Outcome-Based Education (OBE)			
SYNOPSIS/RATIONALE			
To teach the students about the concepts, principles, and working of basic electronic circuits. It is targeted to provide a basic foundation for technology areas like electronic devices, communication systems, industrial electronics, instrumentation, control systems, and various electronic circuit designs.			
OBJECTIVE			
1. To understand the basics of electronic devices like Diode, Transistor, MOSFET, Op-Amp, etc., and its applications. **2.** To become skilled at designing different electronic circuits like rectifiers, amplifiers, active filters, etc. using electronic devices.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** semiconductor devices' basic operation and characteristics like diodes, BJTs, and FETs.	PO1	C2	1	-	3	T, F
CO2	Be able to **apply** the established equivalent models to find the important ac parameters for an amplifier.	PO1	C3	1,3	-	3	T, F
CO3	Be able to **analyze** the DC and AC output response of a network designed with BJT and become acquainted with the BJT amplifiers' design process.	PO2	C4	1	-	3	MT, F
CO4	Be able to **understand** the characteristics of Op-Amps and its applications.	PO2	C2	1,3	-	3	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to Semiconductors; P-type and n-type semiconductors, p-n junction diode characteristics, Diode applications, half and full-wave rectifier, clipping and clamping circuits; regulated power supply using Zener diode. Bipolar junction transistor (BJT), principle of operation, I-V characteristics, Transistor circuits configurations (CB, CE and CC), BJT biasing, load lines, small-signal analysis of single and multi-stage amplifiers, frequency response of BJT amplifiers. Field effect transistors (FET), principle of operation of JFET and MOSFET, Depletion and Enhancement type NMOS and PMOS, biasing of FETs, Low and High frequency models of FETs, Switching circuit using FETs, Introduction to CMOS. Operational amplifier (OPAMP), linear application of OPAMPs, gain, input and output impedances, differential amplifiers, common-mode rejection ratio, instrumentation amplifier, active filters, frequency response and noise, zero crossing, positive and negative level detectors, and application of Op-Amp.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **understand** semiconductor devices' basic operation and characteristics like diodes, BJTs, and FETs.	3											
CO2	Be able to **apply** the established equivalent models to find the important ac parameters for an amplifier.	3											
CO3	Be able to **analyze** the DC and AC output response of a network designed with BJT and become acquainted with the BJT amplifiers' design process.		2										
CO4	Be able to **understand** the characteristics of Op-Amps and its applications.		2										

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous and (or) subsequent lecture at home	21
Preparation for the final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	**Topic**	**Assessment**
Week 1	**Semiconductor devices**	
Lecture 1	Basic idea about Electronics, Examples of electronic devices, and comparison with electrical equipment's.	
Lecture 2	Introduction to semiconductor devices and its classifications, P-type and N-type materials, and doping	**CT – 1, Final**
Lecture 3	Semiconductor diode and its band diagram, Biasing of semiconductor diodes	
Week 2	**Diodes**	
Lecture 4	I-V characteristics of the diode and equivalent circuit of diodes, Shockley's equation and related mathematical problems	
Lecture 5	Zener diode and related maths of Zener diode	

Lecture 6	Applications of diode	
Week 3	**Diodes**	
Lecture 7	Diode rectifiers	
Lecture 8	Ripple factor, and related mathematical problems.	
Lecture 9	Clipper circuit and related problems, Clamper circuit and related problems	
Week 4	**BJT**	
Lecture 10	Introduction to BJT and construction	
Lecture 11	Working principle and operating regions of BJT, CB, CE, and CC configurations and characteristics curves	
Lecture 12	Mathematical problems related to different configurations using BJT	
Week 5	**BJT**	
Lecture 13	BJT Biasing, Mathematical problems related to BJT biasing	
Lecture 14	Mathematical problems related to BJT biasing	
Lecture 15	Mathematical problems related to BJT biasing	**CT-2, Final**
Week 6	**BJT**	
Lecture 16	BJT as an amplifier, BJT as a switch, and biasing the BJT for discrete circuits	
Lecture 17	Small-signal analysis of single and multi-stage amplifiers	
Lecture 18	Voltage and current gain, input and output impedance of a common base configurations	
Week 7	**BJT**	
Lecture 19	Voltage and current gain, input and output impedance of a common emitter configurations	
Lecture 20	Voltage and current gain, input and output impedance of a common collector configurations	
Lecture 21	The frequency response of BJT amplifiers	
	Midterm Break	
Week 8	**FET**	
Lecture 22	Introduction to FET and comparative studies between BJT and FET	
Lecture 23	Construction, operation, Drain characteristics, and Transfer characteristics of JFET	
Lecture 24	Pinch off voltage	
Week 9	**FET**	
Lecture 25	Mathematical problems related to JFET	**Midterm**
Lecture 26	Introduction to MOSFET, construction, operation, input characteristics, output characteristics of depletion type MOSFET, and related mathematical problems.	
Lecture 27	Construction, operation, input characteristics, output characteristics of enhancement type MOSFET, and related mathematical problems	
Week 10	**Biasing of FET**	
Lecture 28	Biasing of JFET and related problems	
Lecture 29	Biasing of MOSFET and related problems	
Lecture 30	Biasing of MOSFET and related problems	
Week 11	**MOSFET**	
Lecture 31	Threshold voltage, Body effect, current-voltage characteristics of an enhancement MOSFET	
Lecture 32	Single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter	**Final**
Lecture 33	Mathematical Problems	
Week 12	**OP-AMP**	**CT – 3, Final**
Lecture 34	Introduction to Op-amp, Characteristics, Gain, Input and Output	

	Impedances	
Lecture 35	Summing, Scaling, Averaging, and Subtractor Amplifiers	
Lecture 36	Differential Amplifiers, Differentiator, and Integrator	
Week 13	**OP-AMP**	
Lecture 37	Common Mode Rejection Ratio (CMRR)	
Lecture 38	Active filters	**FINAL**
Lecture 39	Active filters	
Week 14	**OP-AMP**	
Lecture 40	Instrumentation Amplifiers	
Lecture 41	Zero-Crossing Detector, Positive and Negative Voltage level detector	
Lecture 42	Other Applications of Op-Amp	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO3	C2
			CO4	C4
	Class Participation	5%	CO3	C2
	Class Attendance	5%		
	Midterm	10%	CO2	C3
Final Exam		60%	CO 1	C2
			CO 2	C3
			CO 3	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electronic Device and Circuit Theory by Robert L. Boylestad
2. Op-amps and linear integrated circuits by Ramakant A Gayakwad
3. Operational Amplifiers and Linear Integrated Circuit – by Robert F. Coughlin and Frederic R. Driscoll.
4. Microelectronic Circuits Theory and Applications - by Adel S. Sedra and Kenneth C. Smith Electronic Devices Circuits by Millman and Halkias

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.6.4. EECE 292: Electronic Circuits and Devices Sessional
Level-2, Term-I(Spring Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 292 : Electronic Circuits and Devices Sessional	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Electronic Circuits and Devices (EECE 291)

CURRICULUM STRUCTURE

Outcome-Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize with the basics of electronic circuits and utilize electronic devices for practical purposes.

OBJECTIVE

1. To learn about electronic circuits and to implement the basic electronic devices circuits.
2. To know and use of BJT, MOSFET and JFET devices for theoretical and practical purposes.
3. To learn about operational amplifier and filter circuits.
4. To solve complex design problems regarding electronics based on realistic aspects.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** practically the basic electronic devices such as Diode, BJT, MOSFET, FET, and special electronic devices like operational amplifiers.	PO9	P1				T, Q, R
CO2	Be able to **assemble** the basic circuit components and know-how to connect them to make filters and other devices with amplifiers.	PO10	P4				T, Q, R
CO3	Be able to **explain** the concepts of electronic devices, circuits, and uses.	PO9	A3				T, Q, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 291 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** practically the basic electronic devices such as Diode, BJT, MOSFET, FET, and special electronic devices like operational amplifiers.									2			
CO2	Be able to assemble the basic circuit components and know-how to connect them to make filters and other devices with amplifiers.										2		
CO3	Be able to explain the concepts of electronic devices, circuits, and uses.									2			

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Practical / Tutorial / Studio	35
Student-Centered Learning	-
Self-Directed Learning	

Non-face-to-face learning Revision of the previous and (or) subsequent lecture at home Preparation for the final examination	- 15 10
Formal Assessment Continuous Assessment Lab Test Quiz Viva	 1 1 0.75 0.25
Total	70

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	**Lecture Topics**
1	Study of diode characteristics and half-wave rectifier
2	Study of full-wave rectifier, clipper and clamper circuits
3	Study of CB (Common Base) Transistor Characteristics
4	Study of CE (Common Emitter) Transistor Characteristics
5	Study of BJT Biasing Circuits
6	Study the Characteristics of JFET
7	**Lab Test- 01 and Viva**
8	Study the Characteristics of MOSFET
9	Study of Inverting and Non- inverting operations using OP-AMP
10	Mathematical operations using OP-AMP
11	Design Active Filters using Op-Amp
12	Design Differential Amplifiers using Op-Amp
13	**Lab Test- 02 and Viva**
14	Final Quiz

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Report	20%	CO1	P1
			CO2	P4
			CO3	A3
	Class Participation	20%	CO1	P1
			CO2	P4
Final Exam (60%)	Lab Test	20%	CO1	P1
			CO2	P4
			CO3	A3
	Quiz	30%	CO1	P1
			CO2	P4
			CO3	A3
	Viva	10%	CO1	P1
			CO2	P4
			CO3	A3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor, A = Affective Domain)

EXT AND REFERENCE BOOKS

1. Electronic Device and Circuit Theory by Robert L. Boylestad
2. Op-amps and linear integrated circuits by Ramakant A Gayakwad
3. Operational Amplifiers and Linear Integrated Circuit –Robert F. Coughlin and R. Driscoll.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.6.5. EECE 391: Digital Electronics
Level-3, Term-I (Spring Term)

COURSE INFORMATION			
Course Code	: EECE 391	Lecture Contact Hours	: 3.00
Course Title	: Digital Electronics	Credit Hours	: 3.00

PRE-REQUISITE
EECE 291: Electronic Circuits and Devices
CURRICULUM STRUCTURE
Outcome-Based Education (OBE)
SYNOPSIS/RATIONALE
This course will cover the topics/subtopics that will help to learn and familiarize the fundamentals of digital electronics, including the basic logic gates, combinational and sequential circuits, Programmable logic devices, and Modular sequential logic circuit design.
OBJECTIVE
1. To acquire the basic knowledge of digital logic levels and knowledge to understand digital electronics circuits. 2. To prepare students for performing the analysis and design of various combinational and sequential circuits.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	Corresponding PO	CP	CA	KP	Assessment Methods
CO1	Be able to **remember** the structure of various number systems and its application in digital design.	C1	PO1	1	-	3	T, F
CO2	Be able to **understand** the design criterion of combinational and sequential logic circuits as needed.	C2	PO1	1,3	-	3	T, F
CO3	Be able to **apply** the logic gates to solve the real-world Problem of electronic circuits.	C3	PO2	1	-	3	MT, F
CO4	Be able to **analyze** the memory elements, state table, and state diagrams of the sequential circuit.	C4	PO2	1,3	-	3	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to number systems and codes: Number base conversion, Complements, and related problems, Binary codes; Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, combinational logic design, minimization of combinational logic. Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin, and power dissipation. Power optimization of basic gates and combinational logic circuits. Modular combinational circuit design: Pass transistor, pass gates, multiplexer, demultiplexer, and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements, and ALU design. Programmable logic devices: Logic arrays, field programmable logic arrays, and programmable read-only memory. Sequential circuits:
Different types of latches, SR flip-flops, master-slave, JK flip-flops, T & D flip-flops, Flip-flops design using ASM approach, Timing analysis, and power optimization of sequential circuits. Modular sequential logic circuit design: Shift registers, Parallel I/O and Series I/O shift registers, Universal shift register, Counters: Introduction, Asynchronous and Synchronous counters: up and down, BCD counters, Ring counter, Johnson counter. Applications of registers and counters.

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **remember** the structure of various number systems and its application in digital design.	3											
CO2	Be able to **understand** the design criterion of combinatory and sequential logic circuits as needed.	3											
CO3	Be able to **apply** the logic gates to solve the real-world Problem of electronic circuits.		3										
CO4	Be able to **analyze** the memory elements, state table, and state diagrams of the sequential circuit.		3										

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous and (or) subsequent lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Topic	Assessment
Week 1	**Introduction to number systems and codes**	**CT – 1, Final**
Lecture 1	Number base conversion	
Lecture 2	Complements and related problems	
Lecture 3	Binary codes	
Week 2	**Analysis and synthesis of digital logic circuits**	
Lecture 4	Basic logic functions	
Lecture 5	Boolean algebra	
Lecture 6	Boolean algebra	
Week 3	**Analysis and synthesis of digital logic circuits**	
Lecture 7	Combinational logic design	
Lecture 8	Combinational logic design	
Lecture 9	Minimization of combinational logic	
Week 4	**Implementation of basic static logic gates in CMOS and**	

	BiCMOS	**Midterm, Final**
Lecture 10	DC characteristics, noise margin, and power dissipation	
Lecture 11	Power optimization of basic gates	
Lecture 12	Combinational logic circuits	
Week 5	**Modular combinational circuit design**	
Lecture 13	Pass transistor, Pass gates	
Lecture 14	Multiplexer	
Lecture 15	Demultiplexer	
Week 6	**Modular combinational circuit design**	
Lecture 16	Implementation of multiplexer and demultiplexer in CMOS	
Lecture 17	Decoder	
Lecture 18	Encoder	
Week 7	**Modular combinational circuit design**	
Lecture 19	Comparators	
Lecture 20	Binary arithmetic elements and ALU design	
Lecture 21	Binary arithmetic elements and ALU design	
Week 8	**Programmable logic devices**	**CT – 2, Final**
Lecture 22	Logic arrays	
Lecture 23	Field programmable logic arrays	
Lecture 24	Programmable read-only memory	
Week 9	**Sequential Circuits**	
Lecture 25	Different types of latches	
Lecture 26	SR flip-flops, master-slave	
Lecture 27	JK flip-flops	
Week 10	**Sequential Circuits**	
Lecture 28	T & D flip-flops	
Lecture 29	Flip-flops design using the ASM approach	
Lecture 30	Timing analysis and power optimization of sequential circuits	
Week 11	**Modular sequential logic circuit design**	**CT – 3, FINAL**
Lecture 31	Shift registers	
Lecture 32	Parallel I/O shift registers.	
Lecture 33	Series I/O shift registers and	
Week 12	**Modular sequential logic circuit design**	
Lecture 34	Universal shift register	
Lecture 35	Counters: Introduction	
Lecture 36	Asynchronous counters: up and down	
Week 13	**Modular sequential logic circuit design**	**FINAL**
Lecture 37	Synchronous counters: up and down	
Lecture 38	BCD counters	
Lecture 39	Ring counter	
Week 14	**Application of sequential logic circuits**	
Lecture 40	Johnson counter	
Lecture 41	Applications of registers	
Lecture 42	Applications of counters	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1
			CO3	C3
			CO4	C4

	Class Participation		CO3	C2
	Class Attendance	5%		
	Mid term	10%	CO2	C3
Final Exam		60%	CO 1	C2
			CO 2	C3
			CO 3	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain)

TEXT AND REFERENCE BOOKS

Digital Electronics:
1. Digital Logic and Computer Design- M Morris Mano; Prentice Hall of India Private Ltd.
2. Fundamentals of Digital Logic with Verilog Design – Stephen Brown, Zvonko Vranesic
3. S Salivahanan and S Arivazhagan, Digital Electronics, 2011.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.6.6. EECE 392: Digital Electronics Sessional
Level-3, Term-I (Spring Term)

COURSE INFORMATION

Course Code	: EECE 392	Contact Hours	: 3.00
Course Title	: Digital Electronics Sessional	Credit Hours	: 1.50

PRE-REQUISITE

Course Code: EECE 391
Course Title: Digital Electronics

CURRICULUM STRUCTURE

Outcome-Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize with the basics of digital electronic circuits and utilize digital electronic circuits for practical purposes.

OBJECTIVE

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 391. In the second part, students will design simple systems using the principles learned in EECE 391.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Bloom's Taxonomy	Corresponding PO	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** the knowledge of basic digital electronic circuits practically.	C3	PO5	1	-	6	T, Q, R
CO2	Be able to analyze and **evaluate** the necessity and utilization of different types of logic and sequential circuits for real problems.	C5	PO5	1, 3	-	6	T, Q, R, ASG
CO3	Be able to **create** different digital circuits with ICs to use for our day to day necessities.	C6	PO9	1	-		T, Q, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T-Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 391 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to apply the knowledge of basic digital electronic circuits practically.					3							
CO2	Be able to analyze and evaluate the necessity and utilization of different types of logic and sequential circuits for real problems.					3							
CO3	Be able to create different digital circuits with ICs to use for our day to day necessities.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Practical / Tutorial / Studio	35
Student-Centered Learning	-
Self-Directed Learning	
Non-face-to-face learning	-
Revision of the previous and (or) subsequent lecture at home	15
Preparation for final examination	10
Formal Assessment	
Continuous Assessment	1
Lab Test	1
Quiz	0.75
Viva	0.25
Total	70

TEACHING METHODOLOGY

Lecture and discussion, Co-operative and collaborative method, Problem based method

COURSE SCHEDULE

Week	Lecture Topics	Assessment
1	Familiarization and use of truth table of basic logic Gates	Report, Assignment, Lab Test, Viva
2	Verification of De Morgan's laws using the logic gates	
3	Implementing the truth tables of a digital logic circuit and its simplification using Boolean algebra	
4	Design of adder & subtractor circuits using basic gates	
5	Design and implement of encoder and decoder circuits	
6	Design and implement of BCD to seven-segment decoder circuit using logic gates	
7	Lab Test with Viva-01	
	Midterm Break	
8	Design and implement of multiplexer circuit using logic gates	Report, Lab Test, Quiz, Viva
9	Design and implement of the de-multiplexer circuit using logic gates	

10	Design and implement various types of clocked flip-flop circuits using logic gates	
11	Design and implement of up and down counters	
12	Quiz test	
13	Lab Test-02	
14	Final Viva with Reports	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Report	20%	CO1 CO2 CO3	C3 C5 C6
	Class Participation	20%	CO1 CO2 CO3	C3 C5 C6
Final Exam (60%)	Lab Test	20%	CO1 CO2 CO3	C3 C5 C6
	Quiz	30%	CO1 CO2 CO3	C3 C5 C6
	Viva	10%	CO1 CO2 CO3	C3 C5 C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Biofluid Mechanics:

1. Digital Logic and Computer Design- M Morris Mano; Prentice Hall of India Private Ltd
2. Fundamentals of Digital Logic with Verilog Design – Stephen Brown, Zvonko Vranesic
3. S Salivahanan and S Arivazhagan, Digital Electronics, 2011.
4. Digital Fundamentals - F Loyd; Prentice-Hall International, Inc

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.7. Petroleum and Mining Engineering

6.7.1. EECE 261: Fundamentals of Electrical and Electronic Engineering.
Level-2, Term-II (Fall Term)

COURSE INFORMATION

Course Code Course Title	: EECE-261 : Fundamentals of Electrical and Electronic Engineering.	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

None.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Electrical & Electronic Engineering is a fascinating field, and one which could make your time at unique challenging, enriching and rewarding experience. Just as the world needs its Doctors, Nurses and Teachers, Electrical Engineering is something which we simply couldn't do without.

If you like the idea of creating electrical systems which could help millions of people on a day-to-day basis, like the systems used in phones, or computers, then read these reasons to study Electrical & Electronic Engineering.

OBJECTIVE

1. To develop the basics of electrical circuits and different problems solving techniques.
2. To familiarize students with basic electronic devices
3. To impart the basic operating principle of electrical machines like DC motor, DC generator and Transformer etc.
4. To impart the basic knowledge of electrical control system and instrumentation.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be proficient enough to **apply** basic circuit laws and **conclude** which is the most effective analysis technique to **analyse** and **solve** dc and ac circuit.	PO3	C5			5	T, F
CO2	Be familiarized with electronic devices and become expert in **comparing** the input and output characteristics.	PO1	C4	1		3	T, ASG, F
CO3	Be able to **describe** the principle of operation, explain the construction, classify as per construction or operation of the electrical machines.	PO1	C2			1	T, Midterm, F
CO4	Be familiar with electrical control system, concept of feedback, criteria for sensors and transducers selection and **select** appropriate measurement methods for engineering tasks.	PO1	C2	1		3	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction: Sources of energy; General structure of electrical power systems, Power Transmission and distribution via overhead lines and underground cables; Steam, Hydel, Gas and Nuclear power generation.

DC Networks: Kickoff's laws, Node voltage and mesh current methods, Delta-star and star-delta conversion, Superposition principle, Thevenin's and Norton's theorems.

Single Phase AC Circuits: Single phase EMF generation, average and effective values of sinusoids, solution of R,L,C series circuits, the j operator, complex representation of impedances phasor diagram, power factor, power in complex notation, solution of parallel and series-parallel circuits.

Three Phase AC Circuits: Three phase EME generation, delta and Y-connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in thee phase circuits, Three phase four wire circuits.

Magnetic Circuits: Ampere's circuital law, B-H curve, Solution of magnetic circuits, Hysteresis and eddy current losses, Relays, an application of magnetic force, Basic principles of stepper motor.

Electrical Measuring Instruments: DC PMMC instruments, Shunt and multipliers, Multimeters, Moving iron ammeters and voltmeters, Dynamometers, Wattmeter, AC watthour meter, Extension of instrument ranges.

Electrical Machines: DC generators: Construction, operation and types, DC motors: Operation, classification, characteristics and applications. Transformers: Operation and classification, Three Phase Induction Motors: Working principle, characteristics and starting, Alternators: Working principle and synchronization, Synchronous Motors: Operation and applications.

Electronics: p-n junction diode, rectifiers, BJT: Switching and amplification.

Power Supply: Choice of voltage, surface and underground supply, Mine cable construction, installation, fault location, Switchgears, Earthing methods, Protective devices: over current and over voltage.

Control and Instrumentation: Introduction to control system, open loop and closed loop system, remote control, sequence control, introduction to programmable logic controller, embedded controller. Drives: DC drives: single phase half wave converter drives, AC drives: Induction motor drives-Stator voltage and rotor voltage control Transducers: Electrical Transducers, Advantages of Electrical Transducer, Resistance Thermometers, Thermistor, Thermocouple, Integrated Circuit temperature sensors, Linear Variable Differential Transformer (LVDT), Capacitive Transducer: Piezo-electric Transducer, Opto-electronic transducers. Sensors for measurement of various operational parameters, environmental parameters and safety parameters in underground and open pit mines.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be proficient enough to **apply** basic circuit laws and **conclude** which is the most effective analysis technic to **analyse** and **solve** dc and ac circuit.			2									
CO2	Be familiarized with electronic devices and become expert in **comparing** the input and output characteristics.	3											
CO3	Be able to **describe** the principle of operation, explain the construction, classify as per construction or operation of the electrical machines.	3											
CO4	Be familiar with electrical control system, concept of feedback, criteria for sensors and transducers selection and **select** appropriate measurement methods for engineering tasks.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium, and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	42 21 21
Formal Assessment Continuous Assessment Final Examination	2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE

Week 1		CT-1
Class 1	**Introduction:** Sources of energy; General structure of electrical power systems, Power Transmission and distribution via overhead lines and underground cables	
Class 2	Steam, Hydel.	
Class 3	Gas and Nuclear power generation.	
Week 2		
Class 4	**DC Networks**: Kickoff's laws, Node voltage and mesh current methods.	
Class 5	Delta-star and star-delta conversion.	
Class 6	Superposition principle	
Week 3		
Class 7	Thevenin's and Norton's theorems	
Class 8	Single phase EMF generation, average and effective values of sinusoids, solution of R,L,C series circuits	
Class 9	the j operator, complex representation of impedances phasor diagram, power factor	
Week 4		CT-2
Class 10	power in complex notation	
Class 11	Solution of parallel and series-parallel circuits.	
Class 12	**Three Phase AC Circuits**: Three phase EME generation, delta and Y-connections, line and phase quantities, solution of three phase circuits.	
Week 5		
Class 13	balanced supply voltage and balanced load.	
Class 14	phasor diagram, measurement of power in thee phase circuits	
Class 15	Three phase four wire circuits	
Week 6		
Class 16	**Magnetic Circuits**: Ampere's circuital law, B-H curve, Solution of magnetic circuits, Hysteresis and eddy current losses	
Class 17	Relays, an application of magnetic force.	
Class 18	Basic principles of stepper motor.	
Week 7		
Class 19	**Electrical Measuring Instruments**: DC PMMC instruments, Shunt and multipliers, Multimeters, Moving iron ammeters and voltmeters	
Class 20	Dynamometers, Wattmeter	
Class 21	AC watthour meter, Extension of instrument ranges.	

Week 8		MID
Class 22	**Electrical Machines:** DC generators: Construction, operation and types	
Class 23	DC motors: Operation, classification, characteristics and applications	
Class 24	Transformers: Operation and classification.	
Week 9		
Class 25	Three Phase Induction Motors: Working principle, characteristics and starting, Alternators.	
Class 26	Working principle and synchronization	
Class 27	Synchronous Motors: Operation and applications	
Week 10		CT-3
Class 28	**Electronics:** p-n junction diode	
Class 29	rectifiers, BJT	
Class 30	Switching and amplification	
Week 11		
Class 31	**Power Supply:** Choice of voltage, surface and underground supply, Mine cable construction, installation, fault location.	
Class 32	Switchgears, Earthing methods.	
Class 33	Protective devices: over current and over voltage.	
Week 12		CT-4
Class 34	**Control and Instrumentation:** Introduction to control system.	
Class 35	open loop and closed loop system, remote control, sequence control.	
Class 36	Introduction to programmable logic controller, embedded controller.	
Week 13		
Class 37	Drives: DC drives: single phase half wave converter drives, AC drives.	
Class 38	Induction motor drives-Stator voltage and rotor voltage control Transducers: Electrical Transducers.	
Class 39	Advantages of Electrical Transducer, Resistance Thermometers, Thermistor, Thermocouple.	
Week 14		
Class 40	Integrated Circuit temperature sensors, Linear Variable Differential Transformer (LVDT)	
Class 41	Capacitive Transducer: Piezo-electric Transducer, Opto-electronic transducers.	
Class 42 and Extra Hours	Sensors for measurement of various operational parameters, environmental parameters and safety parameters in underground and open pit mines.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1	C5
			CO 2	C4
			CO 3	C2
			CO4	C2
	Class Participation	5%	CO 1	C5
			CO 2	C4
			CO 3	C2
			CO4	C2
	Class Attendance	5%		
	Mid Term	10%	CO3	C2
Final Exam		60%	CO 1	C5

		CO 2	C4
		CO 3	C2
		CO4	C2
Total Marks	100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS
1.Introductory Circuit Analysis (10th edition)- Robert Boylested 2. Electric Circuits (9^{th} Edition) -- James William Nilsson 3. Electronic Device and Circuit Theory by Robert L. Boylestad 4. Basic Electrical and Electronics Engineering by Sabyasachi Bhattacharya 5. Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N.O. Sadiku 6. A Textbook of Electrical Technology - B.L Theraja 7. The Engineering Handbook by Richard C. Dorf 8. Control Systems Engineering by Norman S. Nise 9.'A Course in Electrical and Electronic Measurements and Instrumentation' by A. K. Sawhney, 19th Revised Edition, Publisher: Dhanpat Rai and Sons, Delhi

*****Details of program outcome and grading policy are attached as Annex A and Annex B**

6.7.2. EECE 262: Electrical and Electronics Engineering Lab
Level-2, Term-II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 262 : Electrical and Electronics Engineering Lab	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE
Course Code: EECE 261 Course Title: Fundamentals of Electrical and Electronics Engineering
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
Electrical Engineering lab is designed to impart into the students the basic concepts of electrical engineering encompassing the practical implementations of DC and AC circuits. At the beginning of this course, students will get to know the projection of fundamental DC circuit using the basic equipment along with the observation of the basic theorems as well as the AC circuit concepts will be experimented accompanying the showcase of various types of filter and their characteristics. In the following part of the lab, some basic electronics experiment using diode and transistor will be done. In the last part of the course, the students will be familiarized with various electrical machines like DC and Ac motor and generator.
OBJECTIVE
1. To introduce the students to basic DC circuit laws and solving of complex circuits using basic circuit theorems 2. To impart into the students with the AC circuit hardware construction and operation. 3. To familiarize the students with different type of filter construction and their characteristics. 4. To give in depth knowledge on the basic electronics circuit using diode and transistor. 5. To introduce the students to different type of Dc and AC motor and generators.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Achieving the quality to construct	PO9	A4				R, Q, T

	DC, AC and electric circuits and justify the basic laws as well as to modify the complex circuits into simple circuits.						
CO2	Attaining the competency to reproduce the basic filters and explain their characteristics	PO10	P3				R, Q, T
CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component	PO9	A3	P1			R, Q, T

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 261 using different hardware equipment and simulation software.

CO-PO Mapping

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Achieving the quality to construct DC, AC and electric circuits and justify the basic laws as well as to modify the complex circuits into simple circuits.									2			
CO2	Attaining the competency to reproduce the basic filters and explain their characteristics										2		
CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component									2			

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	 24 6 6 5 26
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	**120**

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Exp 1: Verification of KVL and KCL

Week 2	Exp 2: Verification of Thevenin's Theorem
Week 3	Exp 3: Familiarization with alternating current (ac) waves and study of RLC series circuit
Week 4	Exp 4: Different types of filters and its characteristics with different input frequency
Week 5	Exp 5: Study the diode characteristics and rectifier circuit
Week 6	Exp 6: Study of N-P-N CB (Common base) and CE (Common emitter) transistor characteristics
Week 7	Exp 7: Regulation of the Transformer in Various Loads
Week 8	Exp 8: Study the properties of Three-Phase Alternator in various loads
Week 9	Exp 9: Study the properties of DC Shunt Motor.
Week 10	Exp 10: Study the properties of DC Separately Excited and Self-Excited Shunt Generator.
Week 11	Exp 11: Study the properties of Squirrel-Cage Induction Motor.
Week 12	Quiz
Week 13	Lab test + Viva
Week 14	Presentation

ASSESSMENT STRATEGY

Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Lab participation and Report	20%	CO1	A4
			CO2	P3
			CO3	A3
	Labtest-1, Labtest-2	40%	CO1	A4
			CO2	P3
			CO3	A3
Lab Quiz		40%	CO1	A4
			CO2	P3
			CO3	A3
Total Marks		100%		

(CO=Course Outcome, C=Cognitive, P=Psychomotor Domain, A=Affective Domain)

TEXT AND REFERENCE BOOKS

1) Basic Electrical and electronics Engineering by Sabyasachi Bhattacharya
2) Fundamentals of Electrical Circuits –Alexander & Sadiku (4th Edition)
3) Introductory Circuit Analysis by R. L. Boylsted
4) Basic Engineering Circuit Analysis by J. D. Irwin & R. M. Nelms

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.8. Industrial and Production Engineering

6.8.1. EECE 171: Basic Electrical and Electronic Circuit
Level-1, Term-II (Fall Term)

COURSE INFORMATION

Course Code	: EECE 171	Contact Hours	: 3.00
Course Title	: Basic Electrical and Electronic Circuit	Credit Hours	: 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The foundational course on electrical circuits is a basis of making freshmen engineering students well familiarize about the arena of DC and AC circuits. The course is aimed towards the methods of electric circuit analysis and evaluating their responses which can be very well achieved by the understanding of circuit laws, techniques and theorems for both AC and DC excitations. Investigation of first and second order DC circuits is vital in understanding circuit elements like capacitors and inductors used in daily life. A hands-on flavour of the course is the assessment of poly phase circuits which addresses the issue of faults and usable power in the transmission lines. Finally, this course is also aimed to teach the students the concepts, principles and working of basic electronic circuits (Diodes, BJTs)

OBJECTIVE

1. **Create** a foundation of basic electrical engineering and circuits.
2. **Familiarize** students with basic Circuit laws (Ohm, Kirchhoff), techniques (Mesh, Nodal), concepts (Superposition, Source Transformation) and theorems (Thevenin, Norton).
3. **Develop** the understanding of AC steady state response of single-phase circuits and power in AC circuits.
4. **Introduce** students to poly-phase circuits as a practical arena of AC Circuits.
5. **Achieve** ability to familiarize the students with the working principle of semiconductor devices (Diodes, BJTs) as electronic circuit elements.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Capable to **interpret** circuit laws and **apply** their corresponding technique to find circuit quantities (Voltage and Current); also **justify** particular circuit concept(s) and theorem(s) for simplifying complex circuits.	PO1	C5	P1		3	T, MT, F
CO2	**Manage to outline** sinusoids and phasors in **explaining** circuit parameters and **analysing** AC power.	PO1	C4			1	F, ASG, MT
CO3	Able to **understand** the current voltage relation of 3 phase circuits for different configurations and **reproduce** knowledge of AC power to **analyze** real life power consumptions of Transmission lines.	PO1	C4	P1		3	F, ASG, Pr
CO4	Be skilful to **explain** the operating principle of some fundamental electronic devices (Diodes, BJTs)	PO1	C2			3	F, ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Direct current circuits: laws and theorems, DC network analysis, alternating current: AC quantities and sinusoidal waveforms, phasors, AC circuit analysis: series and parallel branches-RL, RC, and RLC balanced three-phase circuits. Semiconductor diode: operation, characteristics and applications, introduction to bipolar junction transistors (BJTs), characteristic, common-emitter (CE), common-base (CB), common-collector (CC), and amplifier configurations.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Capable to **interpret** circuit laws and **apply** their corresponding technique to find circuit quantities (Voltage and Current); also **justify** particular circuit concept(s) and theorem(s) for simplifying complex circuits.	3											
CO2	**Manage to outline** sinusoids and phasors in **explaining** circuit parameters and **analysing** AC power.	3											
CO3	Able to **understand** the current voltage relation of 3 phase circuits for different configurations and **reproduce** knowledge of AC power to **analyze** real life power consumptions of Transmission lines.	3											
CO4	Be skilful to **explain** the operating principle of some fundamental electronic devices (Diodes, BJTs)	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	84
Formal Assessment	05
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	
Class 1	Introduction to basic electrical circuit
Class 2	Basic laws and theorems of circuit.
Class 3	Ohm’s law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh
Week 2	
Class 4	Series-parallel connection
Class 5	KCL, KVL, Analysis of equivalent resistance of electrical circuit
Class 6	Analysis of voltage, current and power
Week 3	
Class 7	Analysis of current in different branches
Class 8	Analysis of voltage in different parts of circuit
Class 9	Practice mathematical problems related to current and voltage divider

	rule.
Week 4	
Class 10	Introduction: Concept of phasor and complex impedance / admittance
Class 11	Introduction: Concept of phasor and complex impedance / admittance
Class 12	Theory of Active power, reactive power, apparent power (volt ampere)
Week 5	
Class 13	Mathematical Problems of Active power, reactive power, apparent power (volt ampere)
Class 14	Power factor and energy associated with these circuits
Class 15	Concept of complex power, Phasor diagram
Week 6	
Class 16	Impedance triangle and power triangle associated with complex circuits.
Class 17	Resonance in series and parallel circuits
Class 18	Q factor, half-power frequencies and bandwidth of resonant circuits.
Week 7	CT 3
Class 19	Transient response of RL,RC and RLC series and parallel circuits free response – step and sinusoidal responses
Class 20	Frequency: Damped Frequency
Class 21	Damping Factor and Logarithmic Decrement
Week 8	
Class 22	Response of circuits for non-sinusoidal periodic inputs
Class 23	Passive Filters
Class 24	Magnetically Couples Circuits
Week 9	
Class 25	Analysis of three phase circuits: Three phase supply
Class 26	Balanced and Unbalanced circuits, Power calculation (Lec-01)
Class 27	Balanced and Unbalanced circuits, Power calculation (Lec-02)
Week 10	CT 4
Class 28	Basics of semiconductor.
Class 29	p-n junction, forward bias and reverse bias concept.
Class 30	Basic structure of open-circuited p-n junction.
Week 11	
Class 31	The current components of p-n diode.
Class 32	Volt ampere characteristics of p-n junction.
Class 33	Diode resistance.
Week 12	
Class 34	p-n junction diode switching times.
Class 35	Breakdown voltage and characteristics of diode.
Class 36	Introduction to junction transistor.
Week 13	
Class 37	Basics of BJT
Class 38	Transistor characteristics components.
Class 39	Detailed study of the currents in the transistor.
Week 14	
Class 40	Common emitter, common-base and common-collector configuration of BJT
Class 41	Amplifier configuration of BJT.
Class 42	Cut-off and saturation region in different configuration in BJT.

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous	Test 1-3	20%	CO1	C5

Assessment (40%)			CO2	C4
	Class Participation	5%	CO3	C4
			CO4	C2
	Class Attendance	5%		
	Mid term	10%	CO1	C5
			CO2	C4
			CO3	C4
Final Exam		60%	CO1	C5
			CO2	C4
			CO3	C4
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Fundamentals of Electric Circuit by C. K. Alexander & M. N. Sadiku
2. Introductory Circuit Analysis by R. L. Boylsted
3.Alternating Current Circuits by G. S. Corcoran & R. F. Kerchner
4. Electric Circuits by J. A. Edminister
5. Basic Engineering Circuit Analysis by J. D. Irwin & R. M. Nelms
6. Electric Circuits by James William Nilsson
7. Microelectronic circuit by Sedra Smith

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.8.2. EECE 172: Basic Electrical and Electronic Circuits Sessional
Level-1, Term-II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 172 : Basic Electrical and Electronic Circuits Sessional	Contact Hours Credit Hours	: 1.50 : 0.75

PRE-REQUISITE

Course Code: EECE 171
Course Title: Basic Electrical and Electronic Circuit

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course of electrical engineering discipline aims to familiarize the students with implementation of basic electrical circuits in hardware domain. Designed for fresher students, experiments of this laboratory course will enable them to assemble beginner-level circuits to experimentally verify some fundamental circuit laws and theorems (KVL, KCL, Thevenin, Norton). This course also familiarizes the students with hardware implementation of AC circuits and measurement of ac quantities by oscilloscope. This sessional course is designed to teach the students about the concepts, principles and working of basic electronic devices and circuits by hand-held experiments.

OBJECTIVE

1. To enable the students to apply the fundamental circuit laws (KVL, KCL, Ohm's law) in hardware domain.
2. To develop students' skills to simplify complex electrical circuits into simpler circuits by Thevenin and Norton's theorem and verify them in hardware.
3. To teach the students the basic operation of oscilloscope to measure AC quantities (magnitude and phase).
4. To impart the students the skills of analogue filter design by RLC circuit.
5. To familiarize the students with input and output characteristics of different BJTs, FETs and also the operation of each device in terms of junction bias voltage and charge carrier movement.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	Be able to **assemble** electrical circuits that can **verify** fundamental electrical laws (KVL, KCL, Ohm's Law, Thevenin's and Norton's theorem) by both hardware and software implementation.	PO5	P5, A3		1	6	R, Q, T
CO2	Achieve ability to **produce** desired ac waves and **measure** amplitude and phase of ac waves in oscilloscope.	PO4	P4		1	8	R, Q, T
CO3	Be adept to **design** project using analogue RLC filter that can produce desired frequency response.	PO9	P6		1		R, PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course students will get a hands on experience about electrical and electronic circuits. They will observe the uses of electrical circuits practically and can use this knowledge gained in EECE 171 course for future project works.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **assemble** electrical circuits that can **verify** fundamental electrical laws (KVL, KCL, Ohm's Law, Thevenin's and Norton's theorem) by both hardware and software implementation.					3							
CO2	Achieve ability to **produce** desired ac waves and **measure** amplitude and phase of ac waves in oscilloscope.				3								
CO3	Be adept to **design** project using analogue RLC filter that can produce desired frequency response.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 07

Practical / Tutorial / Studio	14
Student-Centred Learning	21
Self-Directed Learning	
Preparation of Lab Reports	7
Preparation of Lab Test	5
Preparation of presentation	5
Preparation of Quiz	8
Engagement in Group Projects	8
Formal Assessment	
Continuous Assessment	7
Final Examination	1
Total	63

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method.

COURSE SCHEDULE

Week	Topic
1	Verification of KVL and KCL
2	Verification of Superposition and Thevenin’s Theorem
3	Familiarization with ac waves and study of R-L-C series circuit
4	Implementation of Diode Rectifier Circuits and study their rectification characteristics using Hardware implementation.
5	Construction of n-p-n CE (common emitter) and CB (common base) transistor and determine their input and output characteristics
6	Determine the Characteristics of Junction Field Effect Transistor (JFET) using Hardware implementation.
7	Lab test, Quiz and Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous Assessment (75%)	Lab participation and Report	20%	CO1	P5, A3
			CO2	P4
			CO3	P6
	Labtest-1 ,Labtest-2	30%	CO1	P5, A3
			CO2	P4
	Project and Presentation	25%	CO3	P6
Lab Quiz		25%	CO1	P5, A3
			CO2	P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
3. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
4. Electronic Devices and Circuit Theory -Robert L. Boylestad and Louis Nashelsky
5. Micro Electronics Circuits-Adel S. Sedra & Keneth C. Smith-Oxford University Press

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.8.3. EECE 271: Electrical Machines and Electronics
Level-2, Term-I (Spring Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 271 : Electrical Machines and Electronics	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
EECE 171			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To develop a strong foundation in the basic operating principle, constructions, characteristic features, applications etc. of AC and DC electrical machinery like DC generator, DC motor, synchronous generator, synchronous motor and three induction motors. The emphasis has been given on both physical insight and analytical techniques. The subject material covered here will provide the basis for understanding many real-world electric machinery applications as well as the foundation for advanced courses in electric machinery design and control. It is targeted to provide a basic foundation for technology areas like electronics devices (operational amplifiers and silicon-controlled rectifiers) as well as instrumentation, control systems and various electronic circuit design.			
OBJECTIVE			
1. To develop a strong foundation on DC and AC electrical machines (DC motor, DC generator, synchronous machines, induction machines etc) with a special focus on operating principle, identification of parts and accessories, constructional features, types etc 2. To familiarize with advanced electronic circuits (operational amplifier and silicon-controlled rectifiers), their working principles, design criteria and applications. 3. To impart basic knowledge on the basic knowledge of different types of transducers with a view to know the fundamentals of instrument and control systems. 4. To develop a broad idea on application of electronics and electrical machines in practical industrial and domestic field.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the fundamental operation, basic construction and classification of different AC and DC machines	PO1	C2			2	T, F
CO2	**Interpret** and **analyze** the performance characteristics of different electrical machines e.g. transformers, DC and AC machines	PO1	C4			3	T, F
CO3	**Analyze** electronic circuits consists of op-amps and SCRs and **know** the fundamentals of transducers and its application in instrument and control systems	PO1	C4			3	MT, F
CO4	**Design** various electronic circuits using both passive and active components to solve the real-life engineering problems.	PO3	C6	1		5	ASG, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Single phase transformer
DC Generator: Principles and applications
DC motor: principle and applications,
Three phase induction motor: principle and applications.
Alternator: Principles and operation, introduction to synchronous motors.
Introduction to operational amplifiers (OP-AMPs) and applications,
Silicon controlled rectifiers (SCR): operation and characteristics, power control using SCR
Transducers: strain, temperature, pressure, speed and torque measurements.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the fundamental operation, basic construction and classification of different AC and DC machines	3											
CO2	**Interpret** and **analyze** the performance characteristics of different electrical machines e.g. transformers, DC and AC machines	3											
CO3	**Analyze** electronic circuits consists of op-amps and SCRs and **know** the fundamentals of transducers and its application in instrument and control systems	3											
CO4	**Design** various electronic circuits using both passive and active components to solve the real-life engineering problems.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	Single Phase Transformer: Principles, types	Class Test 1, Final
Week 2	Single Phase Transformer: Performances and characteristics.	

Week 3	DC generators: Principles, types	
Week 4	DC generators: Performances and characteristics.	Class Test 2, Final
Week 5	DC Motors: Principles, types	
Week 6	DC Motors: Performances and characteristics	
Week 7	Three phase induction motor: Principles and applications	
Week 8	Alternator: Principles and applications	Mid Term Final
Week 9	Introduction to operational amplifiers (OP-AMPs)	
Week 10	Applications of operational amplifiers (OP-AMPs)	
Week 11	Silicon controlled rectifiers (SCR): operation and characteristics	Class Test 3, ASG/ Pr Final
Week 12	Silicon controlled rectifiers (SCR): power control using SCR	
Week 13	Transducers: strain, temperature, pressure	
Week 14	Transducers: speed and torque measurements.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C4
			CO3	C4
	Class Participation	5%	-	-
	Class Attendance	5%		
	Mid term	10%	CO3	C4
Final Exam		60%	CO1	C2
			CO2	C4
			CO3	C4
			CO4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor, A = Affective Domain)

TEXT AND REFERENCE BOOKS

Text Books:

1. Electrical Machinery Fundamentals – Stephen J. Chapman
2. A textbook of Electrical Technology – B.L. Theraja and A.K. Theraja
3. Op Amps & Linear Integrated Circuits - James M. Fiore; Delmar Thomson Learing.
4. Operation Amplifiers and Linear Integrated Circuits- Robert F. Coughlin;
5. Power Electronics: Device, Principles and Application –Muhammad H Rashid

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.7.3. EECE 272: Electrical Machines and Electronics Sessional
Level-2, Term-I (Spring Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 272 : Electrical Machines and Electronics Sessional	Contact Hours Credit Hours	: 1.50 : 0.75
PRE-REQUISITE			
Course Code: 271 Course Title: Electrical Machines and Electronics			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE
To help the students to explore various DC and AC machines and put theory in practice. Our mission is to expose students to the constructions of electrical machines and analyze their performance. This course is targeted to verify the properties of generator, motor etc. and relate them with their theoretical knowledge. This course is also designed to examine some electronic devices and observe their characteristics.
OBJECTIVE
1**.** Be able to familiarize the students with the basic electrical machines like transformer, dc generator, dc motor, synchronous machines, induction machines etc. 2. Be able to calculate various parameters of machines like voltage regulation, efficiency etc., observe their behaviour under various load conditions and compare them. 3. To develop skills of handling basic machinery equipment by engaging students in experiences with experimental processes and by growing the capability to give connection. 4. Be able to impart practical knowledge on electrical machine crafting and develop collaborative learning skill. 5. To develop communication as well as project management skills among the students through presentation and group projects.
COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to compute the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and **justify** these characteristics under various loading condition.	PO1	C5		1	2	R, Q, LT
CO2	Be able to **identify** the characteristics of electrical machines like dc generator, dc motor etc. and **trace** various curves like armature voltage vs. armature current curve for dc generator or torque-speed curve of dc motor.	PO2	C1, P3	1	1	3	R, Q, LT
CO3	Be able to **compare** the starting and operating characteristics of various induction machines (squirrel cage induction motor, wound rotor induction motor etc.) by measuring the active power, reactive power, apparent power etc and plotting torque-speed curve.	PO5	C4	1	1	6	R, Q, LT
CO4	Developing collaborative nature by discussing and performing as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	PO8	A4		1	7	PR, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)
COURSE CONTENT
In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 271 using different hardware equipment and simulation software.
CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **compute** the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and **justify** these characteristics under various loading condition.	3											
CO2	Be able to **identify** the characteristics of electrical machines like dc generator, dc motor etc. and **trace** various curves like armature voltage vs. armature current curve for dc generator or torque-speed curve of dc motor.		3										
CO3	Be able to **compare** the starting and operating characteristics of various induction machines (squirrel cage induction motor, wound rotor induction motor etc.) by measuring the active power, reactive power, apparent power etc and plotting torque-speed curve.					3							
CO4	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.								3				

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	 7 14
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 6 6 5 6 10
Formal Assessment Continuous Assessment Final Quiz	 7 1

Total	62

TEACHING METHODOLOGY
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method
COURSE SCHEDULE

Week-1	Regulation of the transformer in various loads.
Week-2	Study the properties of DC separately excited and self-excited shunt generator
Week-3	Study the properties of DC shunt motor and squirrel-cage induction motor
Week-4	Study the properties of three-phase alternator in various loads
Week-5	Mathematical operation using OpAmp (Adder and Subtractor)
Week-6	Mathematical operation using OpAmp (Integrator and Differentiator).
Week-7	Lab Test, Viva and Quiz

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	20%	CO 1	C5
			CO 2	C1, P3
			CO 3	C4
	Labtest-1,Labtest-2	30%	CO 1	C5
			CO 2	C1, P3
			CO 3	C4
	Project and Presentation	25%	CO4	A4
Lab Quiz		25%	CO 1	C5
			CO 2	C1, P3
			CO 3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Electrical Machinery Fundamentals – Stephen J. Chapman
2. A textbook of Electrical Technology – B.L. Theraja and A.K. Theraja
3. Op Amps & Linear Integrated Circuits - James M. Fiore; Delmar Thomson Learing.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.9. Aeronautical Engineering

6.9.1. EECE 161: Electrical Circuit Analysis I
Level-1, Term-I (Spring Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 161 : Electrical Circuit Analysis I	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To learn and familiarize the basics of electrical circuit components as well as the analysis of DC circuit.

OBJECTIVE

1. To learn the basic electrical quantities, their applications and unit.
2. To study the different electrical network theorems and apply those theorems in solving complex circuit networks.
3. To use the principles of DC circuit in various practical fields.
4. To understand the basic working principle of various energy storage devices like capacitors, inductors and resistors.
5. To be able to apply the basics of transient circuit in alternating current analysis.
6. To understand the ac circuit and their practical applications in day to day life uses.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Analysis of Resistive Circuits and Solution of resistive circuits with independent sources Understand the most important concepts like mesh and nodal analysis	PO2	C4			1	T, F
CO2	Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuit.	PO3	C4	P1		3	T, F
CO3	Analysis of Single-Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits	PO2	C4	P1		3	Mid Term
CO4	Will be able to explain the concept of capacitance and inductance and the concept of two terminal linear devices.	PO1	C1	P1		3	Mid Term

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Circuit variables and elements: Voltage, current, power, energy, independent and dependent sources, resistance. Basic laws: Ohm‘s law, Kirchoff‘s current and voltage laws.
Simple resistive circuits: Series and parallel circuits, voltage and current division, wye-delta transformation.
Techniques of circuit analysis: Nodal and mesh analysis including supernode and supermesh. Network theorems: Source transformation, Thevenin‘s, Norton‘s and superposition theorems with applications in circuits having independent and dependent sources, maximum power transfer condition and reciprocity theorem.
Energy storage elements: Inductors and capacitors, series parallel combination of inductors and capacitors. Responses of RL and RC circuits: Natural and step responses.
Introduction to Alternating current: Instantaneous current, voltage, power, Effective current and voltage, average power, Phasors and complex quantities, impedance, real and reactive power, Series RL, RC and RLC circuits, analysis of three phase supply.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	Analysis of Resistive Circuits and Solution of resistive circuits with independent sources Understand the most important concepts like mesh and nodal analysis		3										
CO2	Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuit.			3									
CO3	Analysis of Single-Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits		3										
CO4	Will be able to explain the concept of capacitance and inductance and the concept of two terminal linear devices.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning Non-face-to-face learning Revision of previous and (or) subsequent lecture at home Preparation for final Exam	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	**Circuit Variables and Elements**	CT 1
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage	
Class 2	Power and energy, Active elements, Passive elements, Independent and Dependent source	
Class 3	Ohm’s law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh	
Week 2	**Series and Parallel DC Circuits**	
Class 4	Series-parallel connection	
Class 5	KCL, KVL, Analysis of equivalent resistance of electrical circuit	
Class 6	Analysis of voltage, current and power	
Week 3	**Current Divider Rule and Voltage Divider Rule**	

Class 7	Analysis of current in different branches	
Class 8	Analysis of voltage in different parts of circuit	
Class 9	Practice mathematical problems related to current divider and voltage divider rule.	
Week 4	**Y-Δ a d Δ-Y conversion**	
Class 10	Y to Δ conversion der vation	
Class 11	Analysis of electrical circuits with Y-Δ connection	
lass 12	Practice problems related to Y-Δ connection	
Week 5	**Source Calculation Nodal Analysis**	
Class 13	Multiple number of curr nt an voltage so rce calculation	CT 2
Clas 14	Method of Obtaining Node volt g s	
Clas 15	Various mat ematical problems solv ng nodal analysis	
Week 6	**Nodal and Mesh Analysis**	
Class 16	Super node analysis	
Class 17	Super node analysis continued	
Class 18	Method of obtaining mesh currents using mesh analysis	
Week 7	**Mesh Analysis**	
Class 19	Mesh analysis with current source	
Class 20	Mathematical problems related to Mesh analysis	
Class 21	Mathematical problems related to Mesh Analysis (Continued)	
Week 8	**Network Theorem**	
Class 22	Superposition Theorem	MID
Class 23	Application of Superposition Theorem	
Class 24	Continue	
Week 9	**Network Theorem**	
Class 25	Thevenin's Theorem Procedure	
Class 26	Application of Thevenin Theorem	
Class 27	Norton's Theorem	
Week 10		
Class 28	Application of Norton's Theorem	
Class 29	Maximum Power Transfer Theorem	
Class 30	Reciprocity Theorem	
Week 11	**Energy Storage Element- Capacitor & Inductor**	
Class 31	Electric field and capacitance of capacitor and construction and types of capacitor	
Class 32	Inductance, Inductance voltage	
Class 33	Transient response of capacitive networks	
Week 12	**Energy Storage Element-Capacitor**	
Class 34	Transient response of capacitive networks- Charging phase	
Class 35	Transient response of capacitive networks- Discharging phase	CT 3
Class 36	Transient response of capacitive networks- initial condition and instantaneous value	
Week 13	**Energy Storage Element-Inductor**	
Class 37	Transient response of capacitive networks- Charging phase	
Class 38	Transient response of capacitive networks- Discharging phase	
Class 39	Transient response of capacitive networks- initial condition and instantaneous value	
Week 14	**Magnetic Circuits**	
Class 40	Ohm's law and Ampere's circuital law	
Class 41	Instantaneous current, voltage, power, Effective current and voltage, average power, Phasors.	

Class 42	Complex quantities, impedance, real and reactive power, Series RL, RC and RLC circuits, analysis of three phase supply.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2	C4
	Class Participation	5%	-	-
	Class Attendance	5%		
	Mid term	10%	CO3, CO4	C1, C4
Final Exam		60%	CO 1	C4
			CO 2	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Fundamentals of Electric Circuit- Alexander & Sadiku.
2. Introductory Circuit Analysis - R.L. Boylestad;
3. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson;
4. Alternating Current Circuits – Russell & George F. Corcoran;

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.9.2. EECE 162: Electrical Circuit Analysis I Sessional
Level-1, Term-II (Spring Term)

COURSE INFORMATION

Course Code Course Title	: EECE 162 : Electrical Circuit Analysis-I Sessional	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 161
Course Title: Electrical Circuit Analysis-I

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn and familiarize the basics of electrical circuit components as well as the analysis of DC circuit practically.

OBJECTIVE

1. To learn about IC used in building up and development of any required circuit.
2. To know about design and implementation of any desire circuit.
3. To learn to generate desired output of any circuit
4. To compare the theoretical and practical values of circuit.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to construct an electronic device for application in real life adapting the desired requirements.	PO5	P1			6	R,Q,T

CO2	Be able to construct electrical circuits practically applying the knowledge of basic electrical components and networks.	PO5	P4			6	R,Q,T
CO3	Be able to construct an electrical device for application in real life adapting the desired requirements.	PO9	P5	1			Pr,PR

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in EECE 161 using different hardware equipment and simulation software.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to describe the properties of basic electrical networks.					3							
CO2	Be able to construct electrical circuits practically applying the knowledge of basic electrical components and networks.					3							
CO3	Be able to construct an electrical device for application in real life adapting the desired requirements.									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	14
Experiment	28
Self-Directed Learning	
Preparation of Lab Reports	30
Preparation of Lab-test	4
Preparation of Quiz	5
Preparation of Presentation	5
Engagement in Group Projects	24
Formal Assessment	
Continuous Assessment	10
Final Quiz	1
Total	121

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction of DC electrical circuits and various switches implemented for 220 Volts AC systems
Week 2	Implantation of Mesh analysis and verification of Kirchhoff’s Voltage Law
Week 3	Implantation of Nodal analysis and verification of Kirchhoff’s Current Law

Week 4	Verification of Superposition theorem and its realization in practical field.
Week 5	Verification of Thevenin's theorem and its realization in practical field.
Week 6	Lab Test-1
Week 7	Study of Wheatstone bridge and wye- delta circuit.
Week 8	Study of the various types of Alternating Current waveforms and their properties
Week 9	Experimental analysis of Non-linear circuit elements (R-L-C) and their effects on current and voltage
Week 10	Construction of Tuning Circuit using the concepts of series resonant R-L-C network.
Week 11	Construction of Wave Traps using the concepts parallel resonant R-L-C network.
Week 12	Lab Test-2
Week 13	Quiz and Viva
Week 14	Project Presentation

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	10%	CO 1	P1
			CO 2	P4
	Labtest-1, Labtest-2	30%	CO 1	P1
			CO 2	P4
Final Assessment (40%)	Project and Presentation	30%	CO 3	P5
	Lab Quiz	30%	CO 1	P1
			CO 2	P4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson; Prentice Hall of India Private Ltd

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.10. Environment, Water Resource and Coastal Engineering (EWCE)

6.10.1. EECE 167: Basic Electrical Technology
Level-1, Term-I (Spring Term)

COURSE INFORMATION			
Course Code Course Title	: EECE-167 : Basic Electrical Technology	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

None.

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To gain basic knowledge on basic AC and DC electrical circuits, electrical machines and also their principle of operation, characteristics and applications.

OBJECTIVE

1. To develop the basics of electrical circuits and different problems solving techniques.
2. To impart the basic operating principle of electrical machines like DC motor, DC generator and Transformer etc.
3. To impart the concept of active, reactive and apparent powers, power factor and resonance in series and parallel circuits.
4. To introduce with electrical wiring consideration and basic service design concepts.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **apply** network theorems to simplify real life complex networks.	PO2	C3	1		3	T, F
CO2	Be capable to **explain** the structure, operating principle and main features of electrical machines and their applications.	PO1	C4	1		3	T, Mid Term Exam, F
CO3	Be able to **understand** AC circuit concepts and **solve** both single phase and three phase circuit problems.	PO2	C5	1		3	Mid Term Exam, F, ASG
CO4	Be able to **discover** the basic idea of wiring design and electrical appliances.	PO3	C2	1		5	ASG, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Electrical units and standards, Electrical networks and circuit solutions: Series, parallel, node and mesh current analysis. Measurement of electrical quantities: Current, voltage, resistance, Measuring instruments: Ammeters, voltmeters, watt meters and multi-meter. AC circuit analysis: Instantaneous current, voltage and power, effective current and voltage, average power. Phasor algebra: Single phase RLC circuits, balanced three phase circuits. Introduction to electrical wiring for residential and commercial loads. (Illumination and lighting, Air Conditioning, heating, lifts, intercom, public address system, telephone system and LAN, security system including CC TV, stand by generator and substation design considerations.) Basic principles and application of different types of electrical machines (Generator, motor, alternator, transformer) Introduction to Electronics devices with simple application: Diodes, rectifiers

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **apply** network theorems to simplify real life complex networks.		3										
CO2	Be capable to **explain** the structure, operating principle and main features of electrical machines and their applications.	3											
CO3	Be able to **understand** AC circuit concepts and **solve** both single phase and three phase circuit problems.		3										
CO4	Be able to **discover** the basic idea of wiring design and electrical appliances.			1									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level

of matching)	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method	

COURSE SCHEDULE

Week 1	**DC analysis**	CT-1
Class 1	Basic idea about Electrical Circuit, Circuit variables and elements	
Class 2	Applications of electrical circuits, Introduction to basic laws of circuits	
Class 3	Nodes, Branches, Loops, Voltage divider law and examples	
Week 2	**DC analysis (Cont..)**	
Class 4	Current divider law and examples, Wye-Delta transformation	
Class 5	Methods of circuit analysis, Nodal analysis and examples	
Class 6	Mesh analysis and examples, Super node with examples, Basic circuit theorems	
Week 3	**DC analysis (Cont..)**	CT-2
Class 7	Super mesh with examples, Nodal VS Mesh analysis	
Class 8	Superposition theorem, Thevenin’s theorem with examples	
Class 9	Norton’s theorem with examples, Maximum power transfer in a circuit	
Week 4	**AC analysis**	
Class 10	Introduction: Concept of phasor and complex impedance / admittance	
Class 11	Introduction: Concept of phasor and complex impedance / admittance	
Class 12	Analysis of simple series and parallel circuits	
Week 5	**AC analysis (Cont..)**	MID
Class 13	Theory of Active power, reactive power, apparent power (volt ampere)	
Class 14	Mathematical Problems of Active power, reactive power, apparent power	
Class 15	Power factor and energy associated with these circuits	
Week 6	**AC analysis (Cont..)**	
Class 16	Concept of complex power, Phasor diagram	
Class 17	Impedance triangle and power triangle associated with complex circuits.	
Class 18	Resonance in series and parallel circuits	
Week 7	**Alternator**	
Class 19	Synchronous Generator: Operating principle, Losses in Alternator	
Class 20	equivalent circuit of synchronous Generator, Excitation systems of Synchronous Generator	
Class 21	Emf equation of synchronous generator, Mathematical problems	
Week 8	**Induction Motor**	
Class 22	Three phase induction motor: principle, Rotating magnetic field	
Class 23	Construction of squirrel cage IM, equivalent circuit, vector diagram, torque-speed characteristics	
Class 24	starting and braking, speed control, starting and torque speed characteristics	

Week 9	**Synchronous Motor**	
Class 25	Synchronous motor: Operation, Starting method of synchronous motor	
Class 26	Vector diagrams of synchronous motor	
Class 27	Effect of loading under different excitation condition.	CT-3
Week 10	**Diode**	
Class 28	Introduction to semiconductor devices and its classifications	
	P-type and N-type materials and doping, Semiconductor diode and its band diagram	
Class 30	Biasing of semiconductor diodes, I-V characteristics of diode and equivalent circuit of diodes, Zener diode and related maths of zener diode.	
Week 11	**BJT**	
Class 31	Introduction to BJT and construction, Principle and operation of BJT	
Class 32	Operating regions of BJT and its different configurations	
Class 33	CB and CE configurations and characteristics curves, Mathematical problems related to CB and CC configurations.	
Week 12	**Measuring instruments**	
Class 34	Measuring instruments: Ammeters, voltmeters	
Class 35	watt meters and multi-meter	
Class 36	Analysis of three phase circuits: Three phase supply	
Week 13	**Polyphase system**	
Class 37	Balanced and Unbalanced circuits, Power calculation	
Class 38	Balanced and Unbalanced circuits, Power calculation	
Class 39	Introduction to electrical wiring for residential and commercial loads. Illumination and lighting, Air Conditioning	
Week 14	**Instrumentation**	
Class 40	Heating, lifts, intercom, public address system, telephone system and LAN	
Class 41	Security system including CC TV, stand by generator and substation design considerations	
Class 42	Review Class	

ASSESMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1, CO2, CO3, CO4	C2, C3, C4, C5
	Class Participation	5%	CO1, CO2, CO3, CO4	C2, C3, C4, C5
	Class Attendance	5%		
	Mid Term	10%	CO2, CO3	C4, C5
Final Exam		60%	CO 1	C3
			CO 2	C4
			CO 3	C5
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Alternating-Current Circuits by Russell M.; Corcoran, George F. Kerchner
2. Fundamentals of Electric Circuits by Charles Alexander, Matthew Sadiku
3. Introductory Circuit Analysis(10th Edition)-- Robert Boylestad
4. Electronic Device and Circuit Theory by Robert L. Boylestad
5. Electrical Machinery Fundamentals- Stephen J Chapman
6. A Textbook of Electrical Technology - B.L Thereja

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

6.11. Architecture

6.11.1 EECE 3251: Building Services III: Electrical Equipment
Level-3, Term-II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 3251 : Building Services III: Electrical Equipment	Contact Hours Credit Hours	:2.00 :2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To learn and familiarize the basics of electrical circuit components as well as the analysis of DC, AC circuits and Electrical wiring.			
OBJECTIVE			
1. To learn the basic electrical quantities, their applications and unit. **2.** To study the different electrical network theorems and apply those theorems in solving complex circuit networks. **3.** To use the principles of DC and AC circuit in various practical fields. **4.** To understand the basics of electrical wiring.			

COURSE OUTCOMES& GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
1.	**Apply** different laws of circuit theorems to solve various engineering problems.	PO1	C3			3	ASG,F
2.	**Analyze** different circuit related complex engineering problems efficiently.	PO1	C4	2		3	Mid ,ASG,F
3.	**Apply** different electrical wiring techniques in practical building design.	PO3	C3			5	MT,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final, MT- Mid Term)

COURSE CONTENT

Electrical units and standards, Electrical networks and circuit theorems.
RLC series and parallel circuits.
Introduction to electrical wiring for residential, commercial and industrial installations and buildings. Illumination and different types of lighting.

CO PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
1.	**Apply** different laws of circuit theorems to solve various engineering problems.	2											
2.	**Analyze** different circuit related complex engineering problems efficiently.		2										
3.	**Apply** different electrical wiring techniques in practical building design.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 28
Self-Directed Learning Non-face-to-face learning Revision Assessment Preparations	 28 14 14
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	89

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Fundamental Electric Concepts**	CT-1
Class 1	Electricity, Electric element and components, Electric Circuit	
Class 2	Current (AC or DC), Voltage, Ohm's law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh	
Week 2	**Series and Parallel DC Circuits**	
Class 3	Series-parallel connection	
Class 4	KCL, KVL, Analysis of equivalent resistance of electrical circuit	
Week 3	**Nodal Analysis**	
Class 5	Method of Obtaining Node voltages and super node analysis	
Class 6	Various mathematical problems solving nodal analysis	
Week 4	**Mesh Analysis**	CT-2
Class 7	Method of obtaining mesh currents using mesh analysis	
Class 8	Mathematical problems related to Mesh Analysis	
Week 5	**Network Theorem**	
Class 9	Method of obtaining mesh currents using mesh analysis	
Class 10	Mathematical problems related to Mesh Analysis	
Week 6	**Network Theorem**	
Class 11	Norton's Theorem and applications	
Class 12	Maximum power transfer theorem	
Week 7	**AC Current Analysis**	MID
Class 13	AC RLC Circuits	
Class 14	AC Parallel Circuits	
Week 8	**Electrical Wiring**	
Class 15	Introduction to electrical wiring	
Class 16	Rules and Regulations for electrical wiring	
Week 9	**Electrical Wiring**	
Class 17	Electrical wiring for residential buildings	
Class 18	Electrical wiring for residential buildings (continued)	
Week 10	**Electrical Wiring**	CT-3
Class 19	Electrical wiring for industrial buildings	
Class 20	Electrical wiring for industrial buildings (continued)	
Week 11	**Electrical Wiring**	
Class 21	Electrical wiring for commercial buildings	

Class 22	Electrical wiring for commercial buildings (continued)
Week 12	**Electrical Wiring**
Class 23	Cost estimation for electrical wiring of a building
Class 24	Cost estimation for electrical wiring of a building (continued)
Week 13	**Illumination**
Class 25	Introduction to illumination
Class 26	Illumination for different types of building
Week 14	**Lighting**
Class 27	Lighting
Class 28	Different types of lighting

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Test 1-3	20%	CO1	C3
			CO2	C4
	Assignment	5%	CO1	C3
			CO2	C4
	Attendance	5%		
	Mid term	10%	CO2	C4
			CO3	C3
Final Exam		60%	CO1	C3
			CO2	C4
			CO3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.
3. Electrical Wiring, Estimating and Costing - S.L. Uppal; Khanna Publishers

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

CHAPTER 7

COURSES OFFERED BY OTHER DEPARTMENTS TO EECE STUDENTS

1.1. Department of Science and Humanities

7.1.1. Physics

7.1.1.1. PHY 101: Waves & Oscillation, Optics and Modern Physics

Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: PHY 101 : Waves & Oscillation, Optics and Modern Physics	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To learn the basic concepts of Waves and Oscillations, Optics and Modern physics			
OBJECTIVE			
1. To define the different parameter and concepts of Waves and Oscillations, Optics and Modern physics. 2. To explain the basic concepts of Waves and Oscillations, Optics and Modern physics. 3. To solve analytical problems regarding Waves and Oscillations, Optics and Modern physics.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **Define** the different parameters such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.	PO1	C1			1,2	T, MID, F
CO2	Be capable to **Explain** the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theory regarding modern physics such as special theory of relativity, Compton theory, materials according to magnetic properties, nuclear transformation, and nuclear reaction etc.	PO1	C2			1,2	MID, ASG, Pr, F

CO3	Be skilled to **Solve** quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.	PO1	C3	1		1,2	MID, ASG, Pr, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Waves and Oscillations

Simple Harmonic Motion (SHM) and its properties, Differential equation of a SHM and its solution, total energy of a body executing SHM, average kinetic and potential energy of a body executing SHM, LC oscillatory circuit, composition of two SHM, simple pendulum, compound and torsional pendulum, spring-mass system, two body oscillation and reduced mass, damped harmonic motion and its different condition, forced oscillation and its different condition, resonance, equation of a progressive wave, differential equation of a progressive wave, energy density of wave motion, average kinetic and potential energy of a body executing SHM, Stationary wave.

Optics

Lens, equivalent lens and power, defects of images and different aberrations, Interference of light, Young’s double slit experiment, Interference in thin film and Newton's ring method, diffraction of light, diffraction by single slit, diffraction by double slits, Fraunhofer and Fresnel bi-prism, diffraction gratings, polarization of light, Brewster’s law, Malus law, polarization by double refraction, Nicole prism, optical activity and polarimeters, optical instruments, resolving power of optical instrument, Laser: spontaneous and stimulated emission.

Modern Physics

Galilean relativity & Reference frame, Special theory of relativity postulates, Galilean transformation, Lorentz Transformation, Length contraction, Time dilation, Velocity addition, relativity of mass, mass energy relation, Momentum energy relation, Photoelectric effect, Compton effect, de Broglie matter wave, Bohr atom model and explanation, atomic orbital and energy equation, classification of nucleus, nuclear binding energy, radioactivity, radioactive decay law, half-life, mean life, nuclear reaction, introduction to nuclear reactor.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **Define** the different parameters such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.	3											
CO2	Be capable to **Explain** the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theory regarding modern physics such as special theory of relativity, Compton theory, materials	3											

	according to magnetic properties, nuclear transformation, and nuclear reaction etc.												
CO3	Be skilled to **Solve** quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.	3											

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	84
Formal Assessment	5
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week-1	**Topic**	**CT**
Class-1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course	CT-1
Class-2	Simple harmonic motion (SHM) and its differential equations, graphical representation of SHM	
Class-3	Average K.E and total energy	
Week-2		
Class-4	Spring-mass system , electric oscillatory circuit	
Class-5	Simple, compound and torsional pendulum	
Class-6	Combination of two SHM	
Week-3		Mid exam
Class-7	Combination of two SHM	
Class-8	Two body oscillations, reduced mass	
Class-9	Damped oscillations and its differential equation	
Week-4		
Class-10	Displacement equation of damped oscillation, electric damped oscillatory circuit	
Class-11	Forced oscillation and its differential equation	
Class-12	Displacement equation of forced oscillation, resonance	
Week-5		
Class-13	Plane progressive wave, energy density of wave	
Class-14	Stationary wave	
Class-15	Lens and combination of lenses, power of lens	
Week-6		
Class-16	defects of images and different aberrations	
Class-17	defects of images and different aberrations	
Class-18	Interference of light, young’s double slit expeiment	
Week-7		CT-2

Class-19	Interference in Thin films, Newton's ring	
Class-20	Diffraction : Fresnel & Fraunhofer diffraction	
Class-21	Diffraction by single slit	
Week-8		
Class-22	Diffraction by double slit, Diffraction gratings	
Class-23	Polarization and Production and analysis of polarized light	
Class-24	Optics of crystals, Nicole prism	
Week-9		
Class-25	Brewster's and Malus law	
Class-26	Optical activity and polarimeter	
Class-27	Laser & its applications	
Week-10		
Class-28	Theory of relativity: Frame of Reference, Postulates of special relativity, Galilean Transformation	
Class-29	Theory of relativity: Lorentz Transformations, Length Contraction and Time dilation	
Class-30	Velocity addition, Relativistic mass: Concept of relativistic mass and its expression	
Week-11		CT-3
Class-31	Theory of relativity: Mass and Energy equivalence equation and concept of Massless particle and its expression. Related numerical problems	
Class-32	Photoelectric Effect, photocurrent and work function, kinetic energy, stopping potential	
Class-33	photoelectric equation, characteristics of photoelectric effect	
Week-12		
Class-34	Compton effect: Definition, Compton wavelength shift, limitation	
Class-35	De Broglie Concept, Condition for wave and particle behaviour, Bohr atomic model	
Class-36	Expression for Bohr radii and orbital energy for hydrogen atom	
Week-13		
Class-37	Classification of Nucleus, nuclear binding energy	
Class-38	Radioactivity and its transformation, Radioactive Decay Law,	
Class-39	half- life, Mean life, nuclear reaction	
Week-14		
Class-40	Concept of Fusion, Fission and nuclear chain reaction	
Class-41	General idea on nuclear reactor and nuclear power plant	
Class-42	Follow up of the course	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test & Assignment 1-3	20%	CO 1	C1
			CO 2	C2
	Class Participation	5%	CO 2	C2
	Class Attendance	5%		
	Mid term	10%	CO3	C3
Final Exam		60%	CO 1	C1
			CO 2	C2
			CO3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS
1. **Fundamentals of Physics**: Halliday, Resnick and Walker 2. **Physics for Scientists and Engineers**: Serway and Jewett 3. **Concept of Modern Physics**: Arthur Beiser 4. **University Physics with Modern Physics**: Hugh D. Young and Roger A. Freedman 5. **Modern Physics for Science and Engineering**: Marshall L. Burns 6. **Waves and Oscillations**: Walter Fox Smith 7. **The Physics of Vibrations and Waves**: H. J. Pain 8. **Waves and Oscillations**: BrijLal and Subramannyam 9. **Fundamental of Optics**: Francis A. Jenkins and Harvey E.White 10. **Introduction to Modern Optics**: Grant R. Fowles 11. **Fundamental Optical Design**: Michael J. Kidger

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.1.2. PHY 103: Electricity & Magnetism, Thermal Physics, Quantum Mechanics & Photonics
Level-1, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: PHY 103 : Electricity & Magnetism, Thermal Physics, Quantum Mechanics & Photonics	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To learn the basic concepts of Electricity & Magnetism, Thermal Physics, Quantum Mechanics and Photonics			
OBJECTIVE			
1. To define the different parameter and concepts of Electricity & Magnetism, Thermal Physics, Quantum Mechanics and Photonics. 2. To explain the basic concepts of Electricity & Magnetism, Thermal Physics, Quantum Mechanics and Photonics. 3. To solve analytical problems regarding Electricity & Magnetism, Thermal Physics, Quantum Mechanics and Photonics.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **Define** the different parameters such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.	PO1	C1			1,2	T, MID, F

CO2	Be capable to **Explain** the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theory regarding modern physics such as special theory of relativity, Compton theory, materials according to magnetic properties, nuclear transformation, and nuclear reaction etc.	PO1	C2			1,2	MID, ASG, Pr, F
CO3	Be skilled to **Solve** quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.	PO1	C4	1		1,2	MID, ASG, Pr, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Electricity & Magnetism

Electric field, Electric Flux, Gauss' law and application, electric potential, current density & resistance, Magnetic properties of matter, magnetization, susceptibility, permeability, hysteresis loop, soft and hard magnet

Thermal Physics

Temperature, Thermometers, Process of heat transfer, thermal conductivity, Kinetic theory of gases, kinetic interpretation of temperature, specific heats of ideal gas, and equipartition of energy, mean free path, Maxwell's distribution of molecular speeds, zeroth law of thermodynamics, Heat and work, First law of thermodynamics and its applications. Reversible and irreversible process, Carnot cycle, and second law of thermodynamics, Carnot's theorem. Entropy, thermodynamics functions, Maxwell relations, Clausius-Clapeyron equation.

Quantum Mechanics

Wave function, Normalization of Wave Function, Expectation Value, Probability Amplitude, Heisenberg's Uncertainty Principle, One-dimensional Time Independent and time dependent Schrodinger Equation, Transmission and Reflection at a Potential Barrier, Barrier Penetration, Stationary States, Infinite Square Well, Simple Harmonic Oscillator, The Free Particle (Particle with Zero Potential), Energy Calculation, Finite Square Well, The Scattering Matrix

Photonics

Photon Optics : Photon-Optics Theory of Light in a Resonator (Photon Energy, Photon Position), Transmission of a Single Photon Through a Beam-Splitter (Photon Momentum, Photon Polarization, Photon Interference), Transmission of Photon Stream (Mean Photon Flux), Photon-Matter Interaction: Electron Energy Levels of Atoms, Molecules and Solids; Occupation of Energy Levels in Thermal Equilibrium (Boltzmann Distribution and Fermi-Dirac

Distribution), Interaction Between a Photon and an Atom (Absorption, Radiative Recombination---Stimulated Emission and Spontaneous Emission, Non-radiative Recombination, External and Internal Quantum Efficiency). Introduction to Photonic Devices: Laser, LED, Photo detectors, Solar Cells.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **Define** the different parameters such as periodic motion, simple harmonic motion, undamped oscillations, interference, diffraction, polarization and prism, photoelectric effect, Compton effect, matter wave, atomic model, radioactive decay, fusion, fission etc.	3											
CO2	Be capable to **Explain** the wave motion for different systems along with energy, the techniques to derive different formula for interference, diffraction, polarization and prism, different theory regarding modern physics such as special theory of relativity, Compton theory, materials according to magnetic properties, nuclear transformation, and nuclear reaction etc.	3											
CO3	Be skilled to **Solve** quantitative problems in the field of Waves and Oscillations, Optics and Modern physics such as energy of wave motion, wavelength, diffraction pattern, relativistic energy, photon energy, Compton shift, nuclear binding energy etc.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	84
Formal Assessment	5
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1		CT 1
Class 1	Electric field, Electric Flux, Gauss’ law and application	
Class 2	Electric potential, current density & resistance	
Class 3	Magnetic properties of matter, magnetization, susceptibility, permeability, hysteresis loop, soft and hard magnet	
Week 2		

Class 4	Temperature and Thermometers	
Class 5	Heat transfer and conductivity	
Class 6	kinetic interpretation of temperature	
Week 3		
Class 7	Equipartition of energy, calculation of ratio of specific heats, mean free path.	
Class 8	Vander Walls equation of state.	
Class 9	0^{th} law of thermodynamics, 1^{st}law of thermodynamics and its applications	
Week 4		CT 2
Class 10	Isothermal and adiabatic relations, work done by gas. Reversible and irreversible process.	
Class 11	2^{nd} law of thermodynamics, Carnot cycle efficiency,	
Class 12	Solve problems related 2^{nd} law of thermodynamics	
Week 5		
Class 13	Carnot's theorem, solve problems related Carnot theorem	
Class 14	Entropy and third law of thermodynamics	
Class 15	Thermodynamics functions	
Week 6		
Class 16	Maxwell relations, Clausius-Clapeyron equation	
Class 17	Wave function, Normalization of Wave Function	
Class 18	Expectation Value, Probability Amplitude, Heisenberg's Uncertainty Principle	
Week 7		
Class 19	One-dimensional Time dependent Schrodinger Equation	
Class 20	One-dimensional Time Independent Schrodinger Equation	
Class 21	Transmission and Reflection at a Potential Barrier, Barrier Penetration, Stationary States,	
Week 8		MID
Class 22	Infinite Square Well, Simple Harmonic Oscillator	
Class 23	The Free Particle (Particle with Zero Potential), Energy Calculation,	
Class 24	Finite Square Well, The Scattering Matrix	
Week 9		
Class 25	Photon Optics : Photon-Optics Theory of Light in a resonator	
Class 26	Photon Energy, Photon Position	
Class 27	Transmission of a Single Photon Through a Beam-Splitter	
Week 10		
Class 28	Photon Momentum, Photon Polarization, Photon Interference	
Class 29	Transmission of Photon Stream (Mean Photon Flux)	
Class 30	Photon-Matter Interaction: Electron Energy Levels of Atoms	
Week 11		
Class 31	Molecules and Solids; Occupation of Energy Levels in Thermal Equilibrium (Boltzmann Distribution)	
Class 32	Fermi-Dirac Distribution	CT 3
Class 33	Interaction Between a Photon and an Atom (Absorption, Radiative Recombination	
Week 12		
Class 34	Stimulated Emission and Spontaneous Emission	
Class 35	Non-radiative Recombination	
Class 36	High Intensity LEDs: Working Principle of a Hetero-structure LED	
Week 13		
Class 37	Lasers : Population Inversion, Four-Level Pumping Scheme, Rate	

	Equations	
Class 38	Einstein’s Coefficient, Homogeneous and Inhomogeneous Line Broadening, Gain Co-efficient and Phase Shift Co-efficient	
Class 39	High Intensity LEDs: Working Principle of a Hetero-structure LED	
Week 14		
Class 40	Photo detectors	
Class 41	Solar Cells	
Class 42	Revision Class	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous Assessment (40%)	Class Test & Assignment 1-3	20%	CO1	C1
			CO1	C2
			CO2	C4
	Class Participation	5%	CO1	C1
			CO2	C2
	Class Attendance	5%		
	Mid term	10%	CO1	C1
			CO2	C2
			CO3	C4
Final Exam		60%	CO1	C1
			CO2	C2
			CO3	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. “Elementary solid state physics” -M.Ali Omar.
2. “Introduction solid state physics” -C. Kittle.
3. “ Physics part-I” – Resnick and Halliday
4. “Physics part-II” – Resnick and Halliday
5. “Fundamentals of Physics”- Halliday, Resnick and Walker
6. Electrical Engineering Material – A. J. Dekker.
7. Principles of Electrical Engineering Materials and Devices – S. O. Kasap; Irwin.
8. Opto-Electronics – an Introduction – J. Wilson, J.B. Hawkes;
9. Optical Electronics in Modern Communications – Amnon Yariv;
10. Optical Fiber Communications: Principles & Practice – John M. Senior.
11. Introduction to Optical Electronics – A. Jones; Harper & Row.
12. Electro-optical System Design for Information Process – L. Wyatt.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.1.3. PHY 102: Physics Sessional
Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: PHY 102 : Physics Sessional	Lecture Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This course is a laboratory course for the basic physics in the field of Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics. The course will be emphasised the fundamental experiments on different fields of physics which can be applicable in a wide spectrum of engineering disciplines. This laboratory course will enable students to understand basic physics practically as well as do work with team or individual.
OBJECTIVE
1. To develop basic physics knowledge practically 2. To practice use of basic scientific instrument.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding POs	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **Define** the different parameters regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	PO1	C1	-	-	1	Q
CO2	Be capable to **Describe** the different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	PO1	C1	-	-	1	T, F
CO3	Be skilled to **Construct** Experiments by an individual or by a group to determine different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	PO9	C2	-	-		F
CO4	Be able to **Prepare** a report for an experimental work.	PO10	C2				R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT-Mid Term)

COURSE CONTENT
Quantitative measurement of different parameters in the field of Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics such as: Specific resistance of materials, high resistance, Electrochemical equivalent (ECE) of copper, wavelength of light, focal length of lens, specific rotation of sugar, conductivity of a bad conductor, acceleration due to gravity, spring constant, the rigidity modulus, conservation of linear momentum, Young's modulus, Planck's constant, specific heat of a liquid

CO-PO MAPPING													
No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **Define** the different parameters regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	3											
CO2	Be capable to **Describe** the different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	3											
CO3	Be skilled to **Construct** Experiments by an individual or by a group to determine different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.									2			
CO4	Be able to **Prepare** a report for an experimental work.										1		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	10
Experiment	18
Self-Directed learning	
Preparation of lab reports	18
Preparation of Lab-test	25
Preparation of Lab Quiz	9
Preparation of presentation	9
Formal Assessment	
Continuous assessment	2
Quiz	1
Final Lab examination	3
Total	95

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Design Based Method

COURSE SCHEDULE

Week	**Topic**
Week-1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, evaluation system of the course, grouping, visit different section of the laboratory, introduction to different basic equipment’s
Week-2	Determination of specific resistance of materials of a wire by using Meter Bridge / Determination of focal length of a concave lens by auxiliary lens method

Week-3	Determination of a high resistance by the method of deflection/ Determination of specific heat of a liquid by the method of cooling
Week-4	Determination of ECE of copper by using copper voltameter / Determination of the Young's modulus of bar by bending method
Week-5	Determination of the wavelength of light by using diffraction grating
Week-6	Determination of the focal length of a plano-convex lens by Newton's ring method
Week-7	Determination of the specific rotation of sugar by poralimeter
Week-8	Determination of the conductivity of a bad conductor by Lee's method / Verification of the law of conservation of linear momentum
Week-9	Determination of the acceleration due to gravity by means of compound pendulum
Week-10	Determination of the spring constant and the rigidity modulus of a spiral spring
Week-11	Determination of the Planck's constant using photoelectric effect
Week-12	Viva & experimental exam
Week-13	Viva & experimental exam
Week-14	Quiz exam

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class performance/ Assignment	10%	CO1	C1
	Report Writing/ Assignment	30%	C01, CO4	C1, C2
Final Exam (60%)	Lab test	30%	CO1, CO2, CO3	C1, C2
	Viva	10%		
	Quiz	20%		
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. **Practical Physics**: G. L. Squires
2. **Practical Physics**: Dr Giasuddin and Md. Sahabuddin.
3. **B.Sc. Practical Physics**: C. L Arora
4. **Practical Physics**: S.L. Gupta and V. Kumar

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.2. Mathematics

7.1.2.1. MATH 101: Differential and Integral Calculus
Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: Math 101 : Differential and Integral Calculus	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Purpose of this course is to introduce basic knowledge of Differential Calculus and use it in engineering study.			
OBJECTIVE			
1. Be able to impart basic knowledge on differential and Integral Calculus to solve engineering problems and other applied problems. 2. Developing understanding some of the important aspects of rate of change, area, tangent, normal and volume. 3. Be expert in imparting in depth knowledge of functional analysis such as increasing, decreasing, maximum and minimum values of a function			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	**Define** the limit, continuity and differentiability of functions, **identify** the rate of change of a function with respect to independent variables and **describe** the different techniques of evaluating indefinite and definite integrals.	PO1	C2		1	2	T, F, ASG
CO2	**Apply** the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	PO1	C3		1	2	T, Mid Term Exam, F
CO3	**Calculate** the length, area, volume, center of gravity and average value related to engineering study.	PO1	C3		1	2	Exam, F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Differential Calculus: Introduction, Differential Calculus for Engineering, Function and Limit, Continuity and Differentiability, Successive Differentiation, Leibnittz's Theorem, Rolle's Theorem, Mean Value Theorem, Taylor's theorem, Expansion of Finite and Infinite forms, Lagrange's form of remainder, Cauchy's form of remainder, Expansion of functions differentiation and integration, Indeterminate form, Cartesian differentiation, Euler's theorem, Tangent, sub tangent and Normal, sub normal, Maxima and Minima, Curvature, Asymptotes, Partial differentiation.

Integral Calculus: Definition of Integration, Importance of Integration in Eng., Integration by substitution, Integration by parts, Standard integrals, Integration by successive reduction, Definite integrals and its use, Integration as a limit of sum, summing series, Walli's formula, Improper Integrals, beta and gamma function, multiple integral and its application, Area, volume of solid revolution, Area under a plain curve, Area of the region enclosed by two curves, Arc lengths of curves.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Define** the limit, continuity and differentiability of functions, **identify** the rate of change of a function with respect to independent variables and **describe** the different techniques of evaluating indefinite and definite integrals.	3											
CO2	**Apply** the concepts or techniques of differentiation and integration to solve the problems related to engineering study.	3											
CO3	**Calculate** the length, area, volume, center of gravity and average value related to engineering study	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	
Class 1	Introduction to Differential Calculus for Engineering study, Limit of a function and its properties.
Class 2	Basic limit theorems with proofs, Limit of infinity and infinite limit, Sandwich (Squeezing) theorem with problems.
Class 3	Concept of Differentiation, definition, classification of discontinuity and solving problems
Week 2	

Class 4	Basic concept of Differentiability, definition, derivative of a function, differentiable function.	CT 1
Class 5	Differentiability – one sided derivatives (R.H.D and L.H.D), solving problems	
Class 6	Successive differentiation – Concept and problem solving	
Week 3		
Class 7	Leibnitz's theorem and its applications	
Class 8	Determination of $(y_n)_0$	
Class 9	Mean Value theorem, Taylor theorem	
Week 4		CT 2
Class 10	Expansion of finite and infinite forms, Lagrange's and Cauchy's form of remainder.	
Class 11	Indeterminate forms – concept and problem solving,	
Class 12	L'Hospital's rules with application	
Week 5		
Class 13	Partial differentiation - partial derivatives of a function of two variables and problems	
Class 14	Partial differentiation - partial derivatives of a homogeneous function of two variables, Euler's theorem for two variables and problems	
Class 15	Partial differentiation - partial derivatives of a homogeneous function of several variables, Euler's theorem for several (three and m) variables and problem solving	
Week 6		
Class 16	Tangents and Normals – Tangents and Normals in Cartesian, equation of tangent at the origin, equation of normal of functions of explicit and implicit forms, Angle between two intersection of two curves; problem solving	
Class 17	Tangents and Normals – Tangents and Normals in polar, Angle between two intersection of two curves; problem solving	
Class 18	Tangents and Normals – Subtangent and subnormals in Cartesian and polar coordinate; problem solving	
Week 7		Mid Term
Class 19	maxima and minima of functions of single variables – concept,Increasing and decreasing function, Concave up and down with problems	
Class 20	Curvature	
Class 21	Asymptotes	
Week 8		
Class 22	Introduction to integral calculus	
Class 23	Standard integrals – concept of definite and indefinite integrals, applications.	
Class 24	Indefinite integrals – Method of substitution, Techniques of integration	
Week 9		
Class 25	Indefinite integrals – Integration by parts, Special types of integration, integration by partial fraction	
Class 26	Integration by the method of successive reduction	
Class 27	Definite integrals – definite integrals with properties and problems	
Week 10		
Class 28	Definite integrals – Reduction formula, Walli's formula	
Class 29	Definite integrals – definite integral as the limit of the sum	
Class 30	Beta function – concept and problem solving	

Week 11		CT 4
Class 31	Gamma function - concept and problem solving	
Class 32	Relation between beta and gamma function, Legendre duplication formula, problems and applications	
Class 33	Multiple integrals – double integrals	
Week 12		
Class 34	Multiple integrals – triple integrals	
Class 35	Multiple integrals – successive integration for two and three variables	
Class 36	Area in Cartesian	
Week 13		
Class 37	Area in polar	
Class 38	Volume of solid revolution	
Class 39	Area under a plain curve in Cartesian and polar coordinates	
Week 14	**Data Acquisition and microcontroller**	
Class 40	Area of a region enclosed by two curves in Cartesian and polar coordinates	
Class 41	Arc lengths of curves in Cartesian coordinates	
Class 42	Arc lengths of curves in polar coordinates	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO 2	C3
	Class Participation	5%	CO 3	C3
	Class Attendance	5%		
	Mid term	10%	CO 2	C3
Final Exam		60%	CO 1	C2
			CO 2	C3
			CO 3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Calculus (9th Edition) by Howard Anton (Author), Irl C. Bivens (Author), Stephen Davis.
2. Calculus: An Intuitive and Physical Approach By Morris Kline.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.2.2. MATH 105: Vector Analysis, Matrix and Coordinate Geometry
Level-1, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: Math 105 : Vector Analysis, Matrix and Coordinate Geometry	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE
Course Code: Math 101 Course Title: Differential and Integral Calculus
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To teach the students the basic Concepts, Principles and operations of Vector, Matrices and Application of Geometry. The aim of this course is to develop the analytical capability of Vector, Matrices and Geometry. Finally this course is designed to develop a capability of students to solve practical problems.
OBJECTIVE
1. Be able to impart basic knowledge on the Vector Analysis, Matrix and Geometry. **2.** Achieving ability to familiarize the students with the working principle of calculating differentiation and integration of vector valued functions in Cartesian, cylindrical and spherical geometry. **3.** Be able to provide knowledge on using concept of vector, matrix and Geometry in engineering area and solve other applied problems. **4.** Be expert in imparting the depth knowledge on the vector analysis, matrix and co-ordinate geometry.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	**Define and identify** the physical explanation of different vector notation, **explain** the basic concept of matrix, 2D and 3D geometry.	PO1	C2		1	2	T, F
CO2	**Interpret** mathematics, science and engineering such as calculating volume and area of any object in vector field.	PO1	C2		1	2	T, Mid Term Exam, F
CO3	Be proficient to **analyses** and **demonstrate** the technique in engineering problems which is taught in vector, matrix and Geometry.	PO1	C3		1,3	2	F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
Vector Analysis: Definition of Vector, Scalars and Vectors, Equality of direction ratios and vectors, Addition and Subtraction of Vectors, Multiplication of vectors by scalars, Position Vector of a point, Scalar and vector products of two vectors and their geometrical interpretation, Triple products and multiple products, Linear dependence and independence of

vectors, Differentiation of vectors, Gradient of scalar functions, Divergence and curl of point functions, physical significance of gradient, divergence and curl, Definition of line, surface and volume integral, Integration of Vectors, Green's, stroke's and Gauss theorem and their application.

Matrix: Definition of Matrix, different types of matrices, Algebra of Matrices, Multiplication of matrices, Transpose and adjoint of a matrix, inverse of a matrix, rank and elementary transformation, solution of linear equation or System of Linear Equation, linear dependance and independence of vectors, quadratic forms, matrix polynomials, determination characteristic roots and vectors, null space and nullity of matrix, characteristic subspace of matrix, Eigen values and Eigen Vectors, Caley-Hamilton theorem.

Coordinate Geometry: Introduction to geometry, Rectangular co-ordinates, Angle between two lines, Transformation of co-ordinates, changes of axes, The plane-angle between two planes, pair of straight lines, general equation of second degree and reduction to its standard forms and properties, circles (tangents, normal, chord of contact, pole and polar), equation of conics, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates, system of circles (radical axes, coaxial circles, limiting points), Three dimensional co-ordinate system, direction cosines, projections, the plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane) and the straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **define and identify** the physical explanation of different vector notation, **explain** the complete concept about matrix, 2D and 3D geometry.	3											
CO2	Be able to **interpret** mathematics, science and engineering such as calculating volume and area of any object in vector field.	3											
CO3	Be proficient to **determine** and **find** the technique to obtain the inverse matrix and **calculate** length, volume and area of objects related to engineering study by using vector, **solve** the system of linear equations using matrix and the problems related to the pair of straight lines, circles, system of circles, parabola, ellipse etc.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture Practical / Tutorial / Studio	42 -

Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home Preparation for final examination	21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**(Must know)**	CT 1
Class 1	Definition of vector, Scalars and Vectors, Equality of direction ratios and vectors, Addition , Subtraction and multiplication of vectors,	
Class 2	Position vector of a point, Scalar and vector products of two vectors and their geometrical interpretation, Triple products and multiple products,	
Class 3	Linear dependence and independence of vectors, Differentiation of vectors	
Week 2	**(Must know)**	
Class 4	Gradient of scalar functions, Divergence and curl of point functions	
Class 5	Physical significance of gradient, divergence and curl	
Class 6	Physical significance of gradient, divergence and curl	
Week 3	**(Must know)**	
Class 7	Integration of vectors (line, surface and volume integrals)	
Class 8	Integration of vectors (line, surface and volume integrals)	
Class 9	Integration of vectors (line, surface and volume integrals)	
Week 4	**(Must know)**	CT 2
Class 10	Green's, Stoke's and Gauss's theorem and their application	
Class 11	Green's, Stoke's and Gauss's theorem and their application	
Class 12	Green's, Stoke's and Gauss's theorem and their application	
Week 5	**(Must know)**	
Class 13	Definition of Matrix, different types of matrices, Algebra of Matrices, Multiplication of matrices	
Class 14	Transpose and adjoint of a matrix, inverse of a matrix	
Class 15	Rank and elementary transformation	
Week 6	**(Must know)**	
Class 16	Solution of linear equation or System of Linear Equation,	
Class 17	Linear dependance and independence of vectors,	
Class 18	Quadratic forms, matrix polynomials, determination characteristic roots and vectors.	
Week 7	**(Must know)**	Mid Term
Class 19	Null space and nullity of matrix, characteristic subspace of matrix	
Class 20	Eigen values and Eigen Vectors	
Class 21	Caley-Hamilton theorem - concepts and problems	
Week 8	**(Must know)**	
Class 22	Introduction to geometry, Rectangular co-ordinates, Angle between two lines	
Class 23	Transformation of co-ordinates, changes of axes	
Class 24	The plane-angle between two planes, pair of straight lines	
Week 9	**(Must know)**	
Class 25	Pair of straight lines, general equation of second degree and reduction	

	to its standard forms and properties	
Class 26	Circles (tangents, normal, chord of contact, pole and polar)	
Class 27	Circles (tangents, normal, chord of contact, pole and polar)	
Week 10	**(Should know)**	CT 4
Class 28	Equation of conics	
Class 29	Equation of conics	
Class 30	Homogeneous equations of second degree	
Week 11	**(Must know)**	
Class 31	Angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates	
Class 32	Pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates	
Class 33	Pair of lines joining the origin to the point of intersection of two given curves, equations of parabola, ellipse in Cartesian and polar coordinates	
Week 12	**(Must know)**	
Class 34	System of circles (radical axes, coaxial circles, limiting points)	
Class 35	System of circles (radical axes, coaxial circles, limiting points)	
Class 36	Three dimensional co-ordinate system,	
Week 13	**(Must know)**	
Class 37	Direction cosines, projections	
Class 38	The plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane)	
Class 39	The plane (angle between two planes, parallel & perpendicular plane, distance of a point from a plane)	
Week 14	**(Must know)**	
Class 40	The straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid)	
Class 41	The straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid)	
Class 42	The straight line (coplanar lines, shortest distance between two given straight lines), standard equation of sphere, ellipsoid, hyperboloid)	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO 2	C2
	Class Participation	5%	CO3	C3
	Class Attendance	5%		
	Mid term	10%	CO 2	C2
Final Exam		60%	CO 1	C2
			CO 2	C2
			CO 3	C3
Total Marks		100%		

(CO=Course Outcome, C=Cognitive, P=Psychomotor, and A=Affective Domain)

TEXT & REFERENCE BOOKS

1. Calculus (9th Edition) by Howard Anton, Irl C. Bivens, Stephen Davis.
2. Calculus: An Intuitive and Physical Approach By Morris Kline.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.2.3. MATH 205: Differential Equations, Laplace Transform and Fourier Transform Level-2, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: Math 205 : Differential Equations, Laplace Transform and Fourier Transform	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: Math 105 Course Title: Vector Analysis, Matrix and Coordinate Geometry			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
To teach the students the basic Concepts, Principles and operations of Differential Equation, Laplace Transform and Application of Fourier Analysis in Engineering problem. The aim of this course is to develop the analytical and practical capability of Differential equation, Laplace Transform and Fourier Analysis.			
OBJECTIVE			
1. To provide a physical interpretation of the Differential Equations and Laplace Transform. 2. Able to explain the characteristics of Ordinary Differential Equations and Laplace Transform. 3. To apply Laplace and Fourier Transform in solving complex problems. 4. To use differential operations for simplification of complex engineering expressions			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	**Identify** differential equations of various types and **recognize** the basic properties of Laplace and Fourier transform.	PO1	C2		1	2	T, F
CO2	**Interpret** the classifications of differential equations and **estimate** the technique of Laplace transform and Fourier transform of some elementary function.	PO1	C2		1	2	T, Mid Term Exam, F
CO3	**Solve** different types of differential equations and **apply** Laplace transform to Ordinary Differential Equation and Fourier as well as Inverse Fourier transform to make use of boundary value problems in Engineering fields	PO1	C3		1,3	2	F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Differential Equations (DE): Introduction to DE, Formulation of DE, Degree and order of Ordinary Differential Equation (ODE), solution of first order but higher degree DE, solution of first order DE by various methods, solution of general LEs of second and higher order , Solution of Euler's homogeneous linear DEs , Solution of DEs by methods based on factorization, Application of ODE, Frobenious methods, Solution of differential equations of the higher order when dependent and independent variables are absent, Bessel's functions, Legendre's polynomial, Power series solution of DE and their application, Integral form of DE and its application to engineering problem, Formation of partial differential equations, linear and nonlinear first order Partial Differential Equation (PDE), Standard form Linear Equations (LE) of higher order, Equation of second order with variable coefficients, wave equation, particular solutions with boundary and initial condition, Integral surface passing through given curve, Non-linear PDE of order one, Charpit's method, Second order PDE and classification to canonical solution, Linear PDE with constant coefficients, Applications of PDE.

Laplace Transform (LT): Definition and properties of Laplace transform, Sufficient conditions for existence of Laplace transforms, Laplace transform of some basic functions, LT of derivatives, Unit step function, Periodic function, Some special theorems on LT, Inverse Laplace transform, Partial fraction, Heaviside expansion formula, Convolution theorem, Evaluation of improper integral, Solution of Differential Equations by LT, Application of LT.

Fourier Transform: Real and Complex form of Fourier Series, Definition and expansion of a function of x in a Fourier Series, Physical application of Fourier Series, Finite Fourier Transform, Fourier Integral, Inverse Fourier transform, Fourier transform and their uses in solving boundary value problems, Diffusion, wave, Laplace Equation

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Identify** differential equations of various types and **recognize** the basic properties of Laplace and Fourier transform.	3											
CO2	**Interpret** the classifications of differential equations and **estimate** the technique of Laplace transform and Fourier transform of some elementary function.	3											
CO3	**Solve** different types of differential equations and **apply** Laplace transform to DE and Fourier and inverse Fourier transform to make use of boundary value problems in Engineering fields.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2

Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Differential Equations**	CT 1
Class 1	Introduction to DE, Formulation of DE, Degree and order of ODE	
Class 2	Solution of first order DE by various methods	
Class 3	Solution of first order DE by various methods	
Week 2	**Differential Equations**	
Class 4	Solution of first order DE by various methods,	
Class 5	Solution of first order but higher degree DE, solution of general LEs of second and higher order	
Class 6	Solution of Euler's homogeneous linear DEs	
Week 3	**Differential Equations**	
Class 7	Solution of DEs by methods based on factorization,	
Class 8	Frobenious methods - concept	
Class 9	Frobenious methods - problems	
Week 4	**Differential Equations**	CT 2
Class 10	Solution of differential equations of the higher order when dependent and independent variables are absent	
Class 11	Bessel's functions, Legendre's polynomial, Power series solution of DE and their application,	
Class 12	Integral form of DE and its application to engineering problem,	
Week 5	**Differential Equations**	
Class 13	Formation of partial differential equations, linear and non linear first order PDE,	
Class 14	Standard form LEs of higher order	
Class 15	Integral surface passing through given curve	
Week 6	**Differential Equations**	
Class 16	Non-linear PDE of order one, Charpit's method.	
Class 17	Linear PDE with constant coefficients	
Class 18	Linear PDE with constant coefficients	
Week 7	**Differential Equations**	Mid Term
Class 19	Equation of second order with variable coefficients, Second order PDE and classification to canonical solution	
Class 20	wave equation, particular solutions with boundary and initial condition	
Class 21	Application of ODE, Applications of PDE	
Week 8	**Laplace Transform**	
Class 22	Definition and properties of Laplace transform	
Class 23	Sufficient conditions for existence of Laplace transforms	
Class 24	Laplace transform of some basic functions, LT of derivatives	
Week 9	**Laplace Transform**	
Class 25	Unit step function, Periodic function	
Class 26	Some special theorems on LT	
Class 27	Inverse Laplace transform	
Week 10	**Laplace Transform**	
Class 28	Partial fraction,	

Class 29	Heaviside expansion formula	CT 4
Class 30	Convolution theorem	
Week 11	**Laplace Transform**	
Class 31	Evaluation of improper integral,	
Class 32	Solution of Differential Equations by LT	
Class 33	Application of LT	
Week 12	**Fourier Transform**	
Class 34	Real and Complex form of Fourier Series	
Class 35	Definition and expansion of a function of x in a Fourier Series	
Class 36	Physical application of Fourier Seires	
Week 13	**Fourier Transform**	
Class 37	Finite Fourier Transform	
Class 38	Fourier Integral	
Class 39	Inverse fourier transform	
Week 14	**Fourier Transform**	
Class 40	Fourier transform and their uses in solving boundary value problems	
Class 41	Fourier transform and their uses in solving boundary value problems	
Class 42	Diffusion, wave, Laplace Equation	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO 2	C2
	Class Participation	5%	CO 3	C3
	Class Attendance	5%		
	Mid term	10%	CO2	C2
Final Exam		60%	CO 1	C2
			CO 2	C2
			CO 3	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Ordinary and Partial Differential Equations by M.D. Raisinghania.
2. Differential Equations by Shepley L. Ross.
3. Differential Equations by Glen R. Hall.
4. Theory and problems of Laplace Transform, Schaum's outlines series, Murray Spiegel.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.2.4. MATH 213: Complex Variable, Harmonic Function and Statistics
Level-2, Term-II (Fall)

COURSE INFORMATION

Course Code	: Math 213	Contact Hours	: 3.00
Course Title	: Complex Variable, Harmonic Function and Statistics	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: Math 101
Course Title: Differential Calculus and Integral Calculus
Course Code: Math 203
Course Title: Differential Equation, Laplace transform and Fourier Transform

CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To teach the students the concepts, principles and working field of Complex Variable, Statistics and harmonic property of a function which is a special property. It is targeted to provide a basic foundation and applications of complex variable and to develop the concept of harmonic functions, the elementary functions and contour integration, and observing data to give statistical assumption and probability. Finally, this course is designed to demonstrate practical applications of Complex Variable, Harmonic Function and Statistics and their methods of solution.
OBJECTIVE
1. Be able to impart basic knowledge about Complex Variable, Statistics, and Harmonic function. 2. Be able to familiarize the students with the characteristics of Complex number, Complex Integrals and Harmonic functions. 3. Be proficient to familiarize with basic methods of statistics and their application. 4. Be able to impart knowledge on Statistics, Complex Variable, Harmonic Function and thereby students able to solve engineering problems to give physical interpretation .
COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	**Recall** the basic idea about Complex Variable and Statistics.	PO 1	C1		1	2	T, F
CO2	**Explain** the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	PO 1	C2		1	2	T, Mid Term Exam, F
CO3	**Apply** sampling theory and different tests in which giving concept about practical situation.	PO 1	C3		1,3	2	T, Mid Term Exam, F
CO4	**Solve** different coordinate system of engineering problems by Harmonic function	PO 2	C3		1	2	ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Complex Variable: Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Differentiation and the Cauchy-Riemann equations, Mapping by elementary functions, Line integral of a complex function, Cauchy's Integral formula, Complex function, Convergence and Uniform convergence, Liouville's theorem, Taylor's and Laurent's theorem, Singular residues, Cauchy's residue theorem.

Harmonic Function: Definitions of Harmonics function, Laplace's equation in Cartesian, Polar, cylindrical and spherical co-ordinates, Solution of these equations with applications, Gravitational potential due to a ring, Steady state temperature, Properties of harmonic functions, Potential inside and outside of a sphere.

Statistics: Measures of central tendency, Frequency distribution, Graphical representation of data including stem, Leaf and Box Plot, Chebyshev's theorem, z-scores, standard deviation, moments, skewness and kurtosis, elementary probability theory, discontinuous probability distribution, Continuous probability distribution, Binomial, Multinomial, Negative binomial,

Poisson, Exponential, Uniform, Gamma distribution, Elementary sampling theory, Estimation, Sets and probability, Random variable and its probability distribution, Treatment of grouped sampled data, Normal distribution, Tests of hypothesis, regression and correlation, Analysis of variance, Chi-square distributions, Conditional probability, Bayes's Theorem, Counting techniques.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Recall** the basic idea about Complex Variable and Statistics.	3											
CO2	**Explain** the complex functions by line integrals, Cauchy's integral formulae and Cauchy's residue theorem.	3											
CO3	**Apply** sampling theory and different tests in which giving concept about practical situation.	3											
CO4	**Solve** different coordinate system of engineering problems by Harmonic function.		2										

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Complex Variable**
Class-1	Complex number system
Class-2	General functions of a complex variable
Class-3	Graphical representation of complex number and complex variable
Week 2	**Complex Variable**

Class-4	Roots of Complex number	
Class-5	Limits of a function of complex variable.	**CT-1**
Class-6	Continuity of a function of complex variable and related theorems	
Week 3	**Complex Variable**	
Class-7	Differentiation and the cauchy Riemann equations	
Class-8	Mapping by elementary functions	
Class-9	Line integral of a complex function	
Week 4	**Complex Variable**	
Class-10	Green’s theorem in complex form	
Class-11	Cauchy's Integral formula	
Class-12	Convergence and Uniform convergence	
Week 5	**Complex Variable**	
Class-13	Liouville's theorem	**CT-2**
Class-14	Taylor's and Laurents theorem	
Class-15	Singular residues, Cauchy's residue theorem	
Week 6	**Harmonic Function**	
Class-16	Definitions of Harmonics function, Properties of harmonic functions	
Class-17	Laplace's equation in Cartesian, Polar co-ordinates	
Class-18	Laplace's equation in cylindrical co-ordinates	
Week 7	**Harmonic Function**	
Class-19	Laplace's equation in spherical co-ordinates	
Class-20	Solution of these equations with applications	
Class-21	Gravitational potential due to a ring, Steady state temperature, Potential inside and outside of a sphere.	
Week 8	**Statistics**	
Class-22	Measures of central tendency	
Class-23	Frequency distribution, Graphical representation of data including stem	
Class-24	Leaf and Box Plot	
Week 9	**Statistics**	
Class-25	Chebychev‟s the rem, z-scores	**Mid Term**
Class-26	Standard deviation, m ments	
Class-27	S ewness and kurtos s	
Week 10	**Statistics**	
Cl ss-28	Elementary probability theory	
Class-29	Discontinuous probability distribut on, Co tinuous probability distribution	
Cl ss-30	Binomi , Multinomial distribution	
Week 11	**Statistics**	
Class-31	Negative binomial, Poisson, Exponential distribution	
Class-32	Uniform, Gamma distribution	
Class-33	Elementary sampling theory, Estimation	
Week 12	**Statistics**	
Class-34	Sets and probability, Random variable and its probability distribution	
Class-35	Treatment of grouped sampled data	
Class-36	Normal distribution	
Week 13	**Statistics**	
Class-37	Tests of hypothesis	**CT-4**
Class-38	regression and correlation	
Class-39	Analysis of variance	
Week 14	**Statistics**	
Class-40	Chi-square distributions	

Class-41	Conditional probability, Bayes's Theorem	
Class-42	Counting techniques	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1
			CO2	C2
			CO3	C3
			CO4	C3
	Class Participation	5%	CO4	C3
	Class Attendance	5%		
	Mid term	10%	CO2	C2
			CO3	C3
Final Exam		60%	CO1	C1
			CO2	C2
			CO3	C3
			CO4	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Complex Variables by - Murray R. Spiegel, Schaum's Outline Series.
2. Theory and functions of complex variables, Shanti Narayan.
3. Harmonic Function Theory by - Sheldon Axler.
4. Statistics and probability by - Spiegel (Schaum Series).
5. Probability and it's Applications by – H. C. Saxena.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.3. Chemistry

7.1.3.1. CHEM 101: Fundamentals of Chemistry
Level-1, Term-I (Spring)

COURSE INFORMATION

Course Code Course Title	: CHEM-101 : Fundamentals of Chemistry	Lecture Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To learn the basic concepts of inorganic, organic and physical chemistry

OBJECTIVE

1. To define the different parameter and concepts of inorganic chemistry.
2. To apply different chemical theory to evaluate structure of molecules.
3. To explain the basic concepts of physical chemistry.
4. To describe basic reaction mechanism of selective organic reactions.

COURSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.	PO1	C1			1	T, F
CO2	Be able to apply different theory on chemical bonding and hybridization to **evaluate** structure of molecules.	PO1	C5			1	T, F, ASG
CO3	Be able to classify hydrocarbons and **explain** the mechanism of selective organic reactions.	PO1	C2			1	T, F, ASG
CO4	**Explain** chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.	PO1	C2			1	ASG ,Mid Term Exam, F
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)							

COURSE CONTENT

Atomic Structure: Concepts of atomic structure, Different atom models, Quantum theory and electronic configurations, Heisenberg's uncertainty principle
Periodic Table: Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases
Chemical Bonding: Types and properties, Lewis theory, VBT, MOT, Hybridization and shapes of molecules
Basic Concepts of Organic Chemistry: History, Physical and chemical properties, Classification
Hydrocarbon: Chemistry of hydrocarbon, Nomenclature, Properties
Selective Organic Reactions: Oxidation-reduction, Substitution, Addition, Polymerization, Alkylation reactions
Acids-Bases/Buffer Solution: Different concepts of acids-bases, Buffer solution, Mechanism of buffer solution, Henderson-Hasselbalch equation, Water chemistry and pH of water
Solutions: Solutions and their classification, Unit expressing concentration, Colligative properties and dilute solutions, Raoult's law, Van't Hoff's law of osmotic pressure
Thermochemistry: Laws of thermochemistry, Enthalpy, Hess's law, Heat of formation, Kirchoff's equations, Heat of neutralization, Heat of reaction
Electrochemistry: Conductors & nonconductors, Difference between electrolytic and metallic conduction, Electrolytic conductance, Factors influencing the conductivity of electrolytes, Kohlrausch Law & conductometric titrations
Chemical Equilibria: Equilibrium law/constant, Kp and Kc, Homogeneous and heterogeneous equilibrium, Van't Hoff's reaction isotherm, Le Chatelier's principle
Phase Rule: Basic terms and phase rule derivation, Phase diagram of water and carbon dioxide
Chemical Kinetics: Order and rate of reaction, Pseudo and zero order reaction, Half-life, Determination and factors affecting the rate of a reaction, First order reaction, Second order reaction, Collision theory, Transition state theory.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.	1											
CO2	Be able to **apply** different theory on chemical bonding and hybridization to evaluate structure of molecules.	2											
CO3	Be able to **classify** hydrocarbon and **explain** the mechanism of selective organic reactions.	2											
CO4	**Explain** chemical equilibrium, thermo-chemistry, chemical and ionic equilibria, electro-chemical cells.	2											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	42
Class Performance	-
	-
Self-Directed Learning	
Assignments	42
Revision of the previous lecture at home	21
Preparation for final examination	21
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Atomic Structure**	**CT**
Class 1	Concepts of atomic structure, Different atom models	**CT-1**
Class 2	Concepts of atomic structure, Different atom models	
Class 3	Quantum numbers, Electronic configuration	
Week 2	**Atomic Structure/Periodic Table**	
Class 4	Hydrogen spectral lines, Heisenberg's uncertainty principle	
Class 5	Classification of elements according to electronic configurations	
Class 6	Periodic classification of elements	
Week 3	**Periodic Table/Chemical Bonding**	
Class 7	Periodic properties of elements, Properties and uses of noble gases	
Class 8	Alkali metals: Chemical properties and uses	
Class 9	Chemical bonding (types, properties, Lewis theory, VBT)	
Week 4	**Chemical Bonding**	**CT-2**
Class 10	Molecular orbital theory (MOT)	
Class 11	Molecular orbital theory (MOT)	
Class 12	Hybridization and shapes of molecules	

Week 5	**Chemical Bonding/Organic Chemistry**	
Class 13	Hybridization and shapes of molecules	
Class 14	Hybridization and shapes of molecules	
Class 15	Basic concepts of organic chemistry: History, Physical & chemical properties, Classification	
Week 6	**Organic Chemistry**	
Class 16	Chemistry of hydrocarbon, Nomenclature, Properties	
Class 17	Selective organic reactions: Oxidation-reduction, Substitution	
Class 18	Selective organic reactions: Addition, Polymerization, Alkylation	
Week 7	**Acids-Bases**	**CT-3/ Mid Term**
Class 19	Different concepts of acids-bases	
Class 20	Buffer solution, Mechanism of buffer solution	
Class 21	Henderson-Hasselbalch equation	
Week 8	**Acids-Bases/Solutions**	
Class 22	Water chemistry and pH of water	
Class 23	Solutions and their classification, Unit expressing concentration	
Class 24	Effect of temperature and pressure on solubility, Validity and limitations of Henry's law	
Week 9	**Solutions/Thermochemistry**	
Class 25	Colligative properties and dilute solutions, Raoult's law, deviation from Raoult's law, Elevation of boiling point	
Class 26	Freezing point depression, Van't Hoff's law of osmotic pressure	
Class 27	Thermochemistry: Laws of thermochemistry, Enthalpy	
Week 10	**Thermochemistry/Electrochemistry**	
Class 28	Hess's law, Kirchhoff's equations	
Class 29	Heat of formation, Heat of neutralization, Heat of reaction	
Class 30	Electrolytic conduction and its mechanism	
Week 11	**Electrochemistry**	**CT-4**
Class 31	Faraday's law, Kohlrausch Law, Debye-Huckel-Onsagar theory	
Class 32	Conductrometric titrations	
Class 33	Different types of cells	
Week 12	**Chemical Equilibrium**	
Class 34	Reversible reactions, Characteristics of chemical equilibrium, Law of mass action, Equilibrium constant, Units of equilibrium constant	
Class 35	Relation between Kp & Kc,Van't Hoff's reaction isotherm	
Class 36	Free energy and its significance Heterogeneous equilibrium, Le Chatelier's principle	
Week 13	**Phase Rule/Chemical Kinetics**	
Class 37	Phase Rule: Basic terms and phase rule derivation	
Class 38	Phase Diagram of water and carbon dioxide	
Class 39	Pseudo and zero order reaction, Half-life	
Week 14	**Chemical Kinetics**	
Class 40	Determination and factors affecting the rate of a reaction	
Class 41	First order reaction, Second order reaction	
Class 42	Collision theory, Transition state theory	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment	20%	CO1	C1
			CO2	C5
			CO3	C2
			CO4	C2

	Class Performance	5%	-	-
	Class Attendance	5%	-	-
	Mid term	10%	CO4	C2
Final Exam		60%	CO1	C1
			CO2	C5
			CO3	C2
			CO4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Modern Inorganic Chemistry – S. Z. Haider
2. Concise Inorganic Chemistry – J. D. Lee
3. A Textbook of Organic Chemistry – Arun Bahl And B. S. Bahl
4. Organic Chemistry – Morrison and Boyd
5. Principles of Physical Chemistry – Haque and Nawab
6. Essentials of Physical Chemistry – Bahl and Tuli
7. Physical Chemistry – Atkins

*****Details of program outcome and grading policy are attached as Annex A and Annex B**.

7.1.3.2. CHEM 102: Chemistry Sessional
Level-1, Term-I (Spring)

COURSE INFORMATION

Course Code	: CHEM 102	Contact Hours	: 3.00
Course Title	: Chemistry Sessional	Credit Hours	: 1.50

PRE-REQUISITE

Course Code: CHEM 101
Course Title: Fundamentals of Chemistry

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To implement the basic concepts of inorganic and physical chemistry in a laboratory environment.

OBJECTIVE

1. To familiarize the students with experimentation of acid and base neutralization, titration and quantitative analysis of metals etc.
2. To make students proficient in iodimetric and iodometric analysis and complexometric titration etc.
3. To develop students' ability in estimating zinc, ferrous content in water sample by using various titrimetric methods.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent	PO9	P1				R,Q,T

	weights and so on.						
CO2	Be able to **perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc.	PO5	P5			6	R,Q,T
CO3	Be able to **measure** zinc, ferrous content in water sample by using various titrimetric methods.	PO5	P5			6	R,Q,T, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

In this course, students will perform experiments to practically verify the theories and concepts learned in CHEM 101 using different hardware equipment.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the different parameters regarding acid and base neutralization, titration and quantitative analysis of metals etc. and others key words like primary standard substances, secondary standard substances, molarity, normality, indicator, equivalent weights and so on.									1			
CO2	Be able to **perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc.					2							
CO3	Be able to **measure** zinc, ferrous content in water sample by using various titrimetric methods.					2							

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 12 30
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz	 24 10 10
Preparation of Presentation	6
Formal Assessment Continuous Assessment Final Quiz	 10 1
Total	103

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE	
Class	**Intended topics to be covered**
Class 1	Introduction
Class 2	Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2$ O) Solution.
Class 3	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution.
Class 4	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate (Na_2 CO_3) Solution.
Class 5	Determination of Calcium (Ca) Content in a Calcium Chloride dihydrate ($CaCl_2.2H_2$ O) Solution with Standard Di-Sodium Ethylene DiammineTetraAceticAcid (Na_2-EDTA) Solution.
Class 6	Standardization of Sodium ThiosulphatePentahydrate ($Na_2S_2O_3.5H_2$ O) Solution with Standard Potassium Dichromate ($K_2Cr_2O_7$) Solution.
Class 7	Estimation of Copper (Cu) Content in a Copper SulphatePentahydrate ($CuSO_4$ $.5H_2$ O) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium ThiosulphatePentahydrate ($Na_2S_2O_3$ $.5H_2$ O) Solution.
Class 8	Standardization of Potassium Permanganate ($KMnO_4$) Solution with Standard Oxalic Acid dihydrate (C_2 H_2 O_4 $.2H_2$ O) Solution.
Class 9	Determination of Ferrous (Fe) Content in a Ammonium Ferrous Sulphate (Mohr`s Salt) [$FeSO_4.(NH_4$)$2SO_4.6H_2O$] Solution with Standard Potassium Permanganate ($KMnO_4$)) Solution.
Class 10	Determination of Zinc (Zn) Content in a Zinc SulphateHeptahydrate ($ZnSO_4.7H_2O$) Solution with Standard Di-Sodium EthyleneDiamineTetraAcetic acid (Na_2-EDTA) (Na_2-EDTA) Solution by using Eriochrome black T indicator.
Class 11	Practice Lab
Class 12	Lab Test
Class 13	Quiz Test
Class 14	Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab participation and Report	15%	CO 1	P1
			CO 2	P5
			CO 3	P5
	Labtest-1, Labtest-1, Labtest-2Labtest-2	25%	CO 1	P1
			CO 2	P5
			CO 3	P5
	Presentation	20%	CO3	P5
Lab Quiz		30%	CO 1	P1
			CO 2	P5
			CO 3	P5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. G. H. Jeffery, J. Bassett, J. Mendham, R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition, Longman Scientific & Technical, 1989
2. G. D. Christian., Analytical Chemistry, 6th Edition, Wiley India Pvt. Limited, 2007
3. A. Jabbar Mian and M. Mahbubul Haque- Practical Chemistry

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4. Humanities

7.1.4.1. GES-101: Fundamentals of Sociology
Level-1, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: GES-101 : Fundamentals of Sociology	Contact Hours Credit Hours	: 2.0 : 2.0

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course is designed towards students in order to acquaint them with various aspects of the social science. The main focus of the course is making the students understand the effects of engineering in society and this is achieved through the knowledge provided about culture, civilization, stratification and sociological imaginations. It is required to embed the realization that engineers and the society are interweaved with each other which is the aim of the course.

OBJECTIVE

1. Impart ideas about society and social phenomena.
2. Make the students acquainted with Globalization and social changes.
3. Make students realize about Work and economic life.
4. To instil the ideas of Urbanization and city development.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	**Understand** the basic nature, scope and perspectives of sociology.	PO1	C2		1	1	T,F
CO2	**Apply** sociological imagination to the context of social problems of BD society	PO3	C3		1	5	M
CO3	**Understand** the stages of social research processes and methodologies	PO7	C2		1	7	M
CO4	**Analyze** different cultures, civilizations and different social problems and design solutions for those	PO11	C4		1		T,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam; M- Mid Term)

COURSE CONTENT

Nature and scope Sociological imagination, Perspectives of sociology, Stages of social research and research method, Culture and civilization, Socialization and self -development, Globalization and social changes, Media and individual, Social organizations and social problems, social stratification; industrial revolution, Capitalism and socialism, Work and economic life, Environment and human activities, Climate change and global risk, Population and human society, Urbanization and city development, Social changes and technology.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the basic nature, scope and perspectives of sociology.	3											
CO2	**Apply** sociological imagination to the context of social problems of BD			3									

	society												
CO3	**Understand** the stages of social research processes and methodologies							2					
CO4	**Analyze** different cultures, civilizations and different social problems and design solutions for those											3	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 28 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 14 14
Formal Assessment Continuous Assessment Mid-Term Final Examination	 2 1 3
Total	104

TEACHING METHODOLOGY

Lectures, class performances, assignments, class tests, final exam.

COURSE SCHEDULE

Weeks	Lectures	Lecture/Tutorial/Assignment Topic	Assessment
1	1.	Definition, nature and scope of sociology	Class Test-1
	2.	Sociological imagination	
2	3.	Perspectives of sociology	
	4.	Orientation of sociological theories	
3	5.	Social research and its process	Mid Term
	6.	Research designs and techniques.	
4	7.	Introducing culture and its variations	
	8.	civilization	
5	9.	Defining family and its changes	
	10.	Socialization process and development of self	
6	11.	Introducing globalization and its impact on human life	
	12.	Factors responsible to globalization	
7	13.	Media and its impact in modern society	
	14.	Addressing social problems of Bangladesh	
8	15.	Introducing social groups and organizations	Class Test-2
	16.	Introducing bureaucracy and good governance	
9	17.	Introducing social stratifications and social inequality	
	18.	Poverty and its types and dimensions	
10	19.	Industrial revolution and aftermath	
	20.	Urbanization and city development	
11	21.	Capitalism: features and influence	
	22.	Socialism: features and influence	

12	23.	Environment and human activities	Class Test-3
	24.	Climate change and global risk	
13	25.	Population of Bangladesh: problem or prospect	
	26.	Crime and deviance: a brief analysis	
14	27.	Review 1	
	28.	Review 2	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1, CO4	C2, C4
	Class Participation	5%	-	-
	Class Attendance	5%		
	Mid term	10%	CO 2, CO3	C2, C3
Final Exam		60%	CO 1	C2
			CO 4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Sociology in Modules: by – Richard Schaefer, 2nd edition, 2013
2. Sociology - Primary Principles: by C N Shankar Rao
3. Anthony Giddens - 5th edition
4. Relevant journals

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.2. LANG 102: Communicative English I
Level-1, Term-II (Fall)

COURSE INFORMATION			
Course Code	: LANG 102	Lecture Contact Hours	: 3.00
Course Title	: Communicative English I	Credit Hours	: 1.5

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course has mainly been designed to improve speaking and oral communication skills of the students. The course includes instructions and experience in speech preparation and speech delivery within various real life situations, formal and informal. Emphasis will be given on various speeches, such as informative, persuasive and interactive. This course will help students progress in real life both personally and professionally. Students will be able to understand class lectures and can comfortably continue the Engineering course, and also to compete in the global job market and increase career skills.

OBJECTIVE

1. To develop the four basics skills of English language, i.e. listening, speaking, reading and writing.
2. To develop students' interpersonal skills engaging them in various group interactions and activities.
3. To improve students' pronunciation in order to improve their level of comprehensibility

in both speaking and listening. 4. To give the students exposure to different types of texts in English in order to make them informed using different techniques of reading. To gain an understanding of the underlying writing well-organized paragraphs and also to teach how to edit and revise their own as well as peer's writing.							
COURSE OUTCOMES & GENERIC SKILLS							
No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **listen**, **understand,** and **learn** the techniques of note taking and answering questions	PO10	C2,A1				T,F
CO2	Be able to **understand** and speak English quickly and smartly using the techniques learnt in the class.	PO10	C2				T, F
CO3	Be able to **communicate** effectively and demonstrate competency in oral, written communication/ presentation	PO10	A2				Pr
CO4	Be able to understand the techniques of academic reading and **summarizing** any book article/ literature for review	PO9	C5				T,F
(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)							
COURSE CONTENT							

Speaking	Introduction to Language: Introducing basic skills of language. English for Science and Technology
	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc.
	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions
	Discussing everyday routines and habits, Making requests /offers /invitations /excuses /apologies/complaints
	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event
	Practicing storytelling, Narrating personal experiences/Anecdotes
	Telephone conversations (role play in group or pair) Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)
Listening	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions
	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand
	Listening to short conversations between two persons/more than two
Reading	Reading techniques: scanning, skimming, predicting, inference;
	Reading Techniques: analysis, summarizing and interpretation of texts

Writing	Introductory discussion on writing, prewriting, drafting;
	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
	Paragraph writing, Compare-contrast and cause- effect paragraph

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **listen, understand**, and **learn** the techniques of note taking and answering questions										2		
CO2	Be able to **understand** and speak English quickly and smartly using the techniques learnt in the class.										2		
CO3	Be able to **communicate** effectively and demonstrate competency in oral, written communication/presentation										3		
CO4	Be able to understand the techniques of academic reading and **summarizing** any book article/ literature for review									2			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	42 21 21
Formal Assessment Continuous Assessment Final Examination	2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Classes	**Topic**
	Week 1
Class 1	Introduction to Language: Introducing basic skills of language. English for Science and Technology
Class 2	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc.
Class 3	Self-introduction and introducing others: How a speaker should introduce himself to any stranger / unknown person / a crowd. Name, family background, education, experience, any special quality/interest, likings/disliking, etc.
	Week 2
Class 4	Asking and answering questions, Expressing likings and disliking; (food, fashion

	etc.) Asking and giving directions
Class 5	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions
Class 6	Asking and answering questions, Expressing likings and disliking; (food, fashion etc.) Asking and giving directions
Week 3	
Class 7	Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints
Class 8	Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints
Class 9	Discussing everyday routines and habits, Making requests/offers/invitations/excuses/apologies/complaints
Week 4	
Class 10	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event
Class 11	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event
Class 12	Describing personality, discussing and making plans(for a holiday or an outing to the cinema), Describing pictures / any incident / event
Week 5	
Class 13	Practicing storytelling, Narrating personal experiences/Anecdotes
Class 14	Practicing storytelling, Narrating personal experiences/Anecdotes
Class 15	Practicing storytelling, Narrating personal experiences/Anecdotes
Week 6	
Class 16	Telephone conversations (role play in group or pair), Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)
Class 17	Telephone conversations (role play in group or pair), Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)
Class 18	Telephone conversations (role play in group or pair), Situational talks / dialogues: Practicing different professional conversation (role play of doctor-patient conversation, teacher –student conversation)
Week 7	
Class 19	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions
Class 20	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions
Class 21	Listening and understanding: Listening, note taking and answering questions; Students will listen to recorded text, note down important information and later on will answer to some questions
Week 8	
Class 22	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand
Class 23	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to

	understand
Class 24	Difference between different accents: British and American accents; Documentaries from BBC and CNN will be shown and students will try to understand
Week 9	
Class 25	Listening to short conversations between two persons/more than two
Class 26	Listening to short conversations between two persons/more than two
Class 27	Listening to short conversations between two persons/more than two
Week 10	
Class 28	Reading techniques: scanning, skimming, predicting, inference;
Class 29	Reading techniques: scanning, skimming, predicting, inference;
Class 30	Reading techniques: scanning, skimming, predicting, inference
Week 11	
Class 31	Reading Techniques: analysis, summarizing and interpretation of texts
Class 32	Reading Techniques: analysis, summarizing and interpretation of texts
Class 33	Reading Techniques: analysis, summarizing and interpretation of texts
Week 12	
Class 34	Introductory discussion on writing, prewriting, drafting;
Class 35	Introductory discussion on writing, prewriting, drafting;
Class 36	Introductory discussion on writing, prewriting, drafting
Week 13	
Class 37	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
Class 38	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
Class 39	Topic sentence, paragraph development, paragraph structure, describing a person/scene/picture, narrating an event
Week 14	
Class 40	Paragraph writing, Compare-contrast and cause- effect paragraph
Class 41	Paragraph writing, Compare-contrast and cause- effect paragraph
Class 42	Paragraph writing, Compare-contrast and cause- effect paragraph

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom’s Taxonomy
Continuous Assessment (40%)	Listening Test	15%	CO1	C2,A1
			CO3	A2
	Descriptive Writing	15%	CO1	C2,A1
			CO3	A2
			CO4	C5
	Reading Test	10%	CO4	C5
Public Speaking and Final Presentation		60%	CO1	C2,A1
			CO2	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Langan, J. (2005). College Writing Skills with Readings (6^{th} Ed). McGraw-Hill Publication 2. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication 3. Jones, L. (1981). Functions of English. (Student's Book, 2^{nd} Ed.) Melbourne, Australia: Cambridge University Press. 4. Dixon, R.J. (1987). Complete course in English. (Book 4). New Delhi, India: Prentice Hall of India. (For book presentation) 5. From Paragraph to Essay - Maurice Imhoof and Herman Hudson 6. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd. 7. Speak like Churchill stand like Lincoln - James C. Humes 8. Cambridge IELTS Practice Book **9.** Selected Sample Reports and Selected Research Articles

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.3. LANG 202: Communicative English II
Level-2, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: LANG 202 : Communicative English -II	Contact Hours Credit Hours	: 3.00 : 1.5
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The English language course is designed for the students to develop their competence in communication skills for academic purposes especially in reading and writing. The approach will be communicative and interactive and will involve individual, pair and group work. Students will be exposed to different types of texts to develop efficient reading skill. Reading will also involve activities and discussions leading to effective writing. The course incorporates a wide range of reading texts to develop students' critical thinking which is one of the most essential elements required to write a good piece of academic writing. Emphasis is particularly put on the various forms of essay writing such as descriptive, narrative, cause-effect, compare-contrast, and argumentative. Upon completion of this course, students are expected to be able to communicate at various situations, participate in group activities and prepare formal speech for academic, professional and social purposes. This course also incorporates classroom instructions to provide guidelines on presentations and communication skills. In addition, the course emphasizes on providing constructive feedback on students' oral performances.			
OBJECTIVE			
1. To develop English language skills to communicate effectively and professionally. 2. To strengthen students' presentation skills. 3. To develop competency in academic reading and writing.			
COURSE OUTCOMES & GENERIC SKILLS			

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the technics of academic reading and become familiar with technical terms.	PO9	C2				T,F

CO2	Be able to demonstrate competency in academic reading, preparing report and in written communication/presentation and **communicate effectively** within group in the shortest possible time to present their reports and academic writings.	PO 10	A2				T, F, Pr
CO3	Be able to **analyze** any problem critically, **analyze** and interpret data and synthesize information to provide valid conclusions.	PO9	C4				T,F
CO4	Be able to **apply** the technics to find out the main points of any long article within a very limited time as well as know the technics of any effective writing. In short with consistent practice, they will be able to overcome language barrier.	PO9	C3				T,F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Content	**Detail Contents**
Reading	Reading Comprehension: Practice using different techniques
	Academic reading: comprehension from departmental or subject related passages
	Vocabulary for Engineers (some common Engineering terms for both general and dept specific)
	Reading subject specific text to develop vocabulary
Writing	Writing semi-formal, Formal/official letters, Official E-mail
	Applying for a job: Writing Cover Letter and Curriculum Vitae
	Statement of Purpose (SOP) writing, Proposal Writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;
	Report writing, article writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;
	Analyzing and describing graphs or charts
	Practicing analytical and argumentative writing
Speaking	Public Speaking: Basic elements and qualities of a good public speaker
	Set Speech: How to get ready for any speech.
	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.
Listening	Listening to long lecture on some topics
	Listening and understanding speeches/lectures of different accent

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	Be able to **understand** the technics of academic reading and become familiar with technical terms.									2			
CO2	Be able to demonstrate competency in academic reading, preparing report and in written communication/presentation and **communicate effectively** within group in the shortest possible time to present their reports and academic writings.										2		
CO3	Be able to **analyze** any problem critically, **analyze** and interpret data and synthesize information to provide valid conclusions.									2			
CO4	Be able to **apply** the technics to find out the main points of any long article within a very limited time as well as know the technics of any effective writing. In short with consistent practice they will be able to overcome language barrier.									2			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 42
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Classes	Topic
	Week 1
Class 1	Reading Comprehension: Practice using different techniques
Class 2	Reading Comprehension: Practice using different techniques
Class 3	Reading Comprehension: Practice using different techniques
	Week 2
Class 4	Academic reading: comprehension from departmental or subject related passages
Class 5	Academic reading: comprehension from departmental or subject related passages
Class 6	Academic reading: comprehension from departmental or subject related passages
	Week 3
Class 7	Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary

Class 8	Vocabulary for Engineers (some common Engineering terms for both general and dept specific) Reading subject specific text to develop vocabulary
Class 9	Vocabulary for Engineers (some common Engineering terms for both general and dept specific), Reading subject specific text to develop vocabulary
Week 4	
Class 10	Writing semi-formal, Formal/official letters, Official E-mail
Class 11	Writing semi-formal, Formal/official letters, Official E-mail
Class 12	Writing semi-formal, Formal/official letters, Official E-mail
Week 5	
Class 13	Applying for a job: Writing Cover Letter and Curriculum Vitae
Class 14	Applying for a job: Writing Cover Letter and Curriculum Vitae
Class 15	Applying for a job: Writing Cover Letter and Curriculum Vitae
Week 6	
Class 16	Statement of Purpose (SOP) writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;
Class 17	Proposal writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;
Class 18	Proposal writing: writing steps, principles and techniques, outlining, revising, editing, proofreading;
Week 7	
Class 19	Report writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;
Class 20	Article writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;
Class 21	Article writing: comparison-contrast and cause – effect, argumentative and opinion expression, assignment writing;
Week 8	
Class 22	Analyzing and describing graphs or charts
Class 23	Analyzing and describing graphs or charts
Class 24	Analyzing and describing graphs or charts
Week 9	
Class 25	Practicing analytical and argumentative writing
Class 26	Practicing analytical and argumentative writing
Class 27	Practicing analytical and argumentative writing
Week 10	
Class 28	Public Speaking: Basic elements and qualities of a good public speaker
Class 29	Public Speaking: Basic elements and qualities of a good public speaker
Class 30	Public Speaking: Basic elements and qualities of a good public speaker
Week 11	
Class 31	Set Speech: How to get ready for any speech.
Class 32	Set Speech: How to get ready for any speech.
Class 33	Set Speech: How to get ready for any speech.
Week 12	
Class 34	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.
Class 35	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for

	presentation.
Class 36	Individual / Group presentation: How to be ready for presentation, prepare script for good speech, preparing power point slides, etc. Selected books/Selected stories for presentation.
Week 13	
Class 37	Listening to long lecture on some topics
Class 38	Listening to long lecture on some topics
Class 39	Listening to long lecture on some topics
	Week 14
Class 40	Listening and understanding speeches/lectures of different accents
Class 41	Listening and understanding speeches/lectures of different accents
Class42	Listening and understanding speeches/lectures of different accents

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Testing vocabulary level	15%	CO1	C2
			CO2	A2
	Argumentative/analytical writing	15%	CO2	A2
			CO4	C3
	Reading Test	10%	CO1	C2
			CO2	A2
			CO3	C4
			CO4	C3
Individual Presentation & Group Presentation		60%	CO2	A2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Jones, L. (1981). Functions of English. (Student's Book, 2nd Ed.) Melbourne, Australia: Cambridge University Press.
2. Dixon, R.J. (1987). Complete course in English. (Book 4). (For book presentation)
3. Langan, J. (2005). College Writing Skills with Readings (6th Ed). McGraw-Hill Publication
4. Interactions 1 (Reading), John Langan, Latest edition, McGraw-Hill Publication
5. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
6. Speak like Churchill stand like Lincoln - James C. Humes
7. Cambridge IELTS Practice Book
8. Selected Sample Reports and Selected Research Articles

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.4. GEEM-435: Engineering Ethics and Moral Philosophy
Level-4, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: GEEM-435 : Engineering Ethics and Moral Philosophy	Contact Hours Credit Hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			

SYNOPSIS/RATIONALE

It is essential for professionals in any field to have an understanding of the ethical problems and principles in their field. But anyone, no matter what their job, must deal with many other professions as well. Part of professional ethics is the understanding of the ethics of other professions: how they interact and what can be expected from them as correct ethical behaviour. In turn, any professional will benefit from a critical scrutiny of their own ethics by those from other professions. The general principles of professional ethics will be examined, as well as the distinctive problems of the different fields. This course will help the nuclear engineering students to conceptualize the dynamics of the ethical practice in electrical domain.

OBJECTIVE

1. To inculcate the sense of social responsibility.
2. To develop a firm ethical base.
3. To make the students realize the significance of ethics in electrical professional environment.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO.	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	**Understand** the theoretical aspects of ethics and moral philosophy in professional fields.	PO3	C2			5	T, Q, F
CO2	**Identify** practical and legal problems commonly encountered by engineers in their professional field/industry.	PO6	C3			7	ASG, F
CO3	**Develop** foundation knowledge of ethics to be applied in professional fields.	PO8	C6			7	MT, F
CO4	**Critically assess** the codes of professional conduct and their implications in electrical engineering life.	PO12	C5				T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam; MT-Midterm)

COURSE CONTENT

Introduction to Engineering ethics and professionalism; History and development of engineering ethics and ethical theories; Moral Reasoning and Codes of Ethics; Moral Frameworks for Engineering Ethics; Professional Engineering Codes, Codes of Ethics (IEB); Codes of Ethics (IEEE), Risk, Safety, Accidents, Liability, Trust and reliability Engineer's Responsibilities and Rights; Ethical expectation: Employers and employees, inter-professional relationship, Professional Organization – maintaining a commitment of ethical standards. Human qualities of an engineer. Obligation of an engineer to the clients. Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession. Desired characteristics of a professional code. Institutionalization of ethical conduct. Environmental Ethics; Applied ethics in engineering: Whistle Blowing; Case study methodology, Different Case Studies of ethics and Ethical Problem-Solving Techniques; Ethical Issues in Electrical Engineering Practice: Case studies

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the theoretical aspects of ethics and moral philosophy in professional fields.			3									

CO2	**Identify** practical and legal problems commonly encountered by engineers in their professional field/industry.						3						
CO3	**Develop** foundation knowledge of ethics to be applied in professional fields.								3				
CO4	**Critically assess** the codes of professional conduct and their implications in electrical engineering life.												1

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 28 - -
Self-Directed Learning Non-face-to-face learning Revision	 56 14
Formal Assessment Continuous Assessment Mid term Final Examination	 2 1 3
Total	104

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1		
Class 1	Introduction to Engineering ethics and professionalism;	
Class 2	History and development of engineering ethics and ethical theories	
Week 2		
Class 3	History and development of engineering ethics and ethical theories	
Class 4	Moral Reasoning and Codes of Ethics	
Week 3		
Class 5	Moral Frameworks for Engineering Ethics	CT 1
Class 6	Professional Engineering Codes, Codes of Ethics (IEB)	
Week 4		
Class 7	Codes of Ethics (IEEE)	
Class 8	Risk, Safety, Accidents, Liability, Trust and reliability	
Week 5		
Class 9	Engineer's Responsibilities and Rights	
Class 10	Ethical expectation: Employers and employees, inter-professional relationship	CT 2
Week 6		
Class 11	Professional Organization–maintaining a commitment of ethical standards	

Class 12	Human qualities of an engineer	
Week 7	Ethical Issues in Electrical Engineering Practice: Case studies	Mid Term
Class 13	Obligation of an engineer to the clients	
Class 14	Attitude of an engineer to other engineers	
Week 8		
Class 15	Measures to be taken in order to improve the quality of engineering profession	
Class 16	Desired characteristics of a professional code	
Week 9		
Class 17	Institutionalization of ethical conduct	
Class 18	Environmental Ethics	
Week 10		CT 4
Class 19	Applied ethics in engineering: Whistle Blowing;	
Class 20	Case study methodology,	
Week 11		
Class 21	Different Case Studies of ethics	
Class 22	Different Case Studies of ethics	
Week 12		
Class 23	Ethical Problem-Solving Techniques	
Class 24	Ethical Problem-Solving Techniques	
Week 13		
Class 25	Ethical Issues in Electrical Engineering Practice: Case studies	
Class 26	Ethical Issues in Electrical Engineering Practice: Case studies	
Week 14		
Class 27	Review	
Class 28	Review	

ASSESMENT STRATEGY

Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment (1-3)	20%	CO1	C2
			CO2	C3
			CO4	C5
	Class Participation	5%	CO1	C2
			CO2	C3
	Class Attendance	5%		
	Mid term	10%	CO3	C6
Final Examination		60%	CO1	C2
			CO2	C3
			CO3	C6
			CO4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Charles E. Harris, et el. Engineering Ethics: Concepts and Cases, Cengage Learning Boston, USA: 4th Edition, 2009.
2. Charles B. Fleddermann, Engineering Ethics, 4th Edition, Mc-Grawhill: 2012.
3. Davis, M., ed. Engineering Ethics. Farnham, United Kingdom Ashgate Publishing, 2005.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.5. GEE-201: Fundamentals of Economics
Level-2, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: GEE-201 : Fundamentals of Economics	Lecture Contact Hours Credit Hours	: 2.0 : 2.0
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
The course is designed towards students in order to acquaint them with various aspects of the economics as a whole. The main focus of the course is making the students understand the effects of economics in engineering and this is achieved through the knowledge provided about macro and micro economics. It is required to embed the realization that economics play a vital role towards the stewardship capability of an engineer.			
OBJECTIVE			
1. Students will demonstrate their knowledge of the fundamental and technical concepts of economics. 2. To work effectively in the organizations with honesty and integrity. 3. Students will be able to understand consumer behaviour, elasticity and different market structure. 4. Students will be able to identify the determinants of various macroeconomic aggregates such as national income, full employment, unemployment, consumption and savings function, inflation, productivity and the major challenges associated with the measurement of these aggregates. 5. Students will apply the basic theories of economics in critical thinking and problem solving. 6. Students will be able to identify the basic features of economic development and regarding planning for the economy of the country.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	**Understand** the basic concepts and principles of Micro and Macro Economics.	PO1	C2		1	1	T, F
CO2	**Identify and apply** the indifference curve theory and market equilibrium in real life situation	PO1	C1 C2		1	1	T, M
CO3	**Explain** time-value of money concept and **apply** the knowledge of inflation, investment and cost benefit analysis	PO2	C4 C3		1	3	T, M
CO4	**Understand** the Economic Development and Planning for the country. To get idea of international economy.	PO1	C2		1	1	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R – Report; F – Final Exam; M- Mid Term)

COURSE CONTENT

Broad Topic	Details Topic
Fundamental of Economics	Definition
Production Possibility Frontier and Engineering Decision	1. PPF Curve. 2. Applying the PPF to Society's Choices by the Engineers.
Utility Theory	Law of diminishing marginal utility.
Demand	1. Definition. 2. Law of Demand. 3. Market Demand. 4. Reason for demand curve downward slopping. Mathematical Analysis
Supply	1. Definition. 2. Supply curve. 3. Market Equilibrium.
Elasticity of Demand	1. Different types of elasticity. 2. Different types of price elasticity. 3. Relation between AR, MR and elasticity 4. Mathematical Analysis
Indifference Curve Analysis and Consumers Equilibrium	Budget Line, MRS, Consumer Choice
Production Function from Engineering point of view	1. TP, AP, MP. 2. Law of Variable proportion. 3. Law of returns
Cost Analysis and Engineering Economics	1. TC, AC, MC. 2. Short run cost analysis
Analysis of Market Structure and Engineering Decision	1. Perfectly Competitive Market 2. Monopoly and Monopolistic Market
Key concept of Macroeconomics	Definition
National Income	GDP, GNP, NNP, NI
Circular Flow of National Income and Engineering Resources	Two, Three and Four sector Economy
Savings	Savings Function, APS, MPS. Derive the savings function from consumption functions; Mathematically and Graphically.
Consumptions	Consumption functions, APC, MPC
Investment	Investment Theories, Investment Multiplier
Engineering Plan considering the Inflation Rate of the Country	Demand-Pull and Cost-Push Inflation
The Effect of Monetary policy on Engineering Plan	Impact and Use
The Effect of Fiscal Policy on Engineering Plan	Impact and Use
Theories of Developments	1 or 2 Theories of Economic Development.
Economic Problems in Developing Countries especially in Bangladesh.	

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the basic concepts and principles of Micro and Macro Economics	3		3									
CO2	**Identify and apply** the indifference curve theory and market equilibrium in real life situation	3		3									

CO3	**Explain** time-value of money concept and **apply** the knowledge of inflation, investment and cost benefit analysis		2										
CO4	**Understand** the Economic Development and Planning for the country. To get idea of international economy.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 28 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 14 14
Formal Assessment Continuous Assessment Mid-Term Final Examination	 2 1 3
Total	104

TEACHING METHODOLOGY

Lectures, class performances, assignments, class tests, final exam.

COURSE SCHEDULE

Weeks	Lectures	Lecture/Tutorial/Assignment Topic	Assessment
1	1	Introduction to Engineering Economics Importance of Economics in Engineering.	CT 1
	2	Definition of economics, Difference between micro and macroeconomics. Production possibility frontier (PPF) and Engineering choice.	
2	3	Demand and determinants of Demand	
	4	Demand curve related basic idea and Mathematical Application	
3	5	Supply and Determinants. Market Mechanism.	Mid Term
	6	Consumer Choice (Indifference Curve and Budget Line)	
4	7	Indifference Curve, Properties of IC, MRS	
	8	Theory of production in the point of view of Engineers	
5	9	Theory of cost, Short run and long run cost curve	
	10	Firms Equilibrium (Concepts)	
6	11	Different types of Market.	
	12	How the Engineers will act in perfectly competitive market.	
7	13	How the Engineers will act in Monopoly Market	
	14	National Income analysis	
8	15	Aggregate Demand and Aggregate Supply	CT 2
	16	Determination of Level of Income and Employment	
9	17	Keynes Full Employment. Theory	

	18	Circular flow of Income and Expenditure (How engineers will utilize the resources and decision-making process of project plan)	
10	19	Consumption Function	
	20	Saving Function	
11	21	Inflation, Type of Inflation	
	22	Impact of Inflation	
12	23	Unemployment problem and its impact on society	CT 3
	24	Cost benefit analysis	
13	25	Theories of Economic Development	
	26	Economic Problems in Developing Countries	
14	27	Contribution of the Engineers in the Economic Development of Bangladesh.	
	28	How the Engineers compare their development projects in the context of World Economy.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO 1, CO2, CO 3, CO 4	C1, C2, C3, C4
	Class Participation	5%	-	-
	Class Attendance	5%		
	Mid term	10%	CO 2, CO 3	C1, C2, C3, C4
Final Exam		60%	CO 1	C2
			CO 4	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Economics by P. A. Samuelson and W. D. Nordhaus (7th Edition)
2. Microeconomics by Robert S. Pindyck and Daniel L. Rubinfeld (8th Edition)
3. Macroeconomics by N. Gregory Mankiw (8th Edition)
4. Principle of Economics by N. Gregory Mankiw (8th Edition)
5. Engineering Economics by Niall M. Fraser and Elizabeth M. Jewkes. (5th Edition

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.6. GEBS 101: Bangladesh Studies
Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: GEBS 101 : Bangladesh Studies	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			

This course has been designed for undergraduate engineering students to help them learn the rich history of Bangladesh, and to provide them with basic knowledge of historical events which eventually led to the formation of Bangladesh and constitution of Bangladesh, current trends in economic development, legislation, citizen charter, cultural aspects which will make them responsible citizens.

OBJECTIVE

1. To equip students with factual knowledge that will enable them to learn the history of Bangladesh.
2. To trace the historical roots of Bangladesh as an independent state focusing on the social, cultural and economic developments that have taken place since its independence.
3. To promote an understanding of the development of Bangladesh and its culture.
4. To create an awareness among the students about the Geography, Economy, Politics and Culture of Bangladesh.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and variety of cultural identities of Bangladesh.	PO 6	C2			7	MID, F, ASG
CO2	**Explain** the economy and patterns of economic changes through qualitative and quantitative analysis.	PO 6	C2			7	MID, F, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

<u>Bangladesh Geography:</u> Location, Area, Boundary, Physiography, River system, Forest and Climate, Demography of Bangladesh, Maritime zones.

<u>History:</u> Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal; Bengal under the East India Company; religious and social reform movements; nationalist movements, division of the Indian sub-continent; language movement 1948-1952; education movement of 1962; six-point movement of 1966; mass uprising of 1969; war of independence and emergence of Bangladesh in 1971, Constitution of Bangladesh, Pre and post liberation development in the field of engineering and technology, Bangladesh's contribution to world peace and its security, engineering developments in Bangladesh (Kaptai Dam, Padma bridge, power plants, Karnaphuli River Tunnel etc) and its impact on socio-economic aspect .

<u>Environment, Economy and Culture</u>

Land, Characteristics of tropical monsoon climate, Forests and biomass, Fish, Minerals, Health, Education, Agriculture, Industries, NGOs, Population, Sociological and Cultural aspects of Bangladesh, Economy and National development, Development and Progress of the Millennium Development Goals (MDGs), Public Administration in Bangladesh, State of Good Governance in Bangladesh, Art and Literature, Main traditional cultural events, Vision-2021, Digitalization, Tourism and Natural Resources, Bangladesh and International Relations.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12

CO1	**Identify** specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and variety of cultural identities of Bangladesh.						3						
CO2	**Explain** the economy and patterns of economic changes through qualitative and quantitative analysis.						3						

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 28 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 28 14 14
Formal Assessment Continuous Assessment Final Examination	5 2 3
Total	94

TEACHING METHODOLOGY

Lecture, Tutorial, Assignments

COURSE SCHEDULE

Week 1	**Introduction**	CT 1
Class 1	Introductory class: Brief discussion on the total syllabus, basic requirements of the course, methods of assessment of the course	
Class 2	<u>Bangladesh Geography:</u> Location, Area, Boundary, Physiography, River System, Forest and Climate, Demography of Bangladesh.	
Week 2	**Switching Techniques**	
Class 3	Overview of the ancient Bengal; anthropological identity of the Bengali race; main trends in the history of medieval Bengal	
Class 4	Bengal under the East India Company	
Week 3	**Different stages of Switching**	
Class 5	Religious and Social reform movements	
Class 6	Nationalist movements, division of the Indian sub-continent	
Week 4	**Different types of Switching**	CT 2
Class 7	Language movement 1948-1952, Education movement of 1962	
Class 8	Language movement 1948-1952, Education movement of 1962	
Week 5	**Traffic**	
Class 9	Six-point movement of 1966; Mass uprising of 1969	
Class 10	War of Independence and Emergence of Bangladesh in 1971	
Week 6		
Class 11	Constitution of Bangladesh	
Class 12	Constitution of Bangladesh	
Week 7		

Class 13	Bangladesh's contribution to world peace and security, Pre and post liberation development of engineering and technology	Mid Term
Class 14	Bangladesh's contribution to world peace and security, Pre and post liberation development of engineering and technology	
Week 8		
Class 15	Land, Characteristics of tropical Monsoon climate, Forests and biomass, Fish	
Class 16	Engineering development in Bangladesh (Kaptai Dam, Padma bridge, power plants, Karnaphuli River Tunnel etc) and its impact on socio-economic aspect	
Week 9		
Class 17	Minerals, Health and Education	
Class 18	Agriculture, Industries	
Week 10		CT 4
Class 19	NGOs, Population, Sociological and Cultural aspects of Bangladesh	
Class 20	Economy and national development,	
Week 11		
Class 21	NGOs, Population, Sociological and Cultural aspects of Bangladesh	
Class 22	Economy and national development,	
Week 12		
Class 23	Art and Literature	
Class 24	Traditional cultural events	
Week 13		
Class 25	Vision-2021, Digitalization	
Class 26	Tourism and Natural Resources	
Week 14		
Class 27	Bangladesh and International Relations	
Class 28	Revision of the course	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C2
			CO2	C2
	Class Participation	5%	CO2	C2
	Class Attendance	5%		
	Mid term	10%	CO1	C2
			CO2	C2
Final Exam		60%	CO1	C2
			CO2	C2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Bangladesh Studies: Md. Shamsul Kabir Khan and Daulatunnahar Khanam
2. The Constitution of the People's Republic of Bangladesh
3. Discovery of Bangladesh: Akbar Ali Khan
4. History of Bangladesh, Vols, 1-3: Sirajul Islam
5. History of Modern Bengal, Vol, 1: R C Majumdar
6. Dynastic History of Bengal: Dr. Abdul Mumin Chowdhury
7. A History of Bangladesh: William Van Schendel
8. Geography of Bangladesh: Harun Er Rashid
9. Banglapedia: National Encyclopedia of Bangladesh, Vols, 1-10: Sirajul Islam

10. History of Bengal: (Mughal Period 1526-1765): R. A. Chandra 11. Land of Two Rivers: Nitesh Sengupta 12. A History of Bangladesh: Cambridge University Press 13. Bengali Nationalism and the Emergence of Bangladesh : A.F Salahuddin Ahmed Language Movement and The Making of Bangladesh: Safar Ali Akanda

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.7. GESL 305: Environment, Sustainability and Law

Level-3, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: GESL 305 : Environment, Sustainability and Law	Contact Hours Credit Hours	: 2.00 : 2.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
Although the electricity is now an indispensible part of our day to day life, it is very important to know the fact that the ways which are being used to generate electricity are either environment friendly or not. Additionally, it is imperative to understand the far-reaching consequences of the ways of generating electricity. Moreover, the confliction of the world environmental law should be avoided. This course introduces the students regarding the improvement of electrical technology with era and compares the impact of electricity on environment, human beings and global climates. In addition, student will be familiar with the sustainability and law.			
OBJECTIVE			
1. Make able the students to compare and classify the growth of electrical, electronic and communication technologies with change of era. . 2. Impart the basic knowledge of improvement regarding electrical technology with the impact on environment, human beings and global climates. 3. Deliberate the message regarding the safety concepts, risk management, proactive management techniques for safety issue, safety standard and regulations for engineering works. 4. Impart the in-depth understanding about the legal issues regarding engineering, environment, business and industrial law.			
COURSE OUTCOMES & GENERIC SKILLS			

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Investigate** the growth of electrical, electronic and communication technologies with change of era.	PO 4	C4	1		8	ASG, F
CO2	**Contrast** improvement of electrical technology with the impact on environment, human beings and global climates.	PO 7	C2	1		7	T, Mid, F
CO3	**Discuss** safety concepts, safety and risk management, proactive management techniques for safety issue, safety standard and regulations for engineering.	PO 6	C6	2		7	T, Mid Term Exam, F

CO4	As a leader regarding **appraise** the legal issues regarding engineering, environment, business and industrial law, law of contract and elements for valid contract provided by the government.	PO 12	C5	3	3		ASG, Pr, R

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Environment: Society and development; Growth of electrical, electronic and communication technologies and its contribution to human development; Impact of EECE technology upon the environment, impact of the environment upon human changes in the global climates; Environment friendly technology, Technology and development; Technology and environment hazards, its remedy. Environmental Pollution from Power Plants, E-waste management. The improvement of working conditions in the power plants. Environment and sustainable development

Safety: Evolution of modern safety concepts, safety and risk management, productivity, worker health and safety, proactive management techniques for safety management, safety standard and regulations for engg works, fire safety, hazardous materials, Industrial Hygiene.

Legal Issues: Introduction to Legal Issues for engineering, business and industrial law, Law of contract, elements of valid contract, Consideration, parties competent to contract, Sale of goods and higher purchase. Industrial law in Bangladesh: various ordinance payments of wages, legislation relating employment in industries, factories, shops and agriculture, trade union act, industrial relation ordinance. Workman compensation.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Classify** the growth of electrical, electronic and communication technologies with change of era.				2								
CO2	**Contrast** improvement of electrical technology with the impact on environment, human beings and global climates.							3					
CO3	**Discuss** safety concepts, safety and risk management, proactive management techniques for safety issue, safety standard and regulations for engineering.						3						
CO4	As a leader regarding **appraise** the legal issues regarding engineering, environment, business and industrial law, law of contract and elements for valid contract provided by the government.												3

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 28 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 14 14
Formal Assessment Continuous Assessment Mid-Term Final Examination	 2 1 3
Total	104

TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method
COURSE SCHEDULE

Week	Topic	CT
Week 1	**Environment, society and development**	CT 1
Class 1	**Environment:** society and development;	
Class 2	Growth of electrical, electronic and communication technologies and its contribution to human development;	
Week 2	**Impact of EECE**	
Class 3	Impact of EECE technology upon the environment,	
Class 4	impact of the environment upon human changes in the global climates;	
Week 3	**Friendly technology**	
Class 5	Environment friendly technology,	
Class 6	Technology and development;	
Week 4	**Environmental Pollution**	
Class 7	Technology and environment hazards, its remedy.	
Class 8	Environmental Pollution from Power Plants,	
Week 5	**Environmental Pollution**	
Class 9	Environmental Pollution from Power Plants,	
Class 10	Environmental Pollution from Power Plants,	
Week 6	**Waste management**	Mid-term
Class 11	E-waste management.	
Class 12	The improvement of working conditions in the power plants.	
Week 7	**Sustainable development**	
Class 13	Environment and sustainable development	
Class 14	Safety: Evolution of modern safety concepts,	
Week 8	**Health and Safety**	
Class 15	Safety and risk management,	
Class 16	Productivity, worker health and safety,	
Week 9	**Health and Safety**	
Class 17	Proactive management techniques for safety management,	
Class 18	Safety standard and regulations for engineering works,	
Week 10	**Health and Safety**	
Class 19	Fire safety, hazardous materials	
Class 20	Industrial Hygiene	
Week 11	**Legal Issues**	
Class 21	**Legal Issues:** Introduction to Legal Issues for engineering, business and industrial law,	

Class 22	Law of contract, elements of valid contract,	
Week 12	**Legal Issues**	
Class 23	Consideration, parties competent to contract,	CT 2
Class 24	Sale of goods and higher purchase.	
Week 13	**Industrial Law**	
Class 25	Industrial law in Bangladesh: various ordinance payments of wages,	
Class 26	legislation relating employment in industries, factories, shops and agriculture	
Week 14	**Industrial Law**	
Class 27	Trade union act, industrial relation ordinance. Workman compensation	
Class 28	Review	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C4
			CO2	C2
			CO 3	C6
	Class Participation	5%	CO 4	C5
	Class Attendance	5%		
	Mid term	10%	CO 2	C2
			CO3	C6
Final Exam		60%	CO 1	C4
			CO 2	C2
			CO 3	C6
			CO 4	C5
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning by Bent Sørensen
2. Applications in Electronics Pervading Industry, Environment and Society by Alessandro De Gloria

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.8. GELM 275: Leadership and Management
Level-2, Term-II (Fall)

COURSE INFORMATION			
Course Code	: GELM 275	Contact Hours	: 2.00
Course Title	: Leadership and Management	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The course is designed to make students understand the overlapping connection between engineering and management in an organization through the study of varied management practices and leadership traits as an engineer.

OBJECTIVE

1. To introduce different management functions and approaches.
2. To expose students to different views and styles of leadership
3. To understand how an organization functions collaboratively with managers and engineers.
4. To understand various personality traits and its impact on leadership and management.
5. To solve real-world management problems as an engineer.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Familiarize** with the fundamental concepts of leadership and management skills	PO 9	C2, A1, P1				T, R, F
CO2	**Understand** the role and contribution of a leader in achieving organizational goals	PO 10	C2, A2,P2				ASG, R, F
CO3	**Understand** the contribution of leadership traits and management skills in decision making and solving real life problems	PO 9	C2, A2,P2				T, ASG, R, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to Leadership and Management: Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history.

Management Fundamentals: Definition of management & manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management.

Leadership & Motivation: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory; Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning).

Organizational Management: Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration.

Planning and goal setting: Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal.

Control: Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence.

Change and Innovation: Change and innovation; internal and external for change; changing process; creativity vs innovation.

Attitude: Components of Attitude; behavior model and characteristics model; behavior vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction.

Personality: Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).

Perception and Individual Decision Making: Factors influencing perception; attribution theory; errors/biases in attribution; Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making.

Understanding Work Team: Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges.

HR Management: Process of Human Resource Planning; forecasting demand for labor; staffing; internal supply of labor; performance appraisal.

Operations Management: Project managing basics; goals and boundary of project; WBS; scheduling a project; Demand and supply forecasting; inventory control.

Information Technology and Management: Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Familiarize** with the fundamental concepts of leadership and management skills									3			
CO2	**Understand** the role and contribution of a leader in achieving organizational goals										3		
CO3	**Understand** the contribution of leadership traits and management skills in decision making and solving real life problems									3			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and learning activities	Engagement (hours)
Face-to-face learning	
Lecture	28
Practical/ Tutorial/ Studio	-
Student-centred learning	-
Self-directed learning	
Non face-to-face learning	10
Revision	14
Assessment preparations	14
Formal Assessment	
Continuous Assessment	2
Final Examination	3
Total	71

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Case Study Based Method

COURSE SCHEDULE

Week	Lecture	Topics	TEST
1	Lec 1	**Introduction to Leadership and Management:** Definition of leadership and management; basic difference between a leader and a manager; relation of leaders and managers with respect to efficiency and effectiveness; qualities of leader and managers with examples from history.	**CT 1**
	Lec 2	**Management Fundamentals:** Definition of management &	

		manager; levels of management; management functions and skills; Mintzberg's managerial roles; Henri Fayol's management principles; strategic management.	
2	Lec 3 Lec 4	**Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory	
3	Lec 5 Lec 6	**Leadership:** Leadership styles; leadership trait theory; managerial grid; contemporary leadership; conflicts negotiation; leadership issues in 21st century; cross cultural leadership; engineer as a leader and some simple case discussions on leadership (positive and toxic leadership) in the class (Interactive Learning).	
4	Lec 7 Lec 8	**Case Study – I : Engineer as Great Leaders**	
5	Lec 9	**Organizational Management:** Organization; departmentalization; chain of command; unity of command; cross functional area; authority; centralization and decentralization; traditional & contemporary organization; matrix project structure; learning structure; organizing collaboration.	
	Lec 10	**Planning and goal setting:** Foundation of planning; goals of plan; types of goal; types of goal & plan; goal setting; MBO; well written goal.	
6	Lec 11	**Control:** Controlling process; controlling for organizational performance; types of control: (feed-forward, feedback & concurrent); balanced scorecard; contemporary issues in control; workplace concern & workplace violence.	
	Lec 12	**Change and Innovation:** Change and innovation; internal and external for change; changing process; creativity vs innovation.	
7	Lec 13	**Case Study – II : Planning and Goal Setting; A Managerial Approach: Engineer as Great Managers (Interactive Discussions in the Class)**	
	Lec 14	**Attitude:** Components of Attitude; behaviour model and characteristics model; behaviour vs. attitude; job attitude; job involvement; job satisfaction and customer satisfaction.	
8	Lec 15	**Personality:** Personality determinants: heredity and environment; Myers-Briggs Type Indicator; Big five personality model; personality traits (core self-evaluation, Machiavellianism, narcissism, self-monitoring, risk taking, proactive personality).	**Mid Term / Project**
	Lec 16	**Perception and Individual Decision Making**: Factors influencing perception; attribution theory; errors/biases in attribution	
9	Lec 17	**Perception and Individual Decision Making**: Factors of individual decision making; rational decision making; bounded rationality; satisfice; common errors in decision making; creativity in decision making.	
	Lec 18	**Case Study – III : A Case on Decision Making –** Involves both leadership and managerial skills (Interactive Discussion in Class)	
10	Lec 19	**Understanding Work Team:** Work group; work team; problem solving team; self-managed work team; cross functional team; virtual team; team effectiveness; team challenges.	**Class Test 2**
	Lec 20	**HR Management:** Process of Human Resource Planning; forecasting demand for labor; staffing.	
11	Lec 21	**HR Management:** Internal supply of labor; performance appraisal.	
	Lec 22	**Operations Management:** Project managing basics; goals and	

		boundary of project; WBS; scheduling a project.	
12	Lec 23	**Operations Management:** Demand and supply forecasting; inventory control.	
	Lec 24	**Exercise – Use of Microsoft Project (MSP) for scheduling a project at student level**	
13	Lec 25	**Case Study – IV:** A case that covers all relevant theories taught throughout the course and involves both leadership and management issues, e.g., Columbia's Final Mission. (This may be given as group assignment followed by in class short presentations/discussions)	
	Lec 26		
14	Lec 27	**Information Technology and Management:** Management Information System (MIS); Enterprise Resource Planning (ERP) - For introductory knowledge.	
	Lec 28	**Revision**	

ASSESSMENT STRATEGY

Assessment strategies			CO	Bloom's Taxonomy
Components		Grading		
Continuous Assessment (40%)	Class test 1-2	20%	CO 1	C2, A1, P1
			CO 2	C2, A2, P2
	Class Participation	5%	CO 1	C2, A1, P1
			CO 2	C2, A2, P2
	Class Attendance	5%		
	Mid term	10%	CO 1	C2, A1, P1
			CO 2	C2, A2, P2
			CO 3	C2, A2, P2
Final Exam		60%	CO 1	C2, A1, P1
			CO 2	C2, A2, P2
			CO 3	C2, A2, P2
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT & REFERENCE BOOKS

1. Students must be provided with SOLID reading material instead of referring text books. However, course teacher may select any text book as per his choice.
2. Engineering Management (Revised Edition) – A.K. Gupta
3. Industrial Engineering and Production Management - Martand T. Telsang
4. Leadership in Organizations – Gary Yukl
5. Developing Management Skills – David A. Whetten and Kim S. Cameron

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.9. GERM- 352: Fundamentals of Research Methodology (Sessional)
Level-3, Term-II

COURSE INFORMATION			
Course Code	: GERM-352	Contact Hours	: 4.00
Course Title	: Fundamentals of Research Methodology (Sessional)	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The Fundamentals of Research Methodology is a hands- on course designed to impart education in the foundational methods and techniques of academic research in Science and Engineering context. UG students would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, time management, report writing, and presentation. Once equipped with this knowledge, participants would be well- placed to conduct disciplined research under supervision in an area of their choosing. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments.

OBJECTIVES

1. To develop a research orientation among the UG students and to acquaint them with fundamentals of research methods.
2. To evaluate/review related extant literature, form a variety of sources, pertinent to the research objectives/questions.
3. To expose students to various research methodologies (design), relevant to the research problem needing to be addressed.
4. To explain and justify how researchers will collect and analyse research data.
5. To educate students in the common mistakes, research misconduct, and ethical considerations in the field of research methodology.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the research fundamentals and **formulate** problem statement and research questions/objectives.	PO 2	C2	-		3	Assignment/Quiz
CO2	**Formulate** and **compose** a research proposal considering research activities/design, background studies, and following standard guidelines.	PO 4	C3	-		8	Report/ Presentation/ Assignment/ Quiz
CO3	**Develop** writing and presentation skill, and **demonstrate** ethical considerations in conducting research.	PO 10	C3	-			Report/ Presentation/ Assignment

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test, PR – Project, Q – Quiz, ASG – Assignment, Pr – Presentation, R – Report, F – Final Exam, MT- Mid Term Exam; C1 – Remember, C2 – Understand, C3 – Apply, C4 – Analyze, C5 – Evaluate, and C6 – Create)

COURSE CONTENT

1. Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; General Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.

2. Problem Identification and Formulation: Meaning and need of Review of Literature; How to Conduct the Review of literature; Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

3. Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental/Computational Design: Concept of Independent & Dependent variables.

4. Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

5. Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

6. Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism. Time management and developing Gantt Charts.

SKILL MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the research fundamentals and **formulate** problem statement and research questions/objectives.		3										
CO2	**Formulate** and **compose** a Research proposal considering research activities, background studies, and following standard guidelines.				3								
CO3	**Develop** writing and presentation skill, and **demonstrate** ethical considerations in conducting research.										3		

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	24
Practical / Tutorial / Studio	12
Student-Centred Learning	12
Self-Directed Learning	
Non-face-to-face learning	12
Report Preparation	18
Formal Assessment	
Continuous Assessment	1.5
Report Submission (2)	-
Presentation (2)	0.5
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Mini-Seminars by Experts, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week	**Lecture**	**Topics**
1	Lec 1 Lec 2 Lec 3 Lec 4	Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research; Motivation in Research; General Characteristics of Research; Criteria of Good Research; Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.
2	Lec 5	Practice session on Foundations of Research

	Lec 6 Lec 7 Lec 8	
3	Lec 9 Lec 10 Lec 11 Lec 12	Problem Identification & Formulation: Meaning & need of Review of Literature; How to Conduct the Review of literature; Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.
4	Lec 13 Lec 14 Lec 15 Lec 16	Practice session on Problem Identification & Formulation
5	Lec 17 Lec 18 Lec 19 Lec 20	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
6	Lec 21 Lec 22 Lec 23 Lec 24	Practice session on Research Design
7	Lec 25 Lec 26 Lec 27 Lec 28	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.
8	Lec 29 Lec 30 Lec 31 Lec 32	Practice session on Data Analysis
9	Lec 33 Lec 34 Lec 35 Lec 36	Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues in conducting research; Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
10	Lec 37 Lec 38 Lec 39 Lec 40	Practice session on Research misconduct and Ethics
11	Lec 41 Lec 42 Lec 43 Lec 44	Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search required information effectively; Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office; Software for detection of Plagiarism. Time management and developing Gantt Charts.
12	Lec 45 Lec 46 Lec 47 Lec 48	Practice session on Use of tools / techniques for Research
13	Lec 49 Lec 50 Lec 51 Lec 52	Review Session (Theory) – I /Final Presentation
14	Lec 53 Lec 54 Lec 55	Review Session (Practice) – II /Final Presentation

	Lec 56	

ASSESSMENT STRATEGY

Assessment Criteria		CO	Bloom's Taxonomy
Components	Grading		
Assignment I	20%	CO1 and CO3	C2, C3
Assignment II	50%	CO2 and CO3	C3
Continuous Assessment	30%	CO1 and CO2	C2, C3
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Engineering Research Methodology: A Practical Insight for Researchers. Springer, by Deb, Dipankar, Dey, Rajeeb, Balas, Valentina E.
2. Research Methods for Engineers, 1st Edition, by David V. Thiel.
3. Handbook of Research Methodology by Talati, J.K.
4. Introducing Research Methodology: A Beginner′s Guide to Doing a Research Project by Uwe Flick
5. DRM, a Design Research Methodology by Lucienne T.M. Blessing and Amaresh Chakrabarti
6. Research Methods: Information, Systems, and Contexts by Kirsty Williamson, Graeme Johanson
7. Zelkowitz, M. V. and Wallace, D. R. (1998), Experimental models for validating technology, Computer, vol. 31, no. 5, pp. 23-31.
8. Internet, mail, and mixed-mode surveys : the tailored design method (3rd ed.) by Dillman, D. A., Smyth, J. D., & Christian, L. M.
9. Applied multiple regression/correlation analysis for the behavioral sciences (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, by Cohen, J., Cohen, P., West, S., & Aiken, L.
10. Experimental and Quasi-Experimental Design for Generalized Causal Inference. Boston, Mass: Houghton Mifflin, by Shadish W.R., Cook T.D. & Campbell P.T.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.10. GEPM-465: Project Management and Finance
Level-4, Term-II

COURSE INFORMATION

Course Code Course Title	: GEPM-465 : Project Management and Finance	Contact Hours Credit Hours	: 2.00 : 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The aim of the course is to give the students a sound knowledge of the relevant methodologies and approaches to the planning of industrial and development projects. The course will cover all aspects of the planning process from inception to project implementation. It will include a detailed examination of methods of identifying, appraising, financing and monitoring development projects. The course will also focus on all aspects of studying the techniques of social cost-benefit analysis, with a critical appreciation of their purpose, usefulness and shortcomings maintaining ethics and integrity.

OBJECTIVE

At the end of the course, students are able to:

1. Demonstrate an understanding of the importance of project management.
2. Apply the appropriate project management tools in the job scope and time management of projects.
3. Apply the principles of cost management to manage projects within budget.
4. Develop effective quality, culture and practices in project management and assess the compliance.
5. Develop and implement an information flow system for the dissemination of work instruction (top down) and collation of reports (bottom up) on the progress of the project.
6. Organise and effectively manage the human resources required for the effective execution of the project.
7. Create and apply a comprehensive range of risk management practices to mitigate risks in the projects.
8. Apply procurement management concepts in the fiduciary execution of the purchase function.
9. Evaluate a project from a process perspective – initiating, planning, executing, controlling and closing.
10. Create and implement portfolio management plans to facilitate the management of multiple projects analysing break-even point and cost volume profit relationship.
11. Plan for the eventual completion and wrap up of projects.
12. Focus on all aspects of studying the techniques of social cost-benefit analysis, with a critical appreciation of their purpose, usefulness and shortcomings maintaining ethics and integrity.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CA	CP	KP	Assessment Methods
CO1	**Understand** the Project, Types of Projects, Project Life Cycle: Project Identification, Project Selection, Project Organization, Project Planning, Negotiation and Bidding, Conflicts solving. and ethics in financial reporting for each and every project.	PO1	C3		1	1	T, Q, F
CO2	**Understand** Cost of Project, Sources of Capital, Cost of Capital and Analysis of alternative Sources of Terms Loans, Financial Institutions Capital Rationing. cost benefit analysis of different projects.	PO1	C4	1	2	1	ASG, F
CO3	**Acquire** knowledge of Nature of Investment Decisions, Payback Period NPV, IRR — Profitability Index, Income, Tax Factors, Capital Budgeting and Inflation, Project Risk and Required Rate of Return.	PO 2	C5		2	1	MT, F
CO4	**Apply** and analyze the risk, cost-volume profit, budgeting, standard costing and variance analysis for any project.	PO 11	C6		3	7	T, F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT
1. **Introduction:** Project - Types of Projects - Project Life Cycle: Project Identification - Project Selection - Project Organization - Project Planning - Negotiation and Bidding - Conflicts solving. Project Implementation - Budgeting and Cost Estimation - Scheduling - Resource Allocation - Monitoring and Information Systems - Project Control. Project Termination - Multicultural projects, and unsolved problems - Project Auditing - Project Termination - Multicultural, Environmental & Unsolved Issues. Creativity & Idea Generation - Technological forecasting. Feasibility Study - Project background and history - Market and Plant Capacity - Material Inputs - Location and Site - Project Engineering - Plant Organization and Overhead Costs - Manpower - Project Implementation - Financial and Economic Evaluation. **2. Cost of Project and Means of Financing of Cost of Project:** Cost of Project - Sources of Capital - Cost of Capital and Analysis of alternative financing policies of project - Calculation and Collection of Input information - Means of Financing - Planning Capital Structure - Sources of Terms Loans - Financial Institutions Capital Rationing. **3. Investment Criteria:** Nature of Investment Decisions - Importance - Types of. Investment Decisions - Investment Evaluation Criteria - Payback Period - Discounted Payback Period - NPV - IRR - Profitability Index - ARR - NPV vs IRR - NPV vs P1 Complex Investment Decisions - Projects with different Lives - Replacement of an existing asset - Investment Decisions under Capital Rationing Income - Tax Factors - Income Tax Considerations in Capital Budgeting - Capital Budgeting and Inflation - Project Risk and Required Rate of Return - applicability to Nonprofit Organizations - Implementing the Internal Rate-of-Return Decision Rule. **4. Risk and Sensitivity Analysis**: Types of Risks - Measures of Risk - Use of Subjective Probabilities - Mathematical Analysis - Methods of Measuring Risk - Approaches - Sensitivity Analysis - Simulation Analysis - Decision Tree Analysis - Selection of Project and Risk Analysis in Practice. **5. Accounting in Action:** Meaning & Definition Of Accounting - Users And Uses Of Accounting - Why Ethics Is A Fundamental Accounting Concept - Accounting Standards And The Measurement Principles- Monetary Unit Assumption And The Economic Entity Assumption. - Accounting Equation, -The Effects Of Business Transactions On The Accounting Equation - The Five Financial Statements And How They Are Prepared-Ethics In Accounting-Engineering Accounting. **6. Accounting cycle:** Account - Debits And Credits- Business Transactions - The Basic Steps In The Recording Process- Journal - Ledger -T Account - Trial Balance - Preparation Of Financial Statements Considering Adjusting And Closing Entries - Financial Statements Analysis And Interpretation - Ration Analysis - Tests For Profitability, Liquidity And Solvency - Computerized Accounting- Accounting Software- Cloud Accounting. **7. Cost concept and classification:** Segregation And Mixed Cost - Overhead Cost-Meaning And Classification-Allocation Of Overhead Cost, Overhead Recovery Method-Cost Classification For Decision Making- Manufacturing Costs - Direct Materials - Direct Labor - Manufacturing Overhead-Nonmanufacturing Costs - Product Costs versus Period Costs - Product Costs - Period Costs - Prime Cost and Conversion Cost - Fixed Cost - The Linearity Assumption and the Relevant Range 31 Mixed Costs - The Analysis of Mixed Costs -The High-Low Method - The Least-Squares Regression Method - Direct Cost - Indirect Cost - Cost Classifications for Decision Making - Differential Cost and Revenue - Opportunity Cost -Sunk Cost. **8. Cost Volume Profit relationship (CVP):** CVP Relationships in Equation Form - CVP Relationships in Graphic Form - Contribution Margin Ratio (CM Ratio) - Some Applications of CVP Concepts - Change in Variable Cost, Fixed Cost, and Sales Volume - Change in Selling Price - Target Profit and Break-Even Analysis - Target Profit Analysis - The Equation Method - The Formula Method - Target Profit Analysis in Terms of Sales Dollars - Break-Even Analysis - Break-Even in Unit Sales - Break-Even in Sales Dollars - The Margin of

Safety - CVP Considerations in Choosing a Cost Structure - Cost Structure and Profit Stability - Sales Mix -The Definition of Sales Mix - Sales Mix and Break-Even Analysis.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Understand** the Project, Types of Projects, Project Life Cycle: Project Identification, Project Selection, Project Organization, Project Planning, Negotiation and Bidding, Conflicts solving. and ethics in financial reporting for each and every project.	3											
CO2	**Understand** Cost of Project, Sources of Capital, Cost of Capital and Analysis of alternative Sources of Terms Loans, Financial Institutions Capital Rationing. cost benefit analysis of different projects.	3											
CO3	**Acquire** knowledge of Nature of Investment Decisions, Payback Period NPV, IRR — Profitability Index, Income, Tax Factors, Capital Budgeting and Inflation, Project Risk and Required Rate of Return.		3										
CO4	**Apply** and analyze the risk, cost-volume profit, budgeting, standard costing and variance analysis for any project.											3	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	28
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	56
Revision	14
Formal Assessment	
Continuous Assessment	2
Mid term	1
Final Examination	3
Total	104

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE		
Week 1		CT 1
Class 1	Introduction to Project, Types of Projects, Project Life Cycle	
Class 2	Project Implementation, Budgeting and Cost Estimation, Scheduling, Resource Allocation, Monitoring and Information Systems, Project Control.	
Week 2		
Class 3	Project Termination, Multicultural, Environmental & Unsolved Issues, Creativity & Idea Generation, Technological forecasting,	
Class 4	Overhead Costs, Manpower, Project Implementation, Financial and Economic Evaluation.	
Week 3		
Class 5	Cost of Project, Sources of Capital, Cost of Capital and Analysis of alternative financing policies of project	
Class 6	Calculation and Collection of Input information, Means of Financing, Planning Capital Structure, Sources of Terms Loans, Financial Institutions Capital Rationing.	
Week 4		CT 2
Class 7	Nature of Investment Decisions, Types of. Investment Decisions, Investment Evaluation Criteria, Payback Period	
Class 8	IRR, ARR, NPV vs IRR — NPV vs P1 Complex Investment Decisions — Projects with different Lives, Investment Decisions under Capital Rationing	
Week 5		
Class 9	Income Tax, Capital Budgeting, Inflation	
Class 10	Project Risk and Required Rate of Return	
Week 6		
Class 11	Types of Risks, Measures of Risk	
Class 12	Methods of Measuring Risk, Sensitivity Analysis	
Week 7		Mid Term
Class 13	Decision Tree Analysis, Selection of Project and Risk Analysis in Practice.	
Class 14	Meaning & Definition of Accounting, Users and Uses of Accounting, Why Ethics is a Fundamental Accounting Concept	
Week 8		
Class 15	The Measurement Principles, Monetary Unit Assumption and The Economic Entity Assumption.	
Class 16	Accounting Equation, Engineering Accounting	
Week 9		
Class 17	Financial statement	
Class 18	Account, Debits and Credits, Business Transactions, Journal	
Week 10		CT 4
Class 19	Ledger Account, Trial Balance, Financial Statements	
Class 20	Financial Statements Analysis and Interpretation, Ration Analysis, Tests for Profitability, Liquidity and Solvency	
Week 11		
Class 21	Manufacturing Costs — Direct Materials, Direct Labor, Manufacturing Overhead, Nonmanufacturing Costs, Product Costs versus Period Costs, Product Costs	
Class 22	Period Costs, Prime Cost and Conversion Cost.	
Week 12		

Class 23	The Linearity Assumption and the Relevant Range	
Class 24	Cost Classifications for Decision Making	
Week 13		
Class 25	CVP Relationships in Equation Form	
Class 26	Break-Even Analysis	
Week 14		
Class 27	Cost Structure and Profit Stability, Sales Mix	
Class 28	Review of all chapters	

ASSESMENT STRATEGY

Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Class Test/ Assignment (1-3)	20%	CO1	C3
			CO2	C4
			CO4	C6
	Class Participation	5%	CO1	C3
			CO2	C4
	Class Attendance	5%		
	Mid term	10%	CO3	C5
Final Examination		60%	CO1	C3
			CO2	C4
			CO3	C5
			CO4	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain)

TEXT & REFERENCE BOOKS

Recommended Textbook:

1. Gray C.F., Larson. E.W. & Desai G.V. (2014). Project Management-The managerial process. NEW Delhi: MacGraw-Hill Education Private Ltd.
2. Weygandt, Kimmel and Kieso. (IFRS edition). Principles of Accounting.

Reference books and Supplementary Readings:

1. Field, M. & Keller, L. (1998). Project management. London: Int Thomson Business Press.
2. Ray H. Garrison, Eric W. Noreen , Peter C. Brewer (Latest edition) Managerial Accounting
3. Heerkens, G. (2002). Project management. New York: McGraw-Hill.
4. Pitate, R. L. 1987 Project Appraisal Technique. 2nd Edition. New Delhi: Oxford & IBH Publishing Company Pvt Ltd.
5. Maylor, H. (2010). Project management. Harlow, England: Financial Times Prentice Hall.
6. Kerzner, H. (2001). Project management. New York: John Wiley.

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.1.4.11. GEA-201: Principles of Accounting
Level-x, Term x

COURSE INFORMATION

Course Code	: GEA-201	Lecture Contact Hours	: 2.00
Course Title	: Principles of Accounting	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE
This course aims to develop fundamental knowledge of accounting technics, preparation of financial statements, analysis of cost-benefit ratio of different projects and provide students with in-depth knowledge of management accounting.

OBJECTIVE
1. To make students understand the meaning, history and definition of accounting, the users and uses of accounting, importance of ethics in financial reporting. 2. To make students understand the International Financial Reporting (IFRS), Generally Accepted Accounting Principles (GAAP), cost principle, monetary unit assumption and the economic entity assumption. 3. To make students understand the worksheet, preparation of financial statements, cost benefit analysis of different projects with honesty and integrity. 4. To provide the students with an in-depth knowledge of Management Accounting to enable them to apply its methods and techniques for preparing and presenting information for management decision-making and control purposes. 5. To make students proficient in applying selected management accounting techniques and analyze the implications of the techniques with regards to cost-volume profit analysis, budgeting, standard costing and variance analysis.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **understand** the cost principle, monetary unit assumption and the economic entity assumption and ethics in financial reporting for each and every project.	PO8	C2			7	T, F
CO2	Be able to **understand** worksheet, preparation of financial statements, cost benefit analysis of different projects.	PO11	C2				T, F
CO3	Be able to comprehend Management Accounting and **apply** it for preparing and presenting information for management decision-making and control purposes.	PO10	C3				Mid ,F
CO4	Be able to apply and **analyze** the cost-volume profit, budgeting, standard costing and variance analysis for any project.	PO12	C4				ASG , F

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

1. Accounting in Action

a) History & Definition of Accounting,
b) Objectives and Importance of Accounting
c) Accounting & Engineering
d) International Financial Reporting Standard (IFRS), Generally Accepted Accounting Principles (GAAP), Ethics in Accounting
e) Accounting Equation (Math)

2. Recording Process : Journal, Ledger, T-account and Trial balance

3. Adjusting the Accounts :
Adjusting Entries , Adjusted Trial Balance, Income Statement, Retained Earnings Statement and Statement of Financial Position (Balance Sheet) , Worksheet.

4. Financial Statement Analysis : Horizontal Analysis, Vertical Analysis and Ratio Analysis

5. Computerized Accounting System:
Manual vs. Computerized Accounting system, Some Accounting Software: NetSuite ERP. Tipalti. Sage Business Cloud Accounting. Sage 50cloud. Plooto. Tradogram. Tally accounting software.

6. Cost Concepts:
a) Explain The Distinguishing Features of Managerial Accounting
b) Identify The Three Broad Functions of Management
c) Classification of Costs on Various Bases
d) Indicate How Cost of Goods Manufactured is Determined, Break Even Point (BEP) for Different Projects.

7. Absorption costing and Variable costing :
a) Prepare Profit Statements Based on a Variable Costing and Absorption Costing System
b) Cost Volume Profit (CVP) Analysis for different engineering projects
c) Account for the difference in profits between variable and absorption costing profit calculations
d) Explain the arguments for and against variable and absorption costing

8. Job Order Costing and Process Costing :
a) Job Order Costing
b) Process Costing

9. Short & Long-Term Decision-Making in Accounting :
a) Relevant & Irrelevant Costs for Decision-Making
b) How to Determine Costs & Make Decisions
c) Contrast annual rate of return and cash Payback in Capital Budgeting, Budgeting for Various Engineering Projects.
d) Distinguish between the Net Present Value And Internal Rate Of Return Methods

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **understand** the cost principle, monetary unit assumption and the economic entity assumption and ethics in financial reporting for each and every project.								2				
CO2	Be able to **understand** worksheet, preparation of financial statements, cost benefit analysis of different projects.											2	
CO3	Be able to comprehend Management Accounting and **apply** it for preparing and presenting information for management decision-making and control purposes.											2	
CO4	Be able to apply and **analyze** the cost-volume profit, budgeting, standard costing and variance analysis for any project.											2	

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 28
Self-Directed Learning Tutorial/ Assignments Individual learning Preparation for tests and examination	 10 24 13
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	80

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Lectures	Lecture/Tutorial/Assignment Topic	CT
Week-1		CT1
1	Meaning, history and definition of accounting	
2	The users and uses of accounting.	
Week-2		
3	Ethics in financial reporting	
4	The cost principle, monetary unit assumption and the economic entity assumption	
Week-3		
5	Accounting equation and its components	
6	The effects of business transactions on the accounting equation.	
Week-4		CT2
7	Four financial statements and how they are prepared.	
8	Journal	
Week-5		
9	Journal	
10	T-account, Ledger, Trial balance	
Week-6		
11	Adjusting Accounts	
12	Worksheet.	
Week-7		
13	Completion of the Accounting cycle.	
14	Financial Statement Analysis	
Week-8		MID-TERM
15	Managerial Accounting Basics	
16	Cost Concepts	
Week-9		
17	Job Order Cost Accounting	
18	Job Order Cost Accounting	

Week-10		
19	Process Cost Accounting	
20	Process Cost Accounting	
Week-11		
21	Cost-Volume-Profit Relationships	
22	Cost-Volume-Profit Relationships	
Week-12		CT3
23	Performance Evaluation through Standard Costs	
24	Performance Evaluation through Standard Costs	
Week-13		
25	Incremental Analysis	
26	Incremental Analysis	
Week-14		
27	Capital Budgeting	
28	Capital Budgeting	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test	20%	CO1	C2
			CO2	C2
	Class Participation	5%	CO1	C2
			CO2	C2
			CO3	C3
			CO4	C4
	Class Attendance	5%		
	Mid term	10%	CO3	C3
			CO4	C4
Final Exam		60%	CO1	C2
			CO2	C2
			CO3	C3
			CO4	C4
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Financial Accounting IFRS edition by Weygand, Kimmel & Kieso (3th)
2. Accounting Principles by Weygandt, Kieso & Kimmel (IFRS Latest edition)

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.2 Department of Computer Science and Engineering

7.2.1. CSE 109: Computer Programming
Level-1, Term-II (Fall)

COURSE INFORMATION

Course Code	: CSE 109	Contact Hours	: 3.00
Course Title	: Computer Programming	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: None
Course Title: None

CURRICULUM STRUCTURE

SYNOPSIS/RATIONALE
To introduce with the most recent technology and to teach students the basic concepts of programming
OBJECTIVE
1. To understand the basic idea of computer programming in C/C++. 2. Learn how to solve problems with Structured Programming using C/C++.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Learning Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Explain** the fundamental concepts and purpose of computer programming.	PO1	C3	1	-	1	F, T
CO2	**Identify** classes, objects, members of a class and the relationships among them needed for a specific problem.	PO2	C1	-	-	3	F, MT
CO3	**Develop** programming skills with respect to program design and development.	PO3	C6	1,3	-	5	T, F, MT
CO4	**Develop** the communication skill by presenting topics on programming phenomena.	PO1	A2	-	-	3	PR, Q

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, MT- Mid Term Exam)

COURSE CONTENT

Introduction to digital computers. Programming languages, algorithms and flow charts. Structured Programming using C. Variable and constants, operators, expressions, control statements, function, arrays, pointers, structure unions. User defined data types. Input output and files. Advantages of OOP over structured programming; Object oriented Programming using C++: Introduction, classes and objects, encapsulation, access specifiers, Polymorphism, function and operator overloading, inheritance.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	**Explain** the fundamental concepts and purpose of computer programming.	3											
CO2	**Identify** cla ses, o j cts, members of a class nd the re ationships among them needed fo a specific problem.		1										
CO3	**Develop** programming skills with respect to program design and evelopment.			2									
CO4	**Develop** the communication skill by presenting top cs on r gramming phenomena.	3											

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning	 42 - -
Self-Directed Learning Non-face-to-face learning	 42
Revision Assessment Preparations	21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method	
COURSE SCHEDULE	

Week	Lecture	Topics	Assessment Methods
1	Lec 1 Lec 2 Lec 3	Introduction to Digital Computers, Programming languages, Algorithms and Flow charts, Structured Programming using C: Variable and Constants, Expressions, Data types, basic input/output	**CT-1**
2	Lec 4 Lec 5 Lec 6	Control Structure: If, Else if, Nested If-Else, Switch	
3	Lec 7 Lec 8 Lec 9	Control Structure: loop, nested loop	
4	Lec 10 Lec 11 Lec 12	Array: one-dimensional array, multi-dimensional array, character array/ string	**CT-2**
5	Lec 13 Lec 14 Lec 15	Function: Function definition, function declaration, function call;	
6	Lec 16 Lec 17 Lec 18	Recursive function	
7	Lec 19 Lec 20 Lec 21	Pointer: Different types of pointers, pass pointer as arguments, call by value vs call by reference	**Mid Term**
8	Lec 22 Lec 23 Lec 24	Dynamic Memory Allocation: Malloc, calloc, free, realloc	
9	Lec 25 Lec 26 Lec 27	User defined data types: Structure, union, enumeration	
10	Lec 31 Lec 32	File I/O, header files, preprocessors, error handling	

	Lec 33		
11	Lec 28 Lec 29 Lec 30	Introduction to C++: Basic Ideas of OOP-encapsulation, inheritance and polymorphism	**CT-3**
12	Lec 34 Lec 35 Lec 36	Introduction to C++: Classes and objects	
13	Lec 37 Lec 38 Lec 39	Polymorphism (Function and Operator Overloading)	
14	Lec 40 Lec 41 Lec 42	Review	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Test 1-3	20%	CO1	C1-C3
			CO3	C6
	Class Participation	5%	CO4	A2
	Class Attendance	5%		
	Mid term	10%	CO2	C4
			CO3	C6
Final Exam		60%	CO1	C1-C3
			CO2	C4
			CO3	C6
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Teach Yourself C (3rd Edition) by Herbert Schidlt
2. Programming in Ansi C (6th Edition) by E Balagurusamy
3. C: The Complete Reference (4th Edition) by Herbert Schildt
4. C++: The Complete Reference (4th Edition) by Herbert Schildt
5. C Programming Language (2nd Edition) by Dennis M. Ritche

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.2.2. CSE 110: Computer Programming Laboratory
Level-1, Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: CSE 110 : Computer programming Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE
Course Code: None Course Title: None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
To introduce with the most recent technology and to teach students the basic concepts of programming

OBJECTIVE
1. Learn basic idea of programming languages. 2. Students will be able to develop logics which will help them to create programs, applications in C. **3.** Learn how to program with Structured Programming Language using C. **4.** Learning the basic programming constructs using other languages like C++.

LEARNING OUTCOMES& GENERIC SKILLS

No.	Course Learning Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Solve problems systematically using a structured logic approach and Object oriented programming	PO 4	C3	1	-	8	O, E, ASG
CO2	Practically analyse the fundamental principles, typical characteristics and mechanisms of a structured programming language.	PO5	C4	3	-	6	O, E, ASG, Q
CO3	Construct or develop complete programs for simple to moderate problems individually.	PO9	C6	1, 3	2		O, E, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, E – Evaluation ; O – Online; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report;)

COURSE CONTENT

Mathematical problems using printf, scanf ; Introduction to data types, mathematical problems using data types, data type conversion ; Control Structure: “if else”, “switch”, Flow Charts; Control Structures: Loop; Control Structures: Nested Loop; Arrays, Multidimensional Arrays; String; Pointer; Dynamic Memory Allocation; Recursion; User defined data types: structures, unions, enumerations. File I/O; Header files, Preprocessor; Error Handling; Introduction to C++: Basic Ideas of OOP- encapsulation, inheritance and polymorphism, Classes and objects

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Solve problems systematically using a structured logic approach and object oriented programming				3								
CO2	Practically analyse the fundamental principles, typical characteristics and mechanisms of a structured programming language.					3							
CO3	Construct or develop complete programs for simple to moderate problems individually.									2			

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio	 - 42
Student-Centred Learning	-
Self-Directed Learning Non-face-to-face learning Revision	21
Assessment Preparations	
Formal Assessment Continuous Assessment Final Examination	 4 3
Total	70

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week	Lab	Topics	Remarks
1	Lab 1	Mathematical problems using printf, scanf	
2	Lab 2	Number System: Conversion between different number systems such as binary, octal, decimal and hexadecimal systems	Evaluation
3	Lab 3	Control Structure: if-else, switch case, nested if-else, loop, nested loop	Evaluation
4	Lab 4	Control Structure: loop, nested loop	Evaluation
5	Lab 5	Array: one-dimensional array, multi-dimensional array, character array/ string	Evaluation
6	Lab 6	Function: Function definition, function declaration, function call	Evaluation
7	Lab 7	Online – 1	
8	Lab 8	Pointer: Different types of pointers, pass pointer as arguments, call by value vs call by reference	Evaluation
9	Lab 9	Dynamic Memory Allocation: Malloc, calloc, free, realloc	Evaluation
10	Lab 10	User defined data types: Structure, union, enumeration	Evaluation
11	Lab 11	File I/O, header files, preprocessors, error handling	Evaluation
12	Lab 12	Introduction to C++: Classes and objects;	Evaluation
13	Lab 13	Encapsulation, Access Specifiers	Evaluation
14	Lab 14	Online – 2	Viva/ Quiz

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Lab Test	20%	CO1	C3
			CO2	C4
			CO3	C6
	Class Participation	5%	CO1	C3
	Class Attendance	5%		
	Assignment	10%	CO1	C3
			CO2	C4
			CO3	C6
Online Test – 1		20%	CO1	C3

		CO2	C4
		CO3	C6
Online Test – 2	20%	CO1	C3
		CO2	C4
		CO3	C6
Viva/ Quiz	20%	CO2	C4
Total Marks	100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

REFERENCE BOOKS

1. Teach Yourself C (3rd Edition) by Herbert Schidlt
2. Programming in Ansi C (6th Edition) by E Balagurusamy
3. C++: The Complete Reference (4th Edition) by Herbert Schildt

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.2.3. CSE 371: Microprocessors and Interfacing
Level-3, Term-II (Fall)

COURSE INFORMATION

Course Code	: CSE 371	Lecture Contact Hours	: 3.00
Course Title	: Microprocessors and Interfacing	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE-303
Course Title: Digital Electronics
Course Code: CSE-109
Course Title: Computer Programming

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To teach and familiarize the students with microprocessor and its architectures, incorporating various programming languages like assembly language along with interfacing with peripheral devices. It is also targeted to provide them basic understanding on microcontrollers, modern embedded systems and IoT to solve real life engineering problems.

OBJECTIVE

1. To familiarize the students about the basic architecture of microprocessor, microcontrollers and other peripheral devices.
2. To enhance students' skill on building algorithms and control of operations for microcontrollers with programming languages like assembly and C++.
3. To acquaint the students with the different working principle of classical and modern embedded systems and their use in the field of IoT.
4. To emphasize students' ability on identifying and solving real life engineering-problems.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **describe** the mechanism of internal blocks of various microprocessors along with their basic architectures, instructions set and **illustrate** their differences.	PO1	C1			4	T, Mid Term Exam

CO2	Be able to **develop** ideas on memory addressing, software interrupts, hardware interrupts and **estimate** their effects by programming with a compiler like ‘emulator8086’.	PO2	C1			4	T, Mid Term Exam,F
CO3	Be able to **illustrate** embedded systems, their application and incorporate them with the idea of IoT.	PO1	C4			3	T,F
CO4	Be able to **construct** systems based on their interfacing with microcontrollers and microproc-essors like keyboard interfacing and display interfacing and **solve** real-life engineering problems.	PO3	C6			5	F, ASG

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Intel 8086 microprocessor: architecture, addressing modes, instruction sets, assembly language programming, functions of Bus interface unit (BIU), instruction queue and pipelining, Execution Unit (EU) and memory segmentation, Bus timing diagram, system design and interrupt, Pentium processors, intel core processors, Core 2 duo, core i3, core i5, core i7 architectural difference, Mobile microprocessor

Microcontroller: Arduino (ATmega328p), 8051 internal architecture, pin diagram and instruction set and memory addressing. Real life problem solving and system design with microcontrollers. Difference and relation between microprocessor and microcontroller. Application in production line and industrial automation.

Embedded system and IoT: Introduction to modern embedded system and their use in IoT, Application of embedded system and interfacing with sensors, Wearables IoT devices and their networking with embedded system

Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard, display device and other I/O device interface.

CO-PO MAPPING

No.	Course Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to **describe** the mechanism of internal blocks of various microprocessors along with their basic architectures, instructions set and **illustrate** their differences.	2											
CO2	Be able to **develop** ideas on memory addressing, software interrupts, hardware interrupts and **estimate** their effects by programming with a compiler like ‘emulator8086’		3										

CO3	Be able to **illustrate** embedded systems, their application and incorporate them with the idea of IoT	3											
CO4	Be able to **construct** systems based on their interfacing with microcontrollers and microprocessors like keyboard interfacing and display interfacing and **solve** real-life engineering problems.			3									

(Numerical method used for mapping which indicates 3 as high, 2 as medium and 1 as low level of matching)

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio	 42 -
Student-Centred Learning	-
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination	 42 21 21
Formal Assessment Continuous Assessment Final Examination	 2 3
Total	131

TEACHING METHODOLOGY

Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE

Week 1	**Introduction to Microprocessor**	CT 1
Class 1	Introduction to the Course content and Evaluation Process.	
Class 2	Introduction to Microprocessor, Basic computer architecture	
Class 3	Bus structure of microprocessor, Basic elements and task of microprocessor.	
Week 2	**Simple as Possible Computer (SAP)-1**	
Class 4	Details of architecture of SAP- 1 and SAP-1	
Class 5	Adder-Subtractor, Tri-state output and detailed instruction set	
Class 6	Bus organization and Arithmetic and logical unit	
Week 3	**Intel 8086 Microprocessor**	
Class 7	Features and characteristics of 8086, PIN diagram and Detail architecture of 8086	
Class 8	Functions of architectural units, organization of Registers of 8086: General purpose and segment register, flag registers	
Class 9	Address determination of peripheral device/memory, Problems of address determination.	
Week 4	**Disciple of 8086**	
Class 10	Introduction to various 80X86 like 80186, 80286, 80386, 80486	

Class 11	Instruction set for 80X86 and their fundamental differences.	CT 2
Class 12	Intel core architecture for next generation microprocessors.	
Week 5	**Next Generation Microprocessor**	
Class 13	Pentium 4, dual core, core 2 duo, core i3, core i5, core i7, supercomputers and their architectural differences	
Class 14	mobile microprocessor and introduction to raspberry pi microcomputer.	
Class 15	Application of raspberry pie and its advantages and differences.	
Week 6	**Assembly Language**	
Class 16	Assembly Language: Addressing Modes of 8086, 80X86, 8087	
Class 17	Data addressing Modes, Program memory addressing modes, Stack memory addressing modes.	
Class 18	Using compiler 'emulator8086'.	
Week 7	**Assembly Language**	Mid Term
Class 19	Data movement instruction, Arithmetic and Logical instruction	
Class 20	Program control instruction and program flow control	
Class 21	Software interrupts and hardware interrupts	
Week 8	**8051 Microcontroller**	
Class 22	8051 internal architecture	
Class 23	8051 pin diagram and instruction set	
Class 24	8051 memory addressing and practice problems	
Week 9	**8051 Microcontroller**	
Class 25	Real life problem solving and system design with microcontrollers.	
Class 26	Difference and relation between microprocessor and microcontroller.	
Class 27	Application in production line and industrial automation.	
Week 10	**Embedded system and IoT**	CT 4
Class 28	Introduction to modern embedded system and their use in IoT	
Class 29	Application of embedded system and interfacing with sensors	
Class 30	Wearable IoT devices and their networking with embedded system	
Week 11	**Interfacing**	
Class 31	Introduction to 8259 Programmable Interrupt Controller, Internal Architecture of 8259	
Class 32	Initialization Command Words (ICWs) and Operational Command Words (OCWs) of 8259	
Class 33	Cascade mode 8259	
Week 12	**Interfacing**	
Class 34	8255A Programmable Peripheral Interface, Pin diagram and pin function, Internal architecture	
Class 35	Initialization of control word of 8255A, i/o interface problems with 8255A	
Class 36	Keyboard interfacing and display interfacing with 8255A	
Week 13	**Interfacing**	
Class 37	Introduction to 8254 Programmable Timer/ Counter	
Class 38	Pin diagram, internal architecture, system connection and initialization	
Class 39	Modes of 8254 and architecture	
Week 14	**Interfacing**	
Class 40	Direct Memory Access (DMA)	
Class 41	8237 DMA controller	
Class 42	Revision and discussion on scope of research.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous	Class Test/	20%	CO1	C1, C4

Assessment (40%)	Assignment 1-3		CO2	C1, C5
			CO3	C2
			CO4	C1, C6
	Class Participation	5%		
	Class Attendance	5%		
	Mid term	10%	CO1	C1, C4
			CO2	C1, C5
Final Exam		60%	CO1	C1, C4
			CO2	C1, C5
			CO3	C2
			CO4	C1, C6
			CO5	C3
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Assembly Language Programming, Organization of the IBM PC by Ytha Yu, Charles Marut
2. Microprocessors and Interfacing by Douglas V. Hall
3. The Intel Microprocessors – Architecture Programming and Interfacing – Barry B
4. Brey, Pearson Education, Inc.
5. 8051 Microcontroller-Internals, Instructions, Programming& Interfacing - Subrata Ghoshal
6. Introduction to Embedded Systems Using ANSI C and the Arduino Development Environment (Synthesis Lectures on Digital Circuits and Systems) - David Russell
7. Internet of Things Programming Projects_ Build modern IoT solutions with the Raspberry Pi 3 and Python (2018) - Colin Dow

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.2.4. CSE 372: Microprocessors and Interfacing Laboratory
Level-3, Term-II (Fall)

COURSE INFORMATION

Course Code	: CSE 372	Contact Hours	: 3.00
Course Title	: Microprocessors and Interfacing Laboratory	Credit Hours	: 1.50

PRE-REQUISITE

Course Code: CSE 371
Course Title: Microprocessors and Interfacing
Course Code: EECE 303
Course Title: Digital Electronics

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course is one of the cardinal requirements for junior year students of electrical engineering which focuses on a good knowledge of programming and interfacing of the Intel microprocessor 8086. To function in a field of study that uses computers, one must understand assembly language programming, a version of C language and interfacing. The students are first taught about the instruction sets of Intel 8086, Arduino and PIC 16F877A. This surfaces the way of manifestation to modern tools like Emulator 8086, MDA 8086 and Raspberry pi. The aim of the course is to acquaint the students with methods to manipulate a microprocessor, microcontroller and microcomputer.

OBJECTIVE

1. To impart the thorough knowledge of programming the Intel Microprocessor 8086 using assembly language. 2. To enhance skill set of students in interfacing the microprocessor with peripheral devices and systems. 3. To develop students' skills of applying the instruction codes to convert assembly language into machine language and vice versa. 4. To familiarize the students clearly with the basics of Arduino, PIC 16F877A and raspberry pi 3. 5. To develop communication and project management skills in the students through presentation and project.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **follow** the process of forming a structured algorithm, choosing the correct instruction sets along with appropriate addressing modes to accomplish a given programming task followed by proper debugging.	PO10	P3				R,Q,T
CO2	Be adept to **build** communication between the real world and other devices with microprocessors.	PO9	P5				R,Q,T
CO3	Be proficient to differentiate between different instruction sets and demonstrate skills to manipulate the versatility of used devices.	PO5	A3,P1	1		6	R,Q,T
CO4	Be capable to construct different types of digital circuits incorporating modern tools for a specific operation which will be efficient, economic and user friendly.	PO10	P7	4			PR, Pr, Q

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	27 9 18
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	54 9 12 10 5 18
Formal Assessment Continuous Assessment Final Quiz	3 1
Total	73

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introductory session on Emulator 8086 and MDA 8086 followed by depiction of

	the steps to get the MDA 8086 process in the desired condition. Brief introduction on assembly language and hands on experience of Emulator 8086 through working with basic commands (logical and jump).
Week 2	Brief follow up on Rotate, Shift and LOOPs followed by writing and debugging codes incorporating the mentioned topics using Emulator 8086.
Week 3	Brief discussion on Procedures, Stacks and Arrays. Writing and debugging codes which contains the discussed topics using Emulator 8086.
Week 4	Introduction to method of converting Machine Language to Assembly Language and vice versa using MDA 8086.
Week 5	Discussion on 8255 PPI and Stepper motor interface and warning message generation by Intel 8086 using Assembly Language Program, 8255 PPI and MDA 8086.
Week 6	Introduction of Dot-Matrix LED display and interface. Followed by interfacing digital lighting display (Dot-matrix) with Intel 8086 using Assembly Language Program and MDA 8086.
Week 7	Lab Test-1
Week 8	Basics of Arduino and PIC 16F877A.
Week 9	Basic I/O operation with micro-controller Arduino and PIC 16F877A and observe the difference between both the operations.
Week 10	Brief introduction to Linux and process of installing Linux on raspberry pi 3 along with other software such as Emulator 8086.
Week 11	Lab Test-2
Week 12	Lab Quiz
Week 13	Project Presentation
Week 14	Viva

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment	Lab participation and Report	20%	CO 1	P3
			CO 2	P5
			CO 3	A3,P1
			CO4	P7
	Labtest-1,Labtest-2	30%	CO 1	P3
			CO 2	P5
			CO 3	A3,P1
			CO4	P7
	Project and Presentation	25%	CO 4	P4,P7
Project and Presentation		25%	CO 1	P3
			CO 2	P5
			CO 3	P1,A3
			CO 4	P7
Total Marks		100%		

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)

TEXT AND REFERENCE BOOKS

1. Microprocessors and Interfacing by Douglas V. Hall
2. Introduction to Embedded Systems Using ANSI C and the Arduino Development Environment (Synthesis Lectures on Digital Circuits and Systems) - David Russell
3. Internet of Things Programming Projects_ Build modern IoT solutions with the Raspberry Pi 3 and Python (2018) - Colin Dow

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.3 Department of Mechanical Engineering

7.3.1. ME 283: Fundamentals of Mechanical Engineering
Level-2, Term-I (Spring)

<table>
<tr><td colspan="8">COURSE INFORMATION</td></tr>
<tr><td>Course Code
Course Title</td><td colspan="3">ME 283
Fundamentals of Mechanical Engineering</td><td colspan="3">Contact Hours
Credit Hours</td><td>3.00
3.00</td></tr>
<tr><td colspan="8">PRE-REQUISITE</td></tr>
<tr><td colspan="8">None</td></tr>
<tr><td colspan="8">CURRICULUM STRUCTURE</td></tr>
<tr><td colspan="8">Outcome Based Education (OBE)</td></tr>
<tr><td colspan="8">SYNOPSIS/RATIONALE</td></tr>
<tr><td colspan="8">To introduce the students with various fields of Mechanical Engineering with a special consideration to the fields relevant to the Electrical, Electronic and Communication engineering discipline.</td></tr>
<tr><td colspan="8">OBJECTIVE</td></tr>
<tr><td colspan="8">1. To introduce various energy sources available in the world, energy economics and energy savings
2. To introduce steam generating units with accessories and mountings
3. To introduce internal combustion engine and gas turbine and their applications
4. To introduce fluid mechanics and machinery like water turbine, pump, compressor etc.
5. To briefly introduce various type of power plants
6. To briefly introduce hybrid technology, electric car and robot
7. To briefly introduce psychrometry, refrigeration and air conditioning</td></tr>
<tr><td colspan="8">LEARNING OUTCOMES & GENERIC SKILLS</td></tr>
<tr><td>No.</td><td>Course Outcome</td><td>Corresponding PO</td><td>Bloom's Taxonomy</td><td>CP</td><td>CA</td><td>KP</td><td>Assessment Methods</td></tr>
<tr><td>CO1</td><td>Demonstrate knowledge on various energy sources and energy economics</td><td>PO1</td><td>C1</td><td></td><td></td><td>3</td><td>T, F</td></tr>
<tr><td>CO2</td><td>Demonstrate knowledge on various mechanical components in power plants</td><td>PO1</td><td>C3</td><td></td><td></td><td>3</td><td>Mid, ASG, F</td></tr>
<tr><td>CO3</td><td>Demonstrate knowledge on hybrid and electric car technology</td><td>PO1</td><td>C3</td><td></td><td></td><td>3</td><td>ASG, F</td></tr>
<tr><td>CO4</td><td>Perform basic oral and written technical communication according to the accepted standards of the mechanical engineering community</td><td>PO1</td><td>C2</td><td></td><td></td><td>3</td><td>ASG, Pr</td></tr>
<tr><td colspan="8">(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Present,ation; R – Report; F – Final Exam)</td></tr>
<tr><td colspan="8">COURSE CONTENT</td></tr>
<tr><td colspan="8">a. Main Contents:
1. Energy sources, Energy economics
2. Steam generator
3. Internal combustion engine, Gas Turbine
4. Water turbine, Pump, Compressor
5. Power plant
6. Automobiles and Robotics
7. Air conditioning and Refrigeration
b. Detail Contents:
1. Various Energy Source — Renewable and nonrenewable energy sources and their</td></tr>
</table>

applications, Energy economics and proper use.
2. Steam Generator – Various types of steam generator, Mountings and accessories, Rankin cycle, Introduction to steam table, Heat recovery steam generator.
3. Internal Combustion Engine, Gas Turbine — Operating principle of IC (both SI and CI) engine, Valve timing diagram, cycle diagram, relevant mathematics, Gas turbine operation, Components of GT, thermodynamic cycle, Application of SI, CI engine and GT in power generation. Hybrid technology – Various hybrid vehicles, Types, Applications
4. Water Turbine, Pump, Compressor- Introduction to water turbine, Kaplan turbine, Pelton wheel components and operation., study of centrifugal and axial flow machines, pumps, fans, blowers and compressors, study of reciprocating pumps..
5. Power plant – Basic of coal based, GT base, Combined cycle based and nuclear power plant
6. Automobiles and Robotics – Hybrid Technology, Electric Car, Introduction to robotics
7. Refrigeration and Psychrometry –Vapor compression and Absorption refrigeration, COP, Cycle, Psychrometric chart, Basic application of psychrometric chart, Basic of air conditioning.

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Demonstrate knowledge on various energy sources and energy economics	2											
CO2	Demonstrate knowledge on various mechanical components in power plants	3											
CO3	Demonstrate knowledge on hybrid and electric car technology	3											
CO4	Perform basic oral and written technical communication according to the accepted standards of the mechanical engineering community	2											

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	**122.5**

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Presentation, Problem solving

COURSE SCHEDULE

Lecture	Content	CT
L 1 – L 6	Renewable and nonrenewable energy sources and their applications, Energy economics and proper use.	01
L 7 – L 15	Various types of steam generator, Mountings and accessories, Rankin cycle, Introduction to steam table, Heat recovery steam generator.	
L 16 – L 24	Operating principle of IC (both SI and CI) engine, Valve timing diagram, cycle diagram, relevant mathematics, Gas turbine operation, Components of GT, thermodynamic cycle, Application of SI, CI engine and GT in power generation. Hybrid technology – Various hybrid vehicles, Types, Applications	02

L 25 – L 33	Water Turbine, Pump, Compressor- Introduction to water turbine, Kaplan turbine, Pelton wheel components and operation., study of centrifugal and axial flow machines, pumps, fans, blowers and compressors, study of reciprocating pumps	Mid
L 34 – L 36	Basic of coal based, GT base, Combined cycle based and nuclear power plant	04
L 37 – L 38	Hybrid Technology, Electric Car, Introduction to robotics	
L 39 – L 42	Vapor compression and Absorption refrigeration, COP, Cycle, Psychromet-ric chart, Basic application of psychrometric chart, Basic of air conditioning.	

ASSESSMENT STRATEGY

Components		Grading	CO	Bloom's Taxonomy
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%	CO1	C1
			CO2	C3
			CO3	C3
			CO4	C2
	Class Participation	5%	-	-
	Class Attendance	5%		
	Mid-Term	10%	CO2	C3
Final Exam		60%	CO1	C1
			CO2	C3
			CO3	C3
Total Marks		100%		

TEXT AND REFERENCE BOOKS

1. A Text Book of Thermal Engineering - R S Khurmi & J K Gupta
2. Heat Engines – D. A. Low
3. Thermal Engineering- Mahesh M Rathor

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

7.3.2. ME 284: Fundamentals of Mechanical Engineering Laboratory
Level-2, Term-I (Spring)

COURSE INFORMATION

Course Code Course Title	: ME 284 : Fundamentals of Mechanical Engineering Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

To help the students to explore various mechanical equipment and processes and put theory in practice. The students will be exposed to various equipment used in power plant for power generation like turbine, cooling tower, engine etc. and various properties like flash point fire point etc. Thy will be able to understand the working principle of various equipment first hand and compute their performance.

OBJECTIVE

1. Be able to familiarize the students with the basic mechanical equipment like engine, turbine, pump, refrigeration unit etc.
2. Be able to calculate various parameters of equipment like power generation, efficiency, flow rate etc.

3. To develop skills of handling basic mechanical equipment by engaging students in experiences with experimental processes and by growing the capability operate them.   **4.** Be able to impart practical knowledge on mechanical equipment crafting and develop collaborative learning skill.

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to compute the various properties of fuels	PO 4	C5, P4			8	ASG, R, F, Pr
CO2	Be able to identify various component of engine and conduct performance analysis	PO 5	C5, P4			4	ASG, R, F, Pr
CO3	Be able to compute performance of fluid machineries like pump and turbine	PO 5	C5, P4			4	ASG, R, F, Pr
CO4	Demonstrate practical knowledge on psychrometric analysis of air and refrigeration system	PO 4	C5, P4			8	ASG, R, F, Pr

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test ; PR – Project ; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam)

COURSE CONTENT

Introduction to the lab equipment's and safety measures
Expt-01: Determination of flash point of liquid fuel
Expt-02: Viscosity test of liquid substance
Expt-04: Study of an automotive engine, different system and performance test
Expt-05: Determination of water flow rate
Expt-06: Study of sling Psychrometer
Expt-07: Performance test of a cooling tower.
Expt-08: Study of propeller turbine characteristics

CO-PO MAPPING

No.	Course Learning Outcome	PROGRAM OUTCOMES (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	Be able to compute the various properties of fuels				2								
CO2	Be able to identify various component of engine and conduct performance analysis.					2							
CO3	Be able to compute performance of fluid machineries like pump and turbine					2							
CO4	Demonstrate practical knowledge on psychrometric analysis of air and refrigeration system				2								

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	14

Practical	28 Total 42
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 10 10 5 10 20
Formal Assessment Continuous Assessment Final Quiz	 14 1
Total	112

TEACHING METHODOLOGY

Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method

COURSE SCHEDULE

Week 1	Introduction to the lab equipment's and safety measures
Week 2	Expt-01: Determination of flash point of liquid fuel
Week 3	Expt-02: Viscosity test of liquid substance
Week 4	4 Expt-03: Study of refrigeration and air conditioning cycle.
Week 5	Expt-04: Study of an automotive engine, different system and performance test
Week 6	Expt-05: Determination of water flow rate
Week 7	Expt-06: Study of sling Psychrometer
Week 8	Expt-07: Performance test of a cooling tower.
Week 9	Expt-08: Study of propeller turbine characteristics
Week 10	Practice Lab
Week 11	Practice Lab
Week 12	Lab Test + Viva
Week 13	Quiz test
Week 14	Presentation

ASSESSMENT STRATEGY

COs	Assessment Method	(100%)	Remarks
	Class Assessment		
1,2,3,4	Lab participation and Report	**20**	
1,2,3,4	Presentation	**20**	
	Exam		
1,2,3,4	Lab Test 1 & 2	**30**	
1,2,3,4	Final Exam	**30**	

TEXT AND REFERENCE BOOKS

1. Lab Handbook
2. Introduction to Thermal Engineering – R. S. Khurmi

*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

ANNEX-A

PROGRAM OUTCOMES (PO)

PO-1	**Engineering knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.
PO-2	**Problem analysis:** Identify, formulate, research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)
PO-3	**Design/development of solutions:** Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)
PO-4	**Investigation:** Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO-5	**Modern tool usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering problems, with an understanding of the limitations. (K6)
PO-6	**The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)
PO-7	**Environment and sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)
PO-8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)
PO-9	Individual work and teamwork: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PO-10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO-11	**Project management and finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO-12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

KNOWLEDGE PROFILE (KP)

Attributes	
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline
K3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
K5	Knowledge that supports engineering design in a practice area
K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability
K8	Engagement with selected knowledge in the research literature of the discipline

RANGE OF COMPLEX ENGINEERING PROBLEM SOLVING (CP)

Attributes	Complex Engineering Problems
Depth of knowledge required	**P1:** Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
Range of conflicting requirements	**P2:** Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	**P3:** Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	**P4:** Involve infrequently encountered issues
Extent of applicable codes	**P5:** Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder involvement and conflicting requirements	**P6:** Involve diverse groups of stakeholders with widely varying needs
Interdependence	**P7:** Are high level problems including many component parts or sub-problems

RANGE OF COMPLEX ENGINEERING ACTIVITIES (CA)

Attributes	Complex activities
Range of resources	**A1**: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	**A2**: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	**A3**: Involve creative use of engineering principles and research-based knowledge in novel ways
Consequences for society and the environment	**A4**: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	**A5**: Can extend beyond previous experiences by applying principles-based approaches

BLOOM'S TAXONOMY DOMAIN

Cognitive Domain		Psychomotor Domain		Affective Domain	
C1	Remembering	**P1**	Perception	**A1**	Receive
C2	Understanding	**P2**	Set	**A2**	Respond
C3	Applying	**P3**	Guided Response	**A3**	Value
C4	Analyzing	**P4**	Mechanism	**A4**	Organize
C5	Evaluating/	**P5**	Complex Overt Response	**A5**	Internalize
C6	Creating/ Designing	**P6**	Adaptation		
		P7	Origination		

ANNEX-B

GRADING SYSTEM

Numerical Markings	Grade	Grade Points
80% and above	A+	4.00
75% to below 80%	A	3.75
70% to below 75%	A-	3.50
65% to below 70%	B+	3.25
60% to below 65%	B	3.00
55% to below 60%	B-	2.75
50% to below 55%	C+	2.50
45% to below 50%	C	2.25
40% to below 45%	D	2.00
Below 40%	F	0.00
	AB	Absent
	DC	Dis-collegiate
	VW	Voluntary Withdrawn
	X	Project/Thesis Continuation
	E	Expelled
	S	Satisfactory