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)

MARCH 2024

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 Spring 2024 for all Levels.

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1. ____
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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 Science and Engineering (NSE), Biomedical Engineering (BME), Environmental, Water Resources and Coastal Engineering (EWCE) and Architecture (Arch). From 2016 another two departments, viz. Industrial and Production Engineering (IPE) and Petroleum and Mining Engineering (PME), started 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 fulfil 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 two 'B' grade and one 'C' 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)	120
2		Computer Science and Engineering (CSE)	120
3		Electrical, Electronic and Communication Engineering (EECE)	120
4		Mechanical Engineering (ME)	120
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			**810**

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%**

The total number is 810. 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 above.

1.6 Admission Procedure

1.6.1 Syllabus for admission test. 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 Final Selection. 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 Medical Checkup. 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, blood grouping and dope test before the MIST medical authority. The medical authority will decide on the physical fitness of candidates for admission in MIST.

1.7 Students Withdrawal Policy

1.7.1 For Poor Academic Performance.

The undergraduate (B.Sc.) Engineering programs for all engineering disciplines are planned for 4 regular levels, comprising of 8 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 6 (six) academic years (for Architecture- 7 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 6 (six) academic years (for Architecture- 7 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:

i. Communicating with fellow students for obtaining help in the examination.
ii. Copying from another student's script/ report /paper.
iii. Copying from desk or palm of a hand or from other incrimination documents.
iv. 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 Behaviours.** Academic Council may withdraw/expel any student on disciplinary ground if any form of indiscipline or unruly behaviour 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 6 (six) academic years (for Architecture- 7 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 6 or as per syllabus in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow up to 7 courses in exceptional cases if department can accommodate within 24 cr hr.
b. Students will not face any level repeat for failing.
c. Students will get scope to improve their grading.
d. Introduction of more optional courses to enable the students to select courses according to their individual needs and preferences.
e. Continuous evaluation of students' performance.
f. 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	3 weeks
5.	Term Final Examination	3 weeks
6.	Term End Vacation	2 weeks

Course Pattern and Credit Structure

2.7 The undergraduate program is covered by a set of theoretical courses along with a set of laboratories (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:

<u>EECE</u> 101 **<u>Electrical Circuits I</u>**

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

<u>EECE</u> 102 **<u>Electrical Circuits and Simulation Laboratory I</u>**

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

<u>Assignment of Credits</u>

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

<u>Types of Courses</u>

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.

<u>Course Offering and Instruction</u>

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. Counselling 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 enrolment/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 enrolment 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. In special case if any graduating student needs more than 24 Cr Hr, BUGS may allow up to 27 Cr Hr. 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 and 5% 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

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

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

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

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

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

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 301	3.0	A	3.75	11.25
EECE 303	3.0	A+	4.00	12
EECE 305	3.0	A-	3.50	10.5
EECE 313	3.0	B+	3.25	9.75
EECE 315	3.0	A	3.75	11.25
GESL 305	2.0	A	3.75	7.5
EECE 304	1.5	A	3.75	5.625
EECE 306	1.5	A-	3.50	5.25
EECE 314	1.5	B+	3.25	4.875
Total	**21.5**			**78.00**

$$\text{GPA}=\frac{78.00}{21.5}=3.63$$

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	18.5	3.33	61.605
1	II	18.5	3.75	69.375
2	I	20.0	3.85	77
2	II	19.0	3.88	73.72
Total		**76.00**		**281.7**

$$\text{CGPA}=\frac{281.7}{76.00}=3.71$$

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 **seven** years for engineering and **eight** 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 slips 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.
i. If anyone fails in the Laboratory/ Sessional course, that course cannot be taken in the supplementary examination.
j. 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.
k. 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.
l. There will be no provision for add/drop courses after registration.
m. **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. Student needs to apply for the withdrawl and take the approval within one week after the last term final examination. 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

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

a. Maximum 24 credit hour in one regular term (excluding Supplementary Exams).
b. Students may register maximum up-to 7 (seven) theory courses in exceptional case, if department can accommodate within 24 credit hours.
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 be a center of excellence in empowering electrical, electronic and communication engineers to shape a sustainable and innovative future.

Mission: EECE department is working on the following missions:

No	Mission Statement
M-1	Providing comprehensive education on electrical, electronic and communication engineering.
M-2	Preparing future leaders to navigate dynamic technological landscapes with expertise, integrity, and professionalism.
M-3	Delivering ingenious, sustainable engineering solutions through consultancy, testing and research to address local and global challenges, upholding national priorities.

3.3 Program Educational Objectives (PEOs):

No	PEO Statement
PEO-1	Graduates will demonstrate proficiency in Electrical, Electronic and Communication Engineering (EECE) or related field.
PEO-2	Graduates will engage in lifelong learning and professional development activities to stay current with emerging technologies, tools, and practices.
PEO-3	Graduates will demonstrate awareness of ethical, environmental, and societal issues and apply ethical principles in decision-making processes.
PEO-4	Graduates will effectively collaborate with multidisciplinary teams, communicate technical concepts and solutions clearly and concisely, and demonstrate leadership skills when appropriate.

Mapping Missions of the Department with the PEOs

Mission	PEO-1	PEO-2	PEO-3	PEO-4
M-1	✓			
M-2		✓	✓	
M-3			✓	✓

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.

Mapping of PEOs with POs

PEO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	✓	✓	✓	✓	✓							
2					✓							✓
3						✓	✓	✓				
4									✓	✓	✓	

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** mean (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

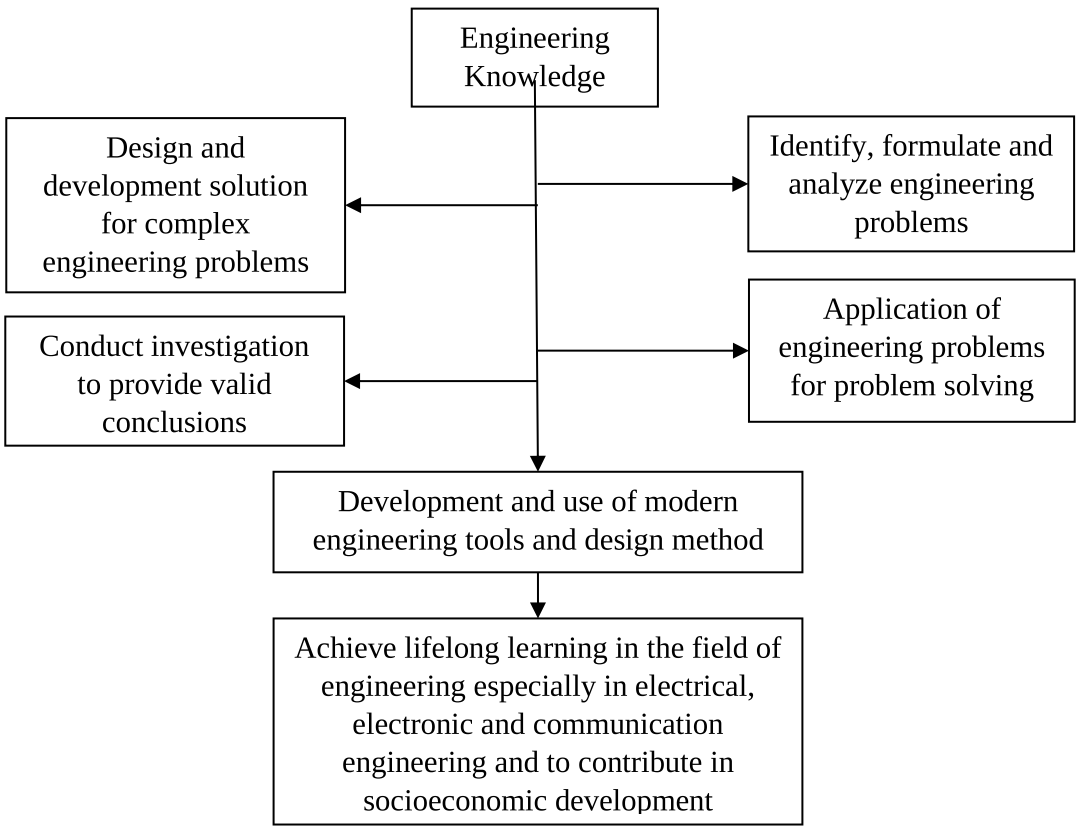
Table 3.4: Bloom's Taxonomy Domain

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 <u>Generic Skills</u>

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 <u>Curriculum/ Skill mapping:</u>



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+1.0	-	-	9.0+5.5	3.0+1.5	-	20.0
L-4 T-I	-	-	-	6.0+5.5	-	9.0+1.5	22.0
L-4 T-II	4.0	-	-	3.0+3.0	-	9.0+1.5	20.5
Total Credit Hr	**18.0**	**12.0**	**12.0**	**83.5**	**13.5**	**21.0**	**160.0**
% of Total Course	**11.26%**	**7.50%**	**7.50%**	**52.19%**	**8.43%**	**13.12%**	**100%**

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	16.0	12	8.0	28.0	20.0
L-4 T-I	15	14.0	15	7.0	29.0	22.0
L-4 T-II	16	9	16	4.5	25.0	20.5
Total	**116.0**	**88.0**	**116.0**	**44.0**	**204.0**	**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	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	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	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 Systems 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	2.0	1.0
EECE 310	Communication Systems 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	2.0	1.0
	Subtotal (Sessional)		**14.0+2.0 (4 weeks)**	**8.0**
	Total = Contact hours : 28.0; Credits : 20.0			

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 407	Artificial Intelligence and Machine Learning	Theory	3.0	3.0
EECE 4**	Elective I	Theory	3.0	3.0
EECE 4**	Elective II	Theory	3.0	3.0
EECE 4 **	Elective III	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 408	Artificial Intelligence and Machine Learning Laboratory	Sessional	2.0	1.0
EECE 4**	Elective I Laboratory	Sessional	3.0	1.5
		Subtotal (Sessional)	**14.0**	**7.0**
				Total = Contact hours: 29.0; Credit hours : 22.0

LEVEL 4, TERM-II

Course No	Course Name	Type of course	Contact hours	Credits
EECE 405	Solid State Devices	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 IV	Theory	3.0	3.0
EECE 4 **	Elective V	Theory	3.0	3.0
EECE 4 **	Elective VI	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 IV Laboratory	Sessional	3.0	1.5
		Subtotal (Sessional)	**9.0**	**4.5**
				Total = Contact hours: 25.0; Credits: 20.5

Note:

a. **A student must take a minimum of 4 elective courses from the major group as listed in Section 4.5.**

b. EECE-19 batch already completed GERM 352 as a 2 cr sessional course in Level 3 instead of currently proposed 1 cr sessional, and they are exempted from taking the newly included EECE 408 Laboratory (1 cr) in Level 4 for graduation. For subsequent batches, EECE 408 will be considered within the core courses.

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-I/ 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-I/ 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	Energy Conversion III	4-I/ 4-II	3.0	3.0
10	EECE 473	Power Electronics	4-I/ 4-II	3.0	3.0
11	EECE 474	Power Electronics Laboratory	4-I/ 4-II	3.0	1.5

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 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-I/ 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	Nano-electronics and Nanotechnology	4-I/ 4-II	3.0	3.0
9	EECE 465	Semiconductor and Nano Devices	4-I/ 4-II	3.0	3.0
10	EECE 473	Power Electronics	4-I/ 4-II	3.0	3.0
11	EECE 474	Power Electronics Laboratory	4-I/ 4-II	3.0	1.5

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-I/ 4-II	3.00	1.50
4	EECE 435	Optical 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-I/ 4-II	3.00	1.50
7	EECE 439	Wireless 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	Radar and Satellite Communication	4-I/ 4-II	3.00	3.00
10	EECE 444	Radar and Satellite Communication Laboratory	4-I/ 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-I/ 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-I/ 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-I/ 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-I/ 4-II	3.00	1.50
7	EECE 427	Robotics and Automation	4-I/ 4-II	3.00	3.00
8	EECE 428	Robotics and Automation Laboratory	4-I/ 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-I/ 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-I/ 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-I/ 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-I/ 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-I/ 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 Course Title	: EECE 101 : Electrical Circuits I	Lecture Contact Hours Credit Hours	: 3.00 : 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	PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Apply** the concepts of circuit elements, circuit, circuit variables, direct current, voltage, dependent and independent sources, circuit laws, analysis methods, theorems to solve various circuit.	PO1	C3	P1, P2, P3		1, 2	ASG, T, F
CO2	**Analyze** first and second order transient circuits, sequential switching circuits using differential equations to recognize natural, forced and complete response.	PO2	C4	P1, P2, P3		4	ASG, T, F
CO3	**Solve** series/parallel magnetic circuits based on the understanding of analogy between electrical and magnetic circuits	PO1	C3	P1, P2, P3		3	ASG, T, F
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)							

(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 Super nodes, Mesh Analysis, Mesh Analysis in Circuits with Super mesh, 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.

Introduction to Magnetism: Magnetic quantities and variables: Field, Flux, Flux Density, Magnetomotive Force, Magnetic Field Strength, permeability and B-H Curve, reluctance.

Introduction to Magnetic laws and Circuits: Ohm’s law and Ampere’s circuital law. Magnetic circuits: Composite series magnetic circuit, parallel and series-parallel circuits. Comparison between electrical and magnetic quantities, Hysteresis and hysteresis loss. Magnetic materials.

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	Ohm's Law; Nodes, Branches and Loops; Kirchhoff's Laws
Week 2	**Basic Circuit Laws**
Class 4	Series Resistors and Voltage Division, Parallel Resistors and Current Division
Class 5	Wye-Delta Transformations, Relevant Practice Problems and Real-Life Applications based on Circuit Laws
Class 6	Nodal Analysis, Nodal Analysis in Circuits with Super nodes

Week 3	**Methods of Circuit Analysis**
Class 7	Practice Problems Relevant to Nodal Analysis
Class 8	Mesh Analysis, Mesh Analysis in Circuits with Super mesh
Class 9	Practice Problems Relevant to Mesh Analysis
Week 4	**Methods of Circuit Analysis**
Class 10	Nodal and Mesh Analysis with Inspection, Real Life Applications based on Circuit Analysis Technics
Class 11	Linearity Property and Practice Problems Relevant to Linearity Property
Class 12	Superposition Theorem Practice Problems Relevant to Superposition Theorem
Week 5	**Circuit Theorems**
Class 13	Source Transformation and Relevant Practice Problems
Class 14	Thevenin's Theorem
Class 15	Practice Problems Relevant to Thevenin’s Theorem
Week 6	**Circuit Theorems**
Class 16	Norton's Theorem
Class 17	Practice Problems Relevant to Norton’s Theorem
Class 18	Maximum Power Transfer Theorem and Practice Problems Relevant to Maximum Power Transfer Theorem, Real Life Applications based on Circuit Theorems
Week 7	**Circuit Theorems**
Class 19	Electrical Properties of Capacitors, Series and Parallel Capacitors
Class 20	Electrical Properties of Inductors, Series and Parallel Inductors
Class 21	Relevant Practice Problems
Week 8	**Capacitors and Inductors**
Class 22	Source Free RC Circuits
Class 23	Practice Problems Relevant to Source Free RC Circuits
Class 24	Source Free RL Circuits
Week 9	**First-Order Circuits**
Class 25	Practice Problems Relevant to Source Free RL Circuits
Class 26	Singularity Functions and Practice Problems Relevant to that
Class 27	Step Response of an RC Circuit
Week 10	**First-Order Circuits**
Class 28	Practice Problems Relevant to Step Response of an RC Circuit
Class 29	Real Life Applications of RC Circuits
Class 30	Step Response of an RL Circuit
Week 11	**First-Order Circuits**
Class 31	Practice Problems Relevant to Step Response of an RL Circuit
Class 32	Real Life Applications of RL Circuits
Class 33	Source Free Series RLC Circuits
Week 12	**First-Order Circuits**
Class 34	Practice Problems Relevant to Source Free Series RLC Circuits
Class 35	Source-Free Parallel RLC Circuits
Class 36	Practice Problems Relevant to Source Free Parallel RLC Circuits
Week 13	**Introduction to Second-Order Circuits**
Class 37	Step Response of a Series RLC Circuit
Class 38	Step Response of a Parallel RLC Circuit
Class 39	Magnetic Field, Flux, Flux Density, Magnetomotive Force, Magnetic Field Strength, Permeability and B-H Curve, Reluctance.
Week 14	**Magnetic Laws and Circuits**
Class 40	Ohm’s law and Ampere’s circuital law.
Class 41	Magnetic circuits: Composite series magnetic circuit, parallel and series-parallel circuits.
Class 42	Comparison between electrical and magnetic quantities, Hysteresis and hysteresis loss. Magnetic materials.

ASSESSMENT STRATEGY		
Components		Grading
Continuous Assessment (40%)	Class Test	20%
	Assignment	5%
	Attendance	5%
	Mid term	10%
Final Exam		60%

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 Course Title	: EECE 102 : Electrical Circuits and Simulation Laboratory -I	Contact Hours Credit Hours	: 3.00 : 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	**Apply** modern computer aided design tools to model and solve problems related to basic electrical systems	PO5	C3, P4	P1, P2, P3		6	R, Q, T
CO2	**Construct** electrical circuits using different types of active and passive components and **analyze** their dc and transient behaviors.	PO3	C6, A4	P1, P2, P3		5	R, PR, T
CO3	**Demonstrate** membership and leadership in team works and safe electrical practices during experimentation.	PO9	A4, P4				Lab-tasks, PR

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

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	Instantaneous and RMS Values of AC Waveforms; KVL, KCL, Phasor Diagram of Simple Series R-C and R-L Circuits with Sinusoidal Excitation
Week 11	Lab Test-2
Week 12	Lab Quiz
Week 13	Presentation on Assigned Problems
Week 14	Project Demonstration

ASSESSMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Lab participation and Report	30%
	Labtest-1, Labtest-2	40%
Lab Quiz		30%
Total Marks		100%

TEXT AND REFERENCE BOOKS

Text Books:

1. Fundamentals of Electrical Circuits –Alexander & Sadiku (4th 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 Coordinate 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	**Apply** techniques corresponding to circuit laws 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	P1, P2, P3		1,2	CT, F
CO2	**Apply** the concept of mutual inductance and dot convention for solving inductively coupled circuits and **illustrate** the idea of isolating Transformer and impedance matching device.	PO2	C3	P1, P2, P3		2,3	A, M, F
CO3	**Analyze** 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, A3	P1, P2, P3		5	CT, M, F

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

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	**Sinusoids and Circuit Variables**
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**
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**
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
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: EECE 106 : Electrical Circuits and Simulation Laboratory II	Contact Hours Credit Hours	: 3.00 : 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 to understand their behaviours in real life scenarios by use of hardware's, certain circuit simulation software and numerical computation software. Emphasis on designing small scale projects involving applications of AC circuit is given in the course, to give students the flavour 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 software (PSpice, Proteus) for their simulations.
2. **Instil** 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 software.
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 showing expertise in using circuit laws and technique to detect AC parameters (voltage, current, power) and **illustrate** 3 phase circuit and magnetically coupled circuit through simulation.	PO5	C6, P4	P1, P2, P3		6	R, Q, T
CO2	Reproduce real world circuits building on the concepts of resonance, also describe and **manipulate** frequency responses of passive filter circuits via simulations.	PO3	C5, A4	P1, P2, P3		5	R, Q, T
CO3	**Perform** steady-state and transient analysis for various constraints of ac circuits and conform the best scenario of circuit operation.	PO2	C3	P1, P2, P3		3	R, Q, T

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)
(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.	
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	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 4	
Week 5	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 6	
Week 7	Familiarization of various passive filter characteristics using hard wares and its frequency response and implementations using PSpice, Proteus
Week 8	
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
Continuous Assessment (40%)	Lab Participation and Report	20%
	Lab Test	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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) and their applications (rectifiers, voltage regulators and amplifiers) as electronic circuit elements. 3. Be expert in give students the necessary background of electronics for the design and analysis of electronic circuits and systems in low and high frequency domains.

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	C1, C4	P1		K1, K3	T, F
CO2	Be able to **compare** the input and output characteristics of different electronic components.	PO2	C4	P1		K3, K4	T, Mid Term Exam, F
CO3	Be proficient to **examine** basic electronic circuits considering existing system models to **explain** practical complex engineering problems.	PO3	C5, A3	P2		K5	Mid Term Exam, F, ASG

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)
(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, Load line and Q-point, simplified DC and AC diode models, static resistance, dynamic resistance. Photo diodes and LED circuits. **Diode circuits:** Half wave and full wave rectifiers, rectifiers with filter capacitor, clamping and clipping circuits, Characteristics of a Zener diode, Zener shunt regulator, voltage multiplier. **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. **BJT amplifier circuits:** Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits, multistage amplifiers. Frequency response of BJT. **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. **Metal-oxide-semiconductor field-effect-transistor (MOSFET) as circuit element:** Structure and physical operation of an enhancement MOSFET, threshold voltage, Body effect, Channel length modulation, current- voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.

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 Electronics (Must know)**
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)**
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)**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	:3.0 :1.5

PRE-REQUISITE
Course Code: EECE 201 Course Title: Electronics I
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
Electronics Circuits and Simulation Laboratory 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 experiment, 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** and **describe** simple electronic circuits using various types of passive and active components.	PO3	C6, A1	P1		K5	R, Q, T

CO2	Developing capability to **compare** and **respond** to the input and output characteristics of different electronic component obtained by both simulations and hand-held experiments.	PO5	C5, P2	P1		K6	R, Q, T
CO3	Becoming proficient in **discussing** the behavior of different electronic circuits by **performing** as a group in projects and presentations.	PO9	A2, P4	P1, P3	-	-	PR, Pr

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

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

ASSESMENT STRATEGY		
Components		**Grading**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1,Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 non-renewable 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	Demonstrate a deep understanding of the fundamental principles underlying the operation of electrical machines, including electromagnetism, Faraday's law, and the principles of energy conversion.	PO1	C2			1	T
CO2	Apply engineering knowledge to identify, formulate and solve complex	PO2	C3			3	T, Midterm, F

	engineering problems of electrical machines, including transformers, and DC machines.						
CO3	Developing potentiality in analyzing the uses of starter circuits and control circuits of different electrical machines.	PO1	C4	2, 3	1	3	F

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)
(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, polarity of transformer windings, vector group, parallel operation of transformers, auto transformer, instrument transformers, 3- phase transformers, different connection and their applications, harmonic suppression in three phase transformer.
Renewable energy: Introduction to wind turbine generators and solar cells.

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**
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.)**
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.)**
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 & DC Motor Starter Circuit Analysis
Class 26	Loss related mathematical problems
Class 27	Loss related mathematical problems (Cont.)
Week 10	**DC Motor (Cont.)**
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 the 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, Auto transformer , Instrument transformers
Class 38	Three phase transformer
Class 39	Mathematical Problems
	Renewable Energy
Week 14	Introduction to Renewable energy
Class 40	Solar cell, solar PV system
Class 41	Review class
Class 42	Parallel operation of transformer, Auto transformer , Instrument transformers

ASSESSMENT STRATEGY		
Components		**Grading**
Continuous Assessment (40%)	Class Test/Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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: Energy Conversion -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	U**nderstand** the fundamental principles of electromagnetism, mechanics, and mathematics necessary for the analysis and design of AC machines.	PO1	C1	1		1	T, F
CO2	**Acquisition** of specialized knowledge in the operation, performance, and	PO2	C1	1		3	Mid Term, F

	control of AC machines, including induction motors, synchronous motors, and alternators.						
CO3	Ability to **analyze** complex engineering problems related to AC machines, including torque-speed characteristics, efficiency calculations, and voltage regulation.	PO3	C3	2		5	ASG

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain)
(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.
Induction Generator: operation, characteristics, voltage build up, applications in wind turbine.
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.

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)**
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	Induction generator & Mathematical problems
Week 4	**Parallel operation of Synchronous Generator**
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)**
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.
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)**
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
Continuous Assessment (40%)	Class Test/Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE-206	Lecture Contact Hours	: 3.00
Course Title	: Electrical Machine Laboratory	Credit Hours	: 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 **measure** the voltage regulation and efficiency of electrical machine, like transformer, alternator, dc motor etc. and **justify** these characteristics under various loading condition and **compare** the starting and operating characteristics of various induction machines.	PO9	P3, A3				T, Class performance, R
CO2	Be able to **explain** and **apply** the characteristics of electrical machines like dc generator, dc motor, alternator, synchronous motor etc.	PO5	C3, P1	P1,P2,P3		6	T, Class performance, R
CO3	Be able to **perform** project-task and **design** electrical-machine **adapting** to requirement.	PO10	A4, P5	P1,P2,P3		7	PR

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

(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.

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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 **analyze** the operation of op amp in mathematical and filtering circuits applications and **determine** different performance parameters of feedback circuits, oscillators.	PO2	C4		1,2,3	1-4	T, Mid Term, F
CO2	Be proficient to **calculate** the output power, efficiency and frequency response of power amplifiers.	PO1	C3		1,2,3	1-4	T, Mid Term, F
CO3	Be skillful in **designing** bode plots of various electronic circuits and **analyzing** the stability effect of feedback on amplifier	PO1	C6		1,2,3	1-4	T, Mid Term, F

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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 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
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**
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**
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
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
Continuous Assessment (40%)	Class Test/Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: EECE 208 : Electronic Circuits & Simulation Laboratory II	Contact Hours Credit Hours	: 3.00 : 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 experiment, 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 **explaining** the difference between the data achieved by hardware and software approach.	PO5	C4 , P1	1,2,3		6	R,Q,T
CO2	Be skillful to **design** various electronic circuits using predetermined requirements and also to **evaluate** unprecedented situations implementing theoretical ideas.	PO5	C5 , P6	1,2,3		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	A5 , P4				PR, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	12
Experiment	30
Self-Directed Learning	24
Preparation of Lab Reports	06
Preparation of Lab-test	06

Preparation of Quiz Preparation of Presentation Engagement in Group Projects	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.	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
Continuous Assessment (40%)	Lab participation and Report	20%
	Lab test- 1, Lab test- 2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 is 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-efficient 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	**Apply** different numerical techniques through an industrially used numerical analysis tool (MATLAB/Python) to solve engineering and scientific problems that involve the application of numerical techniques.	PO1	C3	P1, P3		K2, K3	Lab Tests
CO2	**Apply** interpolation formula to select new data points, **create and evaluate** mathematical problems considering real life scenario with numerical calculus and **select** the most suitable numerical equation solving technique for a particular linear or nonlinear system.	PO5	C3, C5, P5	P1, P2		K6	Lab Tests
CO3	**Adapt** ethical principles of engineering practices during the progress of assigned projects that involve the hands-on application of numerical techniques and additionally, **evaluate** the ethical conduct of team members.	PO9	A3, P6	P1, P2, P3		-	Project Evaluation Report, Quiz Test

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

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)
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.
Week 3	Curve Fitting using Linear Regression, Polynomial Regression and Linearization of Non-linear Relations
Week 4	Numerical Differentiation Using Forward Difference, Backward Difference, Richardson's Extrapolation and Stirling's Interpolation Formula
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
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
Week 8	Solution to a Single Non-linear Equation using Bisection Method, False Position Method, Newton-Raphson Method, Secant Method
Week 9	Solution to a System of Non-linear Equations using Newton-Raphson Method
Week 10	Solutions to Linear Ordinary Differential Equation Using Euler's Method and Improved Euler's Method
Week 11	Solution to Non-linear Ordinary Differential Equation Using Modified Taylor's Series and Runge Kutta Method
Week 12	Solution to Linear Partial Differential Equation Using Finite Difference Method and Finite Element Method
Week 13	Lab Test-II
Week 14	Lab Quiz

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (40%)	Lab participation and Report	30%
	Labtest-1,Labtest-2	30%

Presentation	10%
Lab Quiz	30%
Total Marks	100%

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	**Understand** 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	C1			1	Quiz, Assignment
CO2	**Explain** fundamental laws governing electromagnetic fields to determine						Mid, Quiz, Final

	different properties (Field intensity, Flux density etc.) and **analyze** the boundary value problems by interpreting electric and magnetic fields in different material media.	PO1	C4	1		3	
CO3	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, Final

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

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**
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**
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	Capacitance- electrostatic energy and forces
Class 15	Capacitance calculation of different geometries
Week 6	**Steady Electric Currents**
Class 16	Electrostatic energy and forces
Class 17	Poisson‘s and Laplace‘s equation
Class 18	Poisson’s and Laplace’s equations in different co-ordinate systems.
Week 7	**Steady Electric Currents**
Class 19	Boundary- value problems
Class 20	Methods of images
Class 21	Current density and ohm‘s law
Week 8	**Steady Electric Currents**
Class 22	Equation of continuity
Class 23	Power dissipation and Joule‘s law
Class 24	Resistance Calculation
Week 9	**Static Magnetic Fields**
Class 25	Fundamental Postulates
Class 26	Vector magnetic potential
Class 27	Biot-Savart Law, Magnetic dipole, Magnetization
Week 10	**Static Magnetic Fields**
Class 28	Boundary conditions, Inductances and Inductors
Class 29	Magnetic field intensity, Relative permeability, Magnetic energy
Class 30	Magnetic forces and Torques
Week 11	**Time-Varying Fields**
Class 31	Faraday‘s law of electromagnetic induction
Class 32	Maxwell‘s equation
Class 33	Potential functions, Time-harmonic fields
Week 12	**Time-Varying Fields**
Class 34	Maxwell‘s equation in differential and integral forms
Class 35	Transverse electromagnetic wave
Class 36	Plane waves in lossless media with application
Week 13	**Plane Electromagnetic Waves**
Class 37	Poynting theorem and EM lower flow
Class 38	Plane waves in lossy media with application

Class 39	Group Velocity, Poynting vector
Week 14	**Plane Electromagnetic Waves**
Class 40	Polarization of plane wave
Class 41	Instantaneous and average power densities
Class 42	Normal and oblique incidence of plane waves at plane boundaries for different polarization

ASSESSMENT STRATEGY		
Components		Grading
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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

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

PRE-REQUISITE
None
CURRICULUM STRUCTURE
Outcome Based Education (OBE)
SYNOPSIS/RATIONALE
This course establishes a fundamental understanding of electrical services and equipment. It fosters a deeper comprehension of the various challenges encountered during the design, installation, and maintenance of electrical systems. By engaging in this course, students will refine their engineering judgment and cultivate confidence in addressing practical electrical problems.
OBJECTIVE
1. To impart 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	Proficient in designing electrical services packages in a building and able to draw the fittings and fixtures layout with conduit connections using commercially available AutoCAD tool.	PO4	C6 P5	1, 2,3		8	PR, R, Pr
CO2	Possesses the ability to comprehend the national and international codes and standards in building electrical services design to ensure the public health, safety and societal issues.	PO6	C3 A4	1, 2, 5		7	PR, R, Pr
CO3	Adapt smart electrical amenities for comfort as a sustainable building service solution considering the societal and environmental context.	PO7	C3 A4	1, 2, 4	3	7	PR, R,Pr
CO4	Be able to apply engineering ethical principles in building service design according to national and international guidelines and standards.	PO8	C3 A4	-	-	7	PR, R, Pr
CO5	Communicate with team members in designing the building services solutions and present effectively.	PO10	P5, A4	-	1,2		PR, R, Pr
CO6	Be proficient in using modern computer-aided design (CAD) tools to propose effective electrical service solutions and comprehend and assess practical service design technologies by inspecting a modern building.	PO12	A3 P5	-	-	-	R, Pr, VP

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain
CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile, T – Test; PR – Project; Q – Quiz; ASG – Assignment; Pr – Presentation; R - Report; F – Final Exam, VP- Video Presentation)

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.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	28
Experiment	28
Self-Directed Learning	
Preparation of Lab Reports	30
Preparation of Lab-test	5
Preparation of Quiz	5
Preparation of Presentation	5
Engagement in Group Projects	24
Formal Assessment	
Continuous Assessment	14
Final Quiz	2
Total	141

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	Preparation of conduit layout of residential, Industrial and commercial building.
Week 6	Lighting load Calculation, External lighting and external area electrification.
Week 7	Cable specifications, Low voltage and essential power distribution inside building, Design of substation using Single Line diagram.
Week 8	Electrical load calculation and Preparation of Bill of Quantities.
Week 9	Telephone and Paging system, CCTV, TV-Transmitter antenna signal distribution.
Week 10	Fire detection & alarm system. Earthing, lightning protection and incorporation of Solar Power
Week 11	Earthing, lightning protection and incorporation Solar Power to Electrical Distribution System.
Week 12	Modern smart devices for improvements of comforts and home security.
Week 13	Project Presentation
Week 14	Lab Test and Quiz Test

ASSESSMENT STRATEGY

<table>
<tr><th colspan="2">Components</th><th>Grading</th></tr>
<tr><td rowspan="2">Continuous Assessment (40%)</td><td>Lab Quiz</td><td>20%</td></tr>
<tr><td>Lab Test</td><td>20%</td></tr>
<tr><td colspan="2">Project</td><td>60%</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td></tr>
</table>

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.**

5.1.15. 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	**Understand** the properties of different continuous time signals and **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	C2, C4	1,2,6		1-4	T, Mid Term Exam, F
CO2	**Apply** appropriate analyzing technique of system to **design** solution of electrical system, control system and communication system.	PO3	C3,C6	1,3,6		5	T, Mid Term Exam, F
CO3	**Design** an analogy between electrical and mechanical system and then **justify** the use of this analogy in finding response of mechanical system.	PO3	C6, A5	1,6,7		5	ASG, F

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

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**
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**
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.**
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**
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Analyze** the structure and behavior of different types of combinational and sequential digital logic circuits	PO1	C4	1,2 ,6		1-4	T, F
CO2	**Identify** the requirements of physically implementing digital electronic circuits, different logic technologies and memory circuits using Verilog, FPGA and PCB design tools	PO5	C1, P1	1,3 ,7		6	Mid Term, F
CO3	**Design** combinational and sequential logic circuits with practical constraints using Verilog	PO3	C6, A3	1,2 ,3		5	Mid Term Exam, F, ASG

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain, 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. Introduction to Verilog Hardware Description Language programming and structural and behavioural design of digital systems using Verilog HDL, Verilog Timing analysis and test bench, MOSFET Digital circuits: NMOS inverter, CMOS inverter, CMOS logic circuits, Clocked CMOS logic circuits, transmission gates, sequential logic circuits, BJT digital circuits: ECL, TTL, STTL, BiCMOS, Memories: classification and architecture, RAM memory cells, Read only memory, data converters, Modular combinational circuit design: pass transistor, pass gates, multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements and ALU design. Sequential circuits: latches, flip-flops timing analysis and power optimization of sequential circuits. Modular sequential logic circuit design: shift registers, counters and their applications. Asynchronous and

synchronous sequential circuits. Dual Inline Packaged and Surface Mount Device (SMD) Integrated Circuits, Introduction to System Integration and Printed Circuit Board design, Design of a Simple-As-Possible (SAP) computer: SAP-1, selected concepts from SAP-2 (jump, call, return).	
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**
Class 1	Introduction to Number Systems and codes
Class 2	Introduction to Boolean algebra
Class 3	Introduction to Verilog HDL
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**
Class 10	Programming and structural and behavioral design of digital systems using Verilog HDL
Class 11	Verilog Timing analysis and test bench.
Class 12	Verilog synthesis with combinational logic
Week 5	**Combinational Circuit Design**
Class 13	Introduction to Combinational Logic and Discussion on Design procedure.
Class 14	Adders and subtractors.
Class 15	ALU design
Week 6	**Modular combinational circuit design**
Class 16	Implementation of multiplexer and demultiplexer in CMOS.
Class 17	Decoder and encoder.
Class 18	Related Mathematical problems
Week 7	**Combinational Circuit Design**
Class 19	NMOS inverter, CMOS inverter, CMOS logic circuits
Class 20	Clocked CMOS logic circuits, transmission gates
Class 21	Modular combinational circuit design: pass transistor, pass gates, and their implementation in CMOS
Week 8	**Modular combinational circuit design**
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**
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	**Asynchronous and synchronous sequential circuits**
Class 37	Introducing State Machine Design, State Minimization, Mille and Moore type state machine
Class 38	design of simple FSM using Verilog
Class 39	Design of a Simple-As-Possible (SAP) computer: SAP-1, selected concepts from SAP-2 (jump, call, return)
Week 14	
Class 40	Dual Inline Packaged and Surface Mount Device (SMD) Integrated Circuits,
Class 41	Introduction to System Integration and Printed Circuit Board design,
Class 42	Memories: classification and architecture, RAM memory cells, Read only memory

ASSESSMENT STRATEGY		
Components		**Grading**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	**Construct** Verilog programs and logic circuits for solving problems related to digital electronics, understanding the practical limitations	PO9	P3	1, 2, 3		6	R,Q,T
CO2	**Work** effectively as an individual and as a team member towards the successful completion of the project	PO9	P4, A2				R,Q,T
CO3	**Design** a digital system to solve a relevant problem with due considerations to public health and safety, societal, cultural and environmental consideration and **report** effectively on the design with presentation, user-manual and detailed report	PO10	P6, A3		A1, A3		PR, Pr, Q

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

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 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 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
Continuous Assessment	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Project and Presentation		25%
Total Marks		100%

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 compare different transmission line models of a power system and assess different performance parameters for power system operation and analysis.	PO1	C3	1,2,3	-	2-4	MT, F
CO2	Be proficient in analyzing power flow study problems and formulate best solution algorithms using load flow methods considering technical constraints.	PO2	C4	1,2,3	-	2-4	F, ASG
CO3	Able to design power system networks that adapt to specific constraints and requirements, including those relevant to fault analysis.	PO3	C5, A4	1,3,4	-	5	F, ASG

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

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**
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**
Class 10	Theoretical analysis of long transmission lines (Rigorous method), Reflected and Transmitted wave (practical and lossless transmission lines).
Class 11	Mathematical Problems based 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, Behaviour of interconnected power system, Parameters affecting real and reactive power flow, classification 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.
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.
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.
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	Adept in hands-on learning of power system tools and able to **compute** the power flow, power drop, and voltage regulation of different system conditions.	PO5	P5, C3	1, 2, 3	-	K 5	LT, PR
CO2	Be able to **describe** the characteristics of a power system and **demonstrate** the public health, societal, and safety issues of a power system network.	PO6	C3, A5	1, 2, 4	-	K 7	PR
CO3	Be able to design the power system network with appropriate parameters and investigate its environmental and sustainability with international standards.	PO7	C3, A5	1, 2, 3	-	K 7	PR
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain, 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.	
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
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
Continuous Assessment (40%)	Lab Participation and Report	15%
	Lab test	25%
	Project and presentation	20%
Lab Quiz		40%
Total Marks		100%

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 Systems I
Level-3 Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 309	Lecture Contact Hours	: 3.00
Course Title	: Communication Systems 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	**Understand** and **compare** the basic differences between analog and digital communication system and **outline** the characteristics of various types of noises by **estimating** the channel capacity.	PO1	C2			1	Q, F
CO2	**Analyze** different analog and digital modulation methods and transmission schemes lines various components of communication system and **apply** the knowledge of mathematical and electrical principle to study the performance parameters.	PO2	C4	1		2	Q, Mid Term, F
CO3	**Explain** different methods of multiplexing and multiple access techniques and **solve** related mathematical and design problems.	PO1	C3	1		2	Q, Mid Term, F

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

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 Basics**
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**
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**
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)**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Systems ILaboratory
Level-3 Term-II (Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 310 : Communication Systems I Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
Course Code: EECE 309 Course Title: Communication Systems 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	**Implement** the circuits to understand the analog and digital modulation techniques and **explain** the characteristics of the waveforms.	PO5	C3			1	R,Q,T
CO2	**Analyze** the characteristics of sampled and reconstructed signals and c**ompare** different multiplexing techniques by physically implementing the circuits.	PO9	C4	1		1	R,Q,T
CO3	**Design** and solve complex problems as real life project in group and evaluate the solution in terms of performance parameters.	PO10	C6	2	3	2	R, T, Pr, PR

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

TEACHING LEARNING STRATEGY

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

Lecture Experiments	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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		
Total Marks		100%

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	**Apply** fundamental techniques of discrete time signals and systems to address a range of engineering problems in both time and frequency domains.	PO1	C3	P1, P3		K1, K3	Term Final Exam
CO2	**Identify** suitable signal transformation methods, to **analyze** a challenging engineering problem and **formulate** conclusions of the problem.	PO2	C4	P1, P3		K1, K3, K4	Term Final Exam
CO3	**Design** digital filters in alignment with specified requirements and **evaluate** their performances.	PO3	A3, C5	P1, P3		K5	Assignment, Class Test

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

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 Discrete Time Signals and Systems**
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.)**
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.)**
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.)**
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	**Apply** fundamental theories and techniques associated with diverse discrete-time signals and systems to **analyze** the signals using software tools like MATLAB and **select** the appropriate method to solve a practical problem in digital domain.	PO5	C3, C5, P5	P1, P3		K6	Lab Tests
CO2	**Analyze** experimental results with theoretical solutions, involving the research to interpret the data and synthesis of signal information and validate the practical outcomes of digital signals and systems in both time and frequency domain.	PO1	C4	P1, P3		K1, K2, K4	Lab Tests
CO3	**Evaluate** the performances of designed digital filters and systems with defined specifications, in order to solve a real-world complex engineering problem.	PO4	C5, P3, P6	P1, P3		K8	Project

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

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**
Continuous Assessment (70%)	Lab participation and Report	25%
	Lab Test	30%
	Project and Presentation	15%
Lab Quiz		30%
Total Marks		100%

*****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 Course Title	: EECE 313 : Electrical Measurement, Instrumentation and Sensors	Contact Hours Credit Hours	: 3.00 : 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	Ability to **define** the basics of electrical and electronic measurement equipment	PO1	C2				T, F

	and **explain** their characteristics along with different types of methods of measurement.					1,3	
CO2	**Analyze** measurement data and information with the help of study, design, and implementation and performance analysis of measurement systems.	PO2	C4	1		3	T, Mid Term Exam, F
CO3	**Evaluate**, debug and improve the operation of a measurement system to **apply** and select appropriate measurement method for engineering tasks and scientific researches.	PO3	C5	2		5	Mid Term Exam, F

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

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**
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**
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

*****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 **analyze** and measure different electrical and nonelectrical parameters by assembling measurement circuits.	PO9	C4	1		3	Lab Report, Lab Test
CO2	Achieve ability to calibrate modern measurement equipment and **explain** their accuracy and precision.	PO5	C2	1		6	Lab Report, Lab Test
CO3	Be able to **design** and **evaluate** real life project in group and verify for real world application.	PO10	C5	1,2	3	5	Pr, Project

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain, 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.
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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 crystal structures its application to a broad range of materials.	PO1	C2	1,2,3		1	T/Mid /F
CO2	Becoming adept in **solving** Schrödinger 's equation for one/two-dimensional potential barrier problem and **incorporating** the concept to design semiconductor devices.	PO3	C3, A5	1,2,3		5	PR/F
CO3	Getting in-depth knowledge to **interpret** the physics of magnetic phase transitions and superconductivity.	PO1	C5	1,2,3		3	T,/F

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

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**
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**
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE 317	Contact Hours	: 3.00
Course Title	: VLSI I	Credit Hours	: 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 or digital circuit using NMOS, CMOS and other circuit families.	PO1	C2	1,2,3		1	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.	PO2	C2	1,2,3		4	T, ASG, F
CO3	Be able to **design** subsystems & memory cells based on design constraints such as power, delay, speed, size and draw the stick diagram & layout **maintaining** the design rules.	PO3	C6, A5	1,2,3		5	T, Mid Term, ASG, F

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

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	
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	
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	
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	
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%

	Mid term	10%
Final Exam		60%
Total Marks		100%

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 this 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 **execute** simulations using suitable CAD tools.	PO5	C3 , P4	1,2, 3		6	R,Q,T
CO2	Be able to adapt and adhere to CMOS technology-specific layout rules in the placement and routing of transistors and **practice** different combinational and Sequential circuits using hardware description language - Verilog HDL and **design** circuit simulation tools to validate	PO10	A6, P6		1,2		R,Q,T

	the theoretical prediction of circuit performance using a very challenging yet realistic device model.						
CO3	Be able to **perform** and **contribute** as a team in a group on a comprehensive industry-standard project to collaborate with Bangladesh's semiconductor companies	PO9	A2, P4				PR, R, Pr

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

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
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 330: Industrial Training
Level-3, Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE 330	Contact Hours	: 2.00
Course Title	: Industrial Training	Credit Hours	: 1.0

PRE-REQUISITES

-

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Industrial training is a crucial component of electrical engineering education as it provides students with practical skills, industry exposure, and a real-world context for the theoretical knowledge they acquire in the classroom. This combination of theoretical understanding and practical experience prepares them for successful careers in the field of electrical engineering. In this industrial training course, students typically engage in a variety of activities including hands-on technical tasks, project work, and exposure to industry practices. They may work on real-world projects, operate equipment, troubleshoot electrical systems, adhere to safety protocols, and gain practical experience in applying theoretical knowledge to solve industry-specific challenges. Additionally, students often interact with professionals, participate in teamwork, and develop essential skills for their future careers.

OBJECTIVE

1. To expose students to the 'real' working environment and get them acquainted with the organization structure, business operations, and administrative functions.
2. To have hands-on experience in the students' related field so that they can relate and reinforce what has been taught at the university.
3. To promote cooperation and to develop synergetic collaboration between industry and the academy.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	To be able to **contribute as an effective team member** in an industrial set-up	PO9	A2				R,Pr
CO2	To be able to **communicate** effectively by writing training reports and Presentation	PO10	A2		1,2		R,Pr
CO3	To be able to **identify** the need for and have preparation and ability for lifelong learning	PO12	A2				R,Pr
CO4	To be able to **prepare** environmental and sustainability status report of the industry	PO7	A3	1,2,3		**7**	R,Pr
CO5	To be able to **demonstrate** professional ethics in industrial context	PO8				**7**	R,Pr
CO6	To be able to **identify** Hazards and risks in the industry	PO6	A3	1,2,3		**7**	R,Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain, 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 engage in a variety of activities including hands-on technical tasks, project work, and exposure to industry practices.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Industrial Visit Training	 48 48
Self-Directed Learning Preparation of Reports Preparation of Presentation	 20 10
Formal Assessment Continuous Assessment Final Presentation	 15 1
Total	142

TEACHING METHODOLOGY

Lecture followed by industry visit and hands-on training

<table>
<tr><th colspan="3">COURSE SCHEDULE</th></tr>
<tr><td>Week 1</td><td colspan="2">Industry Orientation and Hands-on training</td></tr>
<tr><td>Week 2</td><td colspan="2">Hands-on training</td></tr>
<tr><td>Week 3</td><td colspan="2">Hands-on training</td></tr>
<tr><td>Week 4</td><td colspan="2">Report Writing and Presentation</td></tr>
<tr><th colspan="3">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th></tr>
<tr><td rowspan="2">Continuous Assessment (40%)</td><td>Performance Report</td><td>30%</td></tr>
<tr><td>Attendance</td><td>10%</td></tr>
<tr><td colspan="2">Presentation and Report</td><td>60%</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td></tr>
<tr><th colspan="3">TEXT AND REFERENCE BOOKS</th></tr>
<tr><td colspan="3"></td></tr>
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*****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 Course Title	: EECE 401 : Control System I	Contact Hours Credit Hours	: 3.00 : 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	**Apply** the control system principles to solve problems relevant to the time and frequency domain operation	PO1	C3	1,2		3	T,Mid,F
CO2	**Analyze** the control system engineering problems related to real-life applications based on the underlying principles	PO2	C4	1,2		3	T,Mid,F
CO3	**Design** control systems such that specified performance characteristics are attained.	PO3	C4	1,2, 3		5	F
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.

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 Control System**
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	**Modelling 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	**Modelling 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	**Modelling in the Time Domain**
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 1st and 2nd 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 1st and 2nd order system.
Week 6	**Reduction of Multiple Subsystems**
Class 16	Derivation of performance parameters of 1st and 2nd order system
Class 17	Analysis and Design of Gain, Transient Response and Feedback Systems of a 1st and 2nd order system.
Class 18	Signal-Flow Graphs and related Problems
Week 7	**Reduction of Multiple Subsystems**
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.)**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE 402	Contact Hours	: 3.00
Course Title	: Control System I Laboratory	Credit Hours	: 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 **use** modern tools related to control system engineering and design.	PO5	C3	1,2		6	R,Q,T
CO2	Be able to **evaluate** EIA and Sustainability Impact of lab project	PO7	C6	1,2		7	R, PR,Pr
CO3	**Demonstrate** knowledge and understanding of engineering management principles and economic decision-making in control system project	PO11	A3	1,2			R,PR,Pr

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

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
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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-II (Fall)

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 establishing the theoretical foundation required for designing solid-state devices so that those can be applied for practical electronic applications and undertaking advanced research in the variety of different branches of solid-state electronic devices.

OBJECTIVE

1. Be able to understand the physics-based characteristics, operation and limitation of solid-state electronic devices.
2. Be able to understand the physical concepts behind designing any solid-state device that can be sent for practical applications.

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. Also able to **interpret** energy band diagrams.	PO1	C2, C4	P1		1,2, 3	T, Mid Term, F
CO2	Achieving capability to **apply** device physics, device operation and characteristics and summarize how device design affects performance.	PO2	C3	P1, P2		3,4	T, Mid Term, F,
CO3	Become adept in **applying** mathematical methods to **describe** solid-state electronics processes and their application to the solution of energy problems.	PO3	C3, A3	P1, P2		5	ASG, T, PR, F

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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. **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.
2. **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.
3. **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.
4. **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.
5. **Metal-semiconductor junction:** Energy band diagram of metal semiconductor junctions, rectifying and ohmic contacts.
6. **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

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**
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**
Class 10	Drift and diffusion Class
Class 11	Drift and diffusion, Generation and recombination of excess carriers
Class 12	Recombination-generation SRH formula, surface recombination
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**
Class 22	Minority and majority carrier currents
Class 23	Transient and ac conditions
Class 24	Time variation of stored charge, Capacitance
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**
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	**Introduction to Multigate FET architecture**
Class 40	Double gate MOSFET, FinFET
Class 41	Surrounding gate FET
Class 42	High-K dielectric FETs

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid-term	10%
Final Exam		60%
Total Marks		100%

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.**

5.2.1.6. EECE 407: Artificial Intelligence and Machine Learning
Level-4 Term- I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE 407 : Artificial Intelligence and Machine Learning	Lecture Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

NA

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This undergraduate course provides a comprehensive introduction to the exciting and rapidly evolving fields of Artificial Intelligence (AI) and Machine Learning (ML). Students will gain a solid foundation in the fundamental concepts and techniques that underpin intelligent systems. The course will delve into the core areas of AI, exploring topics such as search algorithms, knowledge representation, reasoning, and planning. Students will also be exposed to various machine learning approaches, including supervised learning, unsupervised learning, and reinforcement learning. This course is an excellent foundation for students interested in pursuing careers in AI and ML, or for those who simply want to understand the transformative power of these technologies.

OBJECTIVE

1. To understand the fundamentals of AI and machine learning algorithms.
2. To be able to implement AI-based algorithms to solve real-life problems.
3. To analyze various challenges in implementing machine learning and deep learning algorithms.
4. To design machine learning and deep learning algorithms to solve real-life applications.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Understand the fundamentals of AI and machine learning algorithms and analyze real-life challenges in implementing supervised and unsupervised learning algorithms.	PO2	C3	1,2,3	-	K1-K4	F, Mid
CO2	Design deep learning models suitable for performing classification tasks.	PO3	C4, A5	1,2,3	-	K5	ASG/Pr
CO3	Investigate real-life problems by designing suitable AI-based algorithms and applying knowledge of regression analysis for effective recommendation.	PO4	C6, P6	1,3,5	-	K8	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 to Artificial Intelligence (AI): perception and intelligence, history; intelligent agents, algorithms in AI; ethical AI. Search and Optimization: graph search, uniform search, heuristic search, adversarial search, local search with constraint satisfaction. Logical Intelligence: logical agents, propositional logic, syntax, semantics, logical statement, first-order logic.
Introduction to Machine Learning: supervised, unsupervised, and reinforcement learning; components of the learning problem. Data mining and statistical pattern recognition. Learning models: linear classification and linear regression; extending linear models through nonlinear transforms, logistic regression, maximum likelihood, and gradient descent. Supervised learning: parametric/non-parametric algorithms; support vector machines; kernels. Unsupervised learning: clustering; dimensionality reduction; recommender systems.
Deep learning and neural networks: multi-layer perceptron, backpropagation; convolutional networks; recurrent networks; attention mechanism and transformers. Best practices in machine learning:

bias/variance theory; hyperparameter tuning. Case studies and applications.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	48 94
Self-Directed Learning	05
Formal Assessment	147
Total	

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week 1	Introduction to AI and machine learning, history of AI. Intelligent agent: perception and intelligence, rational agent, reflex agent, problem-solving agent. Ethical AI and biases.
Week 2	Search and Optimization: graph search, tree search, uniform search strategies, breadth-first search, depth-first search, bidirectional search. Heuristic search: greedy search, A* search;
Week 3	Local search with constraint satisfaction; adversarial search. Logical intelligence: logical agents, knowledge based agents.
Week 4	Propositional logic, syntax, semantics, logical statement, truth table enumeration, first order logic.
Week 5	Supervised, unsupervised and semi-supervised learning, reinforcement learning, components of the learning problem, relationship between in-sample and out-of-sample, K-nearest neighbour classifier.
Week 6	Introduction with unsupervised learning, K-means clustering, hierarchical clustering, clustering evaluation. Dimensionality reduction, feature extraction, principle component analysis, feature selection: filtering and wrapper method.
Week 7	Introduction to linear classification and linear regression, extending linear models through nonlinear transforms.
Week 8	Parametric/non-parametric algorithms, support vector machines, introduction to kernels.
Week 9	Introduction to logistic regression, maximum likelihood, gradient descent, recommender systems.
Week 10	Introduction to data mining, statistical pattern recognition.
Week 11	Multi-layer perceptron, backpropagation, convolutional neural networks.
Week 12	Recurrent networks, attention mechanism, augmentation, and transformers.
Week 13	Bias/variance theory, hyperparameter tuning, segmentation architecture.
Week 14	Case studies: application of learning algorithms to building smart robots (perception, control), computer vision, medical informatics, voice/audio, image database and other areas.

ASSESSMENT STRATEGY

Components		**Grading**	**CO**	**Bloom's Taxonomy**
Continuous Assessment (40%)	Class Test & Assignment 1-3	20%	CO2	C4, A5
	Mid term	15%	CO3	C5, P6
Final Exam		60%	CO 1	C6
			CO 2	C4,
Total Marks		100%		

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

TEXT AND REFERENCE BOOKS

1. Artificial Intelligence: A Modern Approach by Stuart Jonathan Russell and Peter Norvig.
2. Kernel Methods and Machine Learning by Sun Yan Kung
3. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville.
4. Artificial Intelligence: A New synthesis by Nils J. Nilsson.
5. Pattern Recogntion and Machine Learning by Christopher M. Bishop.
6. Introduction to Machine Learning, Second Edition by Ethem Alpaydin
7. Online resources or supplementary materials will be shared with the class on a need basis

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

5.2.1.7. EECE 408: Artificial Intelligence and Machine Learning Laboratory
Level-4 Term- I (Spring)

COURSE INFORMATION			
Course Code Course Title	: EECE-408 : Artificial Intelligence and Machine Learning Laboratory	Contact Hours Credit Hours	: 2.0 : 1.0
PRE-REQUISITE			
Course Code: EECE 407 Course Title: Artificial Intelligence and Machine Learning			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course offers a hands-on introduction to Artificial Intelligence (AI) and Machine Learning (ML). Through a mix of lectures, labs, and projects, students will build a strong understanding of the core concepts and techniques of AI and machine learning in supervised, unsupervised learning, and reinforcement learning used to create intelligent systems.			
OBJECTIVE			
1. To perform experiments in relevance with the theoretical concepts of the course EEE 401: Artificial Intelligence and Machine Learning. 2. To conduct design projects in order to achieve specific program outcomes described in the Course Outline.			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Analyze** real life challenges in implementing supervised and unsupervised learning algorithms	PO 3	P1,P2,P3	C2		K1	Lab Performance Lab Report Lab Test Quiz
CO2	**Solve** real-life problems by using AI and machine learning based algorithms	PO 4	P4,P2,P3	C3, P1		K3	Lab Performance Lab Report Lab Test Quiz
CO3	**Demonstrate** knowledge and understanding of engineering management principles and economic decision-making in control system project	PO11	P1,P2,P3	C3		K2	Lab Performance Lab Report Lab Test Quiz
CO4	**Demonstrate** application of ethical principles and practices in the project, and **evaluate** peer team members ethically	PO 8	P1,P2,P3	A3		K7	Peer evaluation, Report
CO5	work effectively as an individual and as a team member towards the successful completion of the project	PO 9	P1,P2,P3	P4			Viva, Peer evaluation
CO6	**Report** effectively on the design done forCO4 with presentation, user-manual and detailed report	PO 10	P1,P2,P3	A3		A2,A3	Video Presentation Project Report

(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.	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
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 Engagement in Group Projects	 9 4 5 5 10
Formal Assessment Continuous Assessment Final Examination	 14 1
Total	90
TEACHING METHODOLOGY	
Lecture followed by practical experiments and discussion, Co-operative and Collaborative Method, Project Based Method	
COURSE SCHEDULE	
Week 1	Overview on lab experiments, projects, policies, grading; group formation Introduction to fundamentals of AI and ML and their major applications
Week 2	Introduction to Python programming. Implementation of Python basic libraries
Week 3	Performing basic tasks using Python programming, data handling, statistical operations, data reshaping, filtering, merging, handling missing values. Implementation of basic AI operations
Week 4	Implementation of Breadth First Search (BFS), A* Search and Tree Search algorithm
Week 5	Implement BFS in Tic-Tac-Toe problem or Robot Grid Movemen
Week 6	Project Design Presentation
Week 7	Lab Test- 1
Week 8	Implementation of KNN and Kmeans algorithm and test with a dataset.
Week 9	Implementation of linier regression and logistic regression algorithms and test with a dataset.
Week 10	Implementation of support vector machine algorithm and test with a dataset.
Week 11	Implementation of simple convolutional neural network (CNN) architecture and test with a dataset.
Week 12	Lab Test-2
Week 13	Project Demonstration: Demonstrate the project, team and individual contribution and ethical principles applied to the design. Use multimedia and necessary documentation (user manual, video demonstration and project report) to clearly communicate the project
Week 14	Quiz and Viva

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

TEXT AND REFERENCE BOOKS

1. Artificial Intelligence: A Modern Approach by Stuart Jonathan Russell and Peter Norvig.
2. Kernel Methods and Machine Learning by Sun Yan Kung
3. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville.

5.1.32. EECE 473: Power Electronics
Level-4 Term-I/II (Spring/Fall)

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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.	
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)
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.
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.
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

*****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 LT spice 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	1		1,6	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	1		1,7	R,T
CO3	Collaborate effectively with peers in laboratory exercises and projects, fostering teamwork, communication and interpersonal skills essential for professional engineering practice.	PO8	P3			1,7	PR, Pr

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

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 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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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

5.1.34. EECE 409: Communication Systems II
Level-4 Term-I/II (Spring/Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 409 : Communication Systems II	Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

Course Code: EECE 309
Course Title: Communication Systems 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 **infer** the basic ideas of optical fiber and satellite communication system**.**	PO1	C5			3	T, F, Pr

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

Baseband digital transmission, Limitations, Pulse shaping, Repeaters, Pulse equalization techniques, AWGN channel model, bit error rate of a baseband transmission system, channel capacity theorem.
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

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	**Topic**
Class 1	Overview on digital modulations
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	
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	
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	
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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

This course teaches students how to design complete solutions for electrical engineering problems. Students will use their existing knowledge to create new products or services, test them thoroughly, and evaluate them throughout the development process. The course also aims to improve students' leadership skills in managing technical projects and prepare them to contribute to the advancements of the fourth industrial revolution.

OBJECTIVE

1. Develop research questions in the broader area of electrical engineering.
2. Craft solutions to research questions and
3. Evaluate the effectiveness of proposed solutions.
4. Benchmark results against current scientific advancements.
5. Consider the professional, ethical, and societal implications of your solutions.
6. Employ effective project management practices during research.
7. Foster student leadership through teamwork.
8. Sharpen communication skills through presentations 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	Analyze and identify the requirements to solve a problem by doing an extensive literature survey, objective specifications, and methodology.	PO2	C2	K1-K4	1-7	-	PR

CO2	Design a complex engineering solution that is solvable using a systematic approach to research in the relevant study area.	PO3	C5, A4	K5	1-7	2	PR, PPr
CO3	Investigate multiple methods of the solution to select the most apt method, and evaluate the outcomes by comparing with the objectives, and do obligatory modification based on performance evaluation.	PO4	C6, P6	K8	1-7	-	FR, FPr
CO4	Utilize sophisticated engineering tools to design, simulate, and validate the outcomes of the research.	PO5	P5,C3	K6	1-7	-	FD
CO5	Evaluate the problem and the solution methodology in terms of the impact on engineering society and the environment.	PO7	C3,A5	K7	1-7		IAR
CO6	Possesses the ability to comprehend the national and international codes and standards in designed study problems to ensure public health, safety, and societal issues.	PO6	C3, A5	7	1-7		IAR
CO7	Justify whether the conducted research is ethically conflicting with the engineering and professional principles and incorporate the solutions.	PO8	C3,A5	K7	1-7		ER
CO8	Function effectively as a team member in various stages of research work.	PO9	P5,A5	-	-		PPr, FPr, FD
CO9	Communicate and coordinate with other team members to develop the necessary documentation of different research stages such as reports, presentations, etc.	PO10	P5,A5	-		1-5	FPr, PPr
CO10	Understand proper project management, development of economic analysis of the research and budget estimation.	PO11	C2,P2	-	-	-	PR, Fr
CO11	Verify the designed problem's technological, geographical, and cultural adaptation in the broader context.	PO12	A5,P6	-	-	-	FPr,FD,VP

(CP- Complex Problems, CA-Complex Activities, KP-Knowledge Profile; Proposal Report -PR, Progress Presentation – PrP, Thesis Book/Final Report – TB/FR, Final Presentation – FPr, Final Demonstration-FD, Impact Analysis Report-IAR, Ethics Report -ER, Video Presentation (VP)

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).

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 Project work/Simulation practice at Lab Preparation of report and presentation and demonstration	 84 84 40

Formal Assessment Demonstration Presentation	 3 3
Total	270
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method	
ASSESSMENT STRATEGY	

Assessment Items/tool	Allocated marks	Percentage	Individual Assessment	Group Assessment
Proposal Report	125	21 %	60	65
Progress presentation and demonstration	100	16.5 %	50	50
Thesis book	125	21 %	-	125
Final Presentation and Demonstration	150	25%	150	
Ethics Report, Impact Analysis Report, Video presentation	100	16.5%	40	60
	600	100%	300 (50%)	300 (50%)

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	: EECE 471	Contact Hours	: 3.00
Course Title	: Power System II	Credit Hours	: 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, A5	1,2,4		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	C3	1,2,4		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	1,2,3		4	Mid Term

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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 insulators, 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.

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 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**
Class 4	Transmission line components, Types of insulators
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
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
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**
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
Continuous Assessment (40%)	Class Test & Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE 475	Lecture Contact Hours	: 3.00
Course Title	: Power Plant Engineering	Credit Hours	: 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. Capable 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	Explain the layout and summarize the principles of operation of various power plants.	PO1	C2	1,2,5		1-4	T, Mid, F
CO2	Identify the suitable locations for different power plants and demonstrate the installation, maintenance cost and the sustainable environmental impact of these plants.	PO7	A3	1,2,5		7	T,F
CO3	Justify professional ethics to build different types of power plants from fossils and provide the alternative solutions.	PO8	A5			1-4	ASG

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

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**
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**
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**
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**
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Anne**

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 Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Be able to **analyse** and **demonstrate** the basic operating principles, protective measures and **interpret** specifications and limitations of	PO1	C4	1,2, 3		3	T, Mid Term, F

	various protective devices of different units.						
CO2	Developing potential to **compare** the functions of different protective devices.	PO2	C2	1,2, 3		3	T, Mid Term, F
CO3	Attaining proficiency in **designing** and **preparing** various protection schemes of generation, transmission and distribution networks on both sides	PO3	C6,A3	1,3, 4		5	F,ASG

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

TEACHING LEARNING STRATEGY

	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**
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.)**
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.)**
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**
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	
Continuous Assessment (40%)	Class test/ Assignment	20%
	Class Participation	5%
	Class Attendance	5%
	Mid Term	10%
Final Exam		60%
Total marks		100%

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 faults in the system.			
OBJECTIVE			
. 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. . To provide the students hand-on experience of implementing various protective schemes for the protection of Generator, Induction motor and Transformer etc. . To enable the students to use proper protection scheme and relay considering the type and location of fault. . 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. . 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 and compare the knowledge on relay, circuit breaker, CT, PT working principles, environmental impact and protection topologies for alternators, induction motors, and transformers, and choosing the best scheme.	PO7	A3	1,2,3		7	Q,R,T
CO2	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.	PO6	A6	1,4,5		7	PR, Pr
CO3	Developing capability to **design** any project on protection system considering appropriate ratings of circuit breaker and relay coordination concept.	PO11	C6, P6			7	PR, Pr, R
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.							
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
Continuous Assessment (70%)	Lab participation and Report	25%
	Lab Test	30%
	Project and Presentation	15%
Lab Quiz		30%
Total Marks		100%

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	Analyse various reliability indices and establish probabilistic generator, load and power system equipment for reliability evaluation.	PO3	C4,A4	1,2, 5		5	F, ASG, Pr
CO2	Use the concept of failure rate, restoration times, systems redundancy and illustrate the idea in distribution system reliability analysis.	PO1	C3	1,2, 5		1-4	T, F
CO3	Understand Markov process and reliability parameters in grid reliability analysis and apply different probabilistic methods to solve reliability issues.	PO1	C3	1,2, 5		1-4	Mid Term

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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		
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**	
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**	
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**
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	Proficient in **analyzing** the economic operation of power systems in the electricity market model and able to **design** the optimum unit commitment for a power system.	PO3	C5, A4	1,2,3		5	F, ASG
CO2	Able to use the concept of power system data acquisition and control methods and illustrate the idea in power system state estimation.	PO2	C3	1,2,3		4	F, ASG

CO3	Able to understand the power system security and **i**llustrate different methods to solve the power system contingency problems.	PO1	C3	1,2,3		4	F, MT

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

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
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
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
Class 20	Contingency analysis of single and multiple contingencies 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
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
Continuous Assessment (40%)	Class Test & Assignment 1-3	20%
	Mid term	10%
	Class Attendance	5%
	Class Performance	5%
Final Exam		60%
Total Marks		100%

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 Course Title	: EECE 483 : High Voltage Engineering	Contact Hours Credit Hours	: 3.00 : 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	Apply the understanding of fundamental concepts of high voltage generation and measurement in related practical fields.	PO1	C3	1,2, 5		1-4	T, F
CO 2	Analyse the breakdown phenomenon in gases, liquids and solid insulators.	PO2	C4	1,2, 5		1-4	T, Mid Term, F
CO 3	Evaluate an insulator's performance based on quality assessment techniques and able to establish a high voltage system considering insulation coordination and over voltage protection.	PO3	C5, A4	1,2, 7		5	Mid Term, F, ASG
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.
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**
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**
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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.**

5.2.1.8 EECE 484: High Voltage Engineering Laboratory
Level-4 Term- I/II (Spring/ Fall)

COURSE INFORMATION

Course Code	: EECE 484	Contact Hours	: 3.00
Course Title	: High Voltage Engineering Laboratory	Credit Hours	: 1.50

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

Designed to complement theoretical knowledge, the High Voltage Engineering Lab course offers students practical experience in the application of high voltage principles. Through hands-on experiments and simulations, participants will delve into the intricacies of electrical breakdown, high voltage generation, and testing methodologies. Engaging with state-of-the-art equipment, students will explore measurement and analysis techniques crucial for assessing the performance and reliability of power system apparatus like cables, insulators, transformers, and generators. Emphasizing safety protocols and industry-standard practices, this lab course equips students with the skills and insights essential for real-world applications in high voltage engineering.

OBJECTIVE

1. To provide hands-on training on determining dielectric strength of solid, liquid and gaseous insulating materials.
2. To provide hands-on training on using earth tester to determine earth resistance Be able to familiarize the students with non-destructive insulation quality assessment techniques.
3. To introduce Megger and electrostatic voltmeter To design and present simple high voltage system.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO's	Bloom's Taxonomy	CP	CA	KP	Assessment Method
CO 1	**Use** modern tools to solve problems relevant to high voltage systems	PO5	P4	1,2,3		6	T, ASG
CO 2	**Measure** dielectric strength of solid, liquid, gaseous insulating materials	PO4	C5	1,2,3		8	T,R, ASG
CO 3	**Design** simple high voltage system so that specific performance characteristics are attained	PO3	C6	1,2,3		5	R, PR
CO 4	**Present** designed high voltage system	PO10	A3		1,2		PR,Pr
CO 5	Demonstrate effective **individual and team working skills**	PO9	A3				CA

(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

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 483. In the second part, students will design simple systems using the principles learned in EEE 483.

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

Weeks	Intended topics to be covered
1	**Expt-01:** Determination of dielectric (E) strength of gaseous insulating material
2	**Expt-02:** Determination of dielectric strength of liquid insulating material.
3	**Expt-03:** Determination of dielectric strength of solid insulating material
4	**Expt-04:** Determination of dielectric strength of gas by high voltage testing set with spherical electrodes
5	**Expt-05:** Determination of earth resistance using earth tester
6	**Expt-06:** Introduction of Megger and electrostatic voltmeter
7	**Expt-07:** Design simple high voltage system so that specific performance characteristics are attained.
8	**Expt-08:** No load and full load test of a three phase distribution transformer
9	**Expt-09:** Lightning impulse withstand test**.**
10	**Expt-10:** Power frequency high voltage test of transformer
11	**Expt-11:** Dielectric breakdown test of transformer oil
12	**Expt-12:** Insulation resistance test using Meggar

13	Presentation on designed high voltage system.
14	Quiz + Lab Test + Viva

ASSESSMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Lab participation and Report	15%
	Labtest	25%
	Project and Presentation	20%
Lab Quiz		40%
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

5.2.1.9 EECE 485: Energy Conversion III
Level-2, Term-II (Fall)

COURSE INFORMATION

Course Code	: EECE-485	Contact Hours	: 3.00
Course Title	: Electrical Conversion III	Credit Hours	: 3.00

PRE-REQUISITE

None

OBJECTIVE

1. To understand the basic principles of electromagnetic, electrostatic, thermoelectric, electrochemical, and electromechanical energy conversion.
2. To understand the construction and operations of acyclic machines.
3. To familiarize and understand nonconventional energy conversion.
4. To understand the construction and operations of special purpose motors and drives and their applications

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom‘s Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the basic principles of electromagnetic, electrostatic, thermoelectric, electrochemical, and electromechanical energy conversion	PO1,	C1, C2	1,2, 3		1	T/ F
CO2	**Understand** the construction of and **explain** the operations of acyclic machines: generators, conduction pump and induction pump.	PO2	C1, C2	1,2, 3		2	T/ Mid
CO3	**Apply** basic energy conversion principles to **explain** the operation of various nonconventional energy conversion systems	PO2	C1, C2, C3	1,2, 3		3	Mid/ASG
CO4	**Apply** the knowledge of electrical circuits, electronic devices, and basic energy conversion principles to **explai**n the construction and operation of special purpose motors and drives and their applications	PO3	C1, C2, C3	1,2, 3		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

Basic principles of energy conversion: electromagnetic, electrostatic, thermoelectric, electrochemical, and electromechanical.
Acyclic machines: generators, conduction pump and induction pump.
Nonconventional energy conversion: solar-photovoltaic, solar-thermal, wind, geothermal, wave and tidal energy, MHD (Magneto Hydrodynamic) systems.
Motors and drives: series universal motor, permanent magnet DC motor, brushless DC motor (BLDC), stepper motor, reluctance motor, switched reluctance motor, hysteresis motor, repulsion motor, permanent magnet synchronous motor, linear induction motor, electro static motor.

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	**Basic principles of energy conversion**
Class 1	Electromagnetic
Class 2	Electromagnetic
Class 3	Electrostatic
Week 2	
Class 4	Thermoelectric
Class 5	Thermoelectric
Class 6	Electrochemical
Week 3	
Class 7	Electrochemical
Class 8	Electromechanical
Class 9	Electromechanical
Week 4	**Acyclic machines**
Class 10	Generators
Class 11	Conduction pump
Class 12	Induction pump
Week 5	**Nonconventional energy conversion**
Class 13	Solar-photovoltaic
Class 14	Solar-photovoltaic
Class 15	Solar thermal, wind, geothermal, wave and tidal energy
Week 6	
Class 16	Solar thermal, wind, geothermal, wave and tidal energy
Class 17	Solar thermal, wind, geothermal, wave and tidal energy
Class 18	MHD (Magneto Hydrodynamic) systems

Week 7	Motors and drives
Class 19	MHD (Magneto Hydrodynamic) systems
Class 20	Series universal motor
Class 21	Series universal motor
Week 8	
Class 22	Permanent magnet DC motor
Class 23	Permanent magnet DC motor
Class 24	Brushless DC motor (BLDC)
Week 9	
Class 25	Brushless DC motor (BLDC)
Class 26	Stepper motor
Class 27	Stepper motor
Week 10	
Class 28	Reluctance motor, switched reluctance motor,
Class 29	Reluctance motor, switched reluctance motor,
Class 30	Hysteresis motor
Week 11	
Class 31	Hysteresis motor
Class 32	Repulsion motor
Class 33	Repulsion motor
Week 12	
Class 34	Permanent magnet synchronous motor
Class 35	Permanent magnet synchronous motor
Class 36	Linear induction motor
Week 13	
Class 37	Linear induction motor
Class 38	Electro static motor
Class 39	Electro static motor
Week 14	
Class 40	Review Class
Class 41	Review Class
Class 42	Review Class

ASSESMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
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.**

5.2.2 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	Comprehend the semiconductor growth techniques and their correlation with fabrication processes, considering both bulk and single crystal materials.	PO1	C5	1		3	T,Mid Term, F
CO2	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
CO3	Analyze and choose the appropriate fabrication technique for monolithic Integrated Circuit (IC) with given specification.	PO3	C5	3		5	F,ASG, Pr,R

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.	
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**
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**
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**
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**

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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Code: EECE 317	Course Code: EECE 457
Course Title: Electronics I	Course Title: VLSI I	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	Demonstrate comprehensive understanding of MOSFET physics, including principles, second-order effects, and parasitic effects, to analyze FET amplifiers, current mirrors, and differential amplifiers, while optimizing circuit performance and ensuring voltage headroom requirements are met.	PO1	C2			1	T, F
CO2	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
CO3	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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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
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
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**
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.)**
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		
Components		**Grading**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Devices
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code	: EECE 455	Contact Hours	: 3.00
Course Title	: Compound Semiconductor Devices	Credit Hours	: 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	Being capable of defining and explaining different characteristic properties of compound semiconductor materials and its advantages over prevailing materials.	PO1	C2			3	T
CO2	Being capable of **contrasting** between different types of semiconductor material junctions- homo junction	PO2	C4			4	F

	and heterojunction.						
CO3	Being capable of designing heterojunction-based upcoming electronic, optoelectronic, and photonic devices using promising compound semiconductors.	PO3	C6, A4			5	ASG

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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. Nonideal effects, frequency response, high electron mobility transistor.
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.

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**
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, basic opto-electronic properties
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.
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
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. Nonideal effects, frequency response, high electron mobility transistor.
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.
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 **maintaining** the design constraints and applying the knowledge of logical effort, RC delay modelling and interconnect delay modelling.	PO3	C6 , A5	1,2, 3		5	T, F
CO2	Be skilled enough to **evaluate** layouts of different networks complying with layout design rules and **explain** CMOS manufacturing process.	PO3	C5 , A3	1,2, 3		5	T, F
CO3	Be able to **implement** different VLSI designs using various techniques such as logic verification, silicon debug, fault modelling, test pattern generation, observability and controllability.	PO1	C3	1 , 2,3		1 - 4	Mid Term Exam, ASG, F

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

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**
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**
Class 10 Class 11 Class 12	Current Mirror Basics, CMOS Current Mirror, Example
Week 5	**CMOS Manufacturing Process**
Class 13 Class 14 Class 15	Manufacturing Issues, example, summary
Week 6	**CMOS Manufacturing Process**
Class 16 Class 17 Class 18	Layout Design Rules, Process Enhancements

Week 7	**Testing**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: EECE 458 : VLSI II Laboratory	Contact Hours Credit Hours	: 3.00 : 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 **design** schematics of multistage logic networks by applying the knowledge of CMOS design process of logic gates and finite state machines by adapting to given design specifications using latest technology tools.	PO5	C6 , P5	1,2, 3		6	R,Q,T
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	C4 , P6				PR , Pr R,
CO3	Be able to design RTL schematics of large-scale ASICs **maintaining** the design rules and **originate** physical designs from the designed RTL networks.	PO9	A5 , P6				R,PR,Q

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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 Engagement in Project Preparation of Project Presentation	 30 9 10 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**
Continuous Assessment (80%)	Lab participation and Report	25%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		20%
Total Marks		100%

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	**Describe** the fundamental physical processes of optoelectronic transitions and **apply** the concepts to define the principles of important optoelectronic devices, **compare** and **evaluate** the different device designs.	PO1	C3, C5	1,3, 6		1-4	T, Mid Term Exam, F
CO2	**Infer** modeling to **analyze** the physics behind semiconductor optoelectronic devices.	PO1	C4	1,2, 6		1-4	Mid Term Exam, F, ASG
CO3	**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.	PO3	C5	1,2, 7		5	T, F, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	**Properties of Light**
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)**
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	Being capable of defining and explaining different characteristic properties of compound semiconductor materials and its advantages over prevailing materials.	PO1	C2	1,2,3		3	T
CO2	Being capable of contrasting between different types of semiconductor material junctions- homo junction and heterojunction.	PO2	C4	1,2,5		4	F
CO3	Being capable of **designing** heterojunction-based upcoming electronic, optoelectronic, and photonic devices using promising compound semiconductors.	PO3	C6, A4	1,2,3		5	ASG

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	
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	
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	
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	
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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: Nano-electronics and Nanotechnology
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 463 : Nano-electronics and Nanotechnology	Lecture Contact Hours Credit Hours	: 3.00 : 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	1,2,3		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	1,2,3		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,P3	1,2,4		8	F

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

TEACHING LEARNING STRATEGY

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

Student-Centered 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 Nano**
Class 1 Class 2 Class 3	Why Nanotechnology: importance, size scales, quantum size effects, Revolutionary applications, potentials.
Week 2	**Growth Technique and Band Structure**
Class 4 Class 5 Class 6	Growth Technique and Band Structure
Week 3	**Lattice Mismatch and Strain**
Class 7 Class 8 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 Class 11 Class 12	Nanotools: scanning tunneling microscope, atomic force microscope, electron microscope, measurement techniques based on fluorescence, other techniques.
Week 5	**Hetero-Junctions**
Class 13 Class 14 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 Class 17 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 Class 20 Class 21	Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques.
Week 8	**Hetero-junction Diode**
Class 22 Class 23 Class 24	Bottom-up processes: chemical and organic synthesis techniques, self-assembly, other techniques.
Week 9	**Hetero-junction field effect transistor**
Class 25 Class 26 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**
Class 28 Class 29 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 Class 32 Class 33	Tunneling devices: quantum tunneling, resonant tunneling diodes.
Week 12	**Hetero-structure bipolar transistor**
Class 34 Class 35 Class 36	Tunneling devices: quantum tunneling, resonant tunneling diodes.
Week 13	**Hetero-structure bipolar transistor**
Class 37 Class 38 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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Nano Devices
Level-4, Term- I/II (Spring / Fall)

COURSE INFORMATION

Course Code	: EECE 465	Contact Hours	: 3.00
Course Title	: Semiconductor and Nano 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	PO1	C2	1,2,3		3	T

	many real-life applications regarding energy and thermal issues in modern day electronics.						
CO2	Be adept in **applying** basic quantum mechanical equations for **explaining** atomic level physics.	PO1	C3	1,2,3		3	Mid Term Exam
CO3	Be able to **explain** the charge transport equations that play a pivotal role in any kind of current conducting nanoscale devices.	PO1	C1	1,2,3		4	F

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

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	**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
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
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.
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
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Communication

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 and **Apply** the fundamental principles of optics and light wave to **evaluate** optical fiber based wide area networks and **design** optical fiber communication systems.	PO1	C6	1, 2, 3		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, 2, 3		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, 2, 5		5	T, Mid Term Exam, F, ASG, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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**
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**
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**
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**
Class 25	Mathematical problem on multiplexing
Class 26	Frequency division multiplexing
Class 27	Time division multiplexing
Week 10	**Multiplexing**
Class 28	Orthogonal frequency division multiplexing
Class 29	Poission's Arrival Distribution
Class 30	Mathematical modeling
Week 11	**Modern Telephone Services**
Class 31	Telephone network
Class 32	Basic topologies
Class 33	Idea on PSTN
Week 12	**Modern Telephone Services**
Class 34	Digital cellular communication system
Class 35	CDMA
Class 36	Synchronous Optical Network (SONET)
Week 13	**Modern Telephone Services**
Class 37	The SONET/SDH Hierarchy
Class 38	Mathematical modeling of SONET
Class 39	Basic idea on satellite communication system
Week 14	**Satellite Basics**
Class 40	Low earth orbit satellite
Class 41	Revision
Class 42	Open Discussion

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 waveguide structures to strengthen the concepts of basic microwave engineering.	PO1	C4	1,2, 4		3	T, F
CO2	**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	1,2, 5		5	T, Mid Term Exam, F
CO3	**Analyze** microwave networks using impedance, admittance, transmission and scattering matrix representations to explore practical complex network and **design** different types of antennas with specific radiation properties and antenna parameters.	PO3	C4	1,2, 3	2	5	Mid Term Exam, F, ASG, Pr
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.		
TEACHING LEARNING STRATEGY		
Teaching and Learning Activities		Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning		42 42 - -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination		84 42 21 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**	
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**	
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**	
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**
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
Continuous Assessment (40%)	Test	20%
	Assignment	5%
	Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE 434	Contact Hours	: 3.00
Course Title	: Microwave Engineering Laboratory	Credit Hours	: 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	**Apply** different methods to determine circuit properties for passive/active microwave devices.	PO2	C4	1,2,5		3	R,LT
CO2	**Acquire** comprehensive knowledge of fundamental properties of microwave signal and **design** various microwave system components, employing both hardware and computer-aided design methods, to **analyze** their performance characteristics.	PO5	P6	1,2,3		6	R, Q, LT
CO3	To perform as a group member and assist others during group projects and presentations.	PO10	A4	3	1,2		Pr,PR

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

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	24 8 16
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz Preparation of Presentation Engagement in Group Projects	47 8 10 8 5 16
Formal Assessment Continuous Assessment Final Quiz	4 3 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 |ρ| 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 Quiz-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
Continuous Assessment (70%)	Lab participation and Report	25%
	Labtest-1, Labtest-2	30%
	Project and Presentation	15%
Lab Quiz		30%
Total Marks		100%

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 Communication
Level-4 Term- I/II (Spring / Fall)

COURSE INFORMATION

Course Code	: EECE 435	Contact Hours	: 3.00
Course Title	: Optical 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 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. This course is intended to introduce to students an overview of optical communication systems – guided and unguided.
2. To provide students with the basic theory, design and operating principles of modern optical communication systems.
3. The students should be familiar with different types of fibers, components, transmitters, receivers, different detection methods and receiver noise and they will be able to design a simple optical communication link.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Understand the physics- based knowledge of lightwave propagation and apply it to solve the problems relevant to lightwave propagation in free space and optical fibers.	PO1	C3	1,2, 3		3	T, F
CO2	Classify optical fibers and lightwave transmission systems and explain the impairments of light propagation in optical fibers and free space; analyse the operation of optical sources, detectors, amplifiers, modulators and demodulators etc.	PO2	C4	1,2, 3		3	T, Mid Exam, F
CO3	Compare different optical communication systems and evaluate their performance.	PO2	C4	1,2, 3		3	Mid Exam, F, ASG
CO4	Design optical communication system considering different impairments and components.	PO3	C6,A5	1,2, 4		5	ASG, F, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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 to optical communication. Guided and unguided optical communication system.
2. Light propagation through guided medium, Optical Fibers: SMF and MMF, SI fibers and GI fibers. Fiber modes, mode theory for light propagation through fibers, single mode condition and multimode condition.
3. Transmission impairments: fiber loss, chromatic dispersion in a fiber, polarization mode dispersion (PMD). Different types of fibers: DSF, DCF, Dispersion compensation schemes. Fiber cabling process, Fiber joints/connectors and couplers
4. Optical transmitter: LED and laser, Operating principles, Characteristics and driver circuits.
5. Optical receivers: PN, PIN and APD detectors, Noise at the receiver, SNR and BER calculation, Receiver sensitivity calculation. IM/DD and Coherent communication systems.
6. Nonlinear effects in optical fibers.
7. Optical amplifiers, Optical modulators
8. Multichannel optical systems: Optical FDM, OTDM and WDM. Optical Access Network, Optical link design and Free space optical communication.

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	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	
Class 1-3	Introduction to Optical Fiber Communication
Week 2	
Class 4-6	Guided and unguided light propagation, Light Propagation theory – Ray optics theory and Mode theory.
Week 3-4	
Class 7-12	Optical Fibers- SI Fibers, GI Fibers, Wave Propagation, Fiber Modes, Single mode Fiber, Multimode fiber, Fiber Birefringence, PMD
Week 5	
Class 13-15	Transmission impairments – Dispersion in Single Mode Fiber (SMF), Dispersion-induced limitation, Different types of fibers: DSF, NZDSF, DCF, Fiber Loss
Week 6	
Class 16-18	Nonlinear Effects- SRS, SBS, SPM, XPM, and FWM
Week 7	
Class 19-21	Optical Transmitters – Light Emitting Diodes (LED), LASER Diodes (LD); their basic mechanisms, structures, characteristics, applications
Week 8-10	
Class 22-27	Optical Receivers – Photo-Detectors (PD): Detector responsivity, PN photodiode, PIN photo-detector, Avalanche photo-detector, Direct detection (IM/DD system) and coherent detection, Phase modulated system, Noise at the receiver, BER and Eye pattern
Week 11	
Class 28-33	Optical Amplifiers – Optoelectronic amplifier, Fiber amplifier: Erbium doped fiber amplifier (EDFA) and Raman amplifier, SOA
Week 12	
Class 34-36	Optical Modulators: MZI, MZM, EAM, EOM
Week 13	
Class 37-39	Multichannel Optical Systems – Optical FDM, TDM and WDM
Week 14	
Class 40-42	Power Budget/link design and Free space optical communication

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: EECE 437 : Digital Communication	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 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		1,2,3	4	T, F
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.	PO2	C4		1,2,3	4	T, Mid, F
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		1,2,3	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, A3		1,2,4	5	F, ASG, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
	Final Exam	60%
	Total Marks	100%

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	: EECE 438	Contact Hours	: 3.00
Course Title	: Digital Communication Laboratory	Credit Hours	: 1.50

PRE-REQUISITE	
Course Code: EECE 437	Course Code: EECE 309
Course Title: Digital Electronics	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.	PO5	C3,P2		1,2,3	6	R,Q,T
CO2	Be able to **reproduce** digital modulation schemes and **evaluate** their performance on noisy channels via Matlab.	PO2	C5		1,2,3	4	R,Q,T
CO3	Be able to **design** various real-life communication system based on strict criteria with modern tools like Simulink.	PO3	C6,A5		1,2,4	5	PR,Pr
CO4	Be able to perform individually and as a group during group projects and presentations.	PO9	A5,P6				PR,Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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 437 using different hardware equipment and simulation software.
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 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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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: Wireless Communication
Level-4, Term-I/II (Spring/Fall)

COURSE INFORMATION			
Course Code	: EECE 439	Contact Hours	: 3.00
Course Title	: Wireless 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
This course provides a comprehensive overview of wireless standards evolution and advanced concepts of wireless communications. Topics include radio wave propagation, statistical channel models, channel capacity, digital modulations, diversity techniques, space-time communications, and broadband technologies like LTE and WiMAX. Through theoretical exploration and practical applications, students will gain insights into designing, analyzing, and optimizing wireless communication systems for various environments and scenarios.

OBJECTIVE
1. To impart knowledge on the essential theories and ideas of digital and wireless communications to students in order to support their future job in the communication sectors and research in wireless communications. 2. To increase the students' ability to analyze wireless communication systems' performances at the signal level.

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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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: Wireless communication systems, regulatory bodies. **Radio wave propagation:** Free-space and multi-path propagation, ray tracing models, empirical path loss models, largescale and small-scale fading, power delay profile, Doppler and delay spread, coherence time and bandwidth, Fixed-to-Mobile Channels, Mobile-to-Mobile Channels, Polarized Channel Modeling, Shadowing and Path-loss models. **Statistical channel models:** Statistical Characterization of Multipath-Fading Channels, Time-varying channel models, narrowband and wideband fading models, baseband equivalent model, discrete-time model, space-time model, auto- and cross-correlation, PSD, envelope and power distributions, scattering function. **Channel capacity:** Flat-fading channels - CSI, Cell splitting and components, capacity with known/partially known/unknown CSI. Frequency-selective fading channels - time-invariant channels, time-varying channels. **Performance of digital modulations:** Frequency reuse, co-channel interference, Error and outage probability, inter-symbol interference, **Diversity techniques:** Time diversity - repetition coding, beyond repetition coding. Antenna diversity - SC, MRC, EGC, space-time coding. Frequency diversity - fundamentals, single-carrier with ISI equalization, DSSS, OFDM. **Space-time communications:** Multi-antenna techniques, MIMO channel capacity and diversity gain, STBC, OSTBC, QOSTBC, SM, BLAST, smart antennas, frequency-selective MIMO channels. **Radio Resource Management:** Handoffs and Dropped Calls, Channel Assignment Techniques **Broadband communications:** RAKE receivers, MC-CDMA, OFDM, OFDMA, multiuser detection, LTE, WiMAX, other IEEE standards of wireless communication system

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	Wireless communication systems, standards and regulatory bodies.
Class 2	Free-space and multi-path propagation, ray tracing models.
Class 3	Empirical path loss models.
Week 2	
Class 4	Large-scale and small-scale fading, power delay profile.
Class 5	Doppler and delay spread.
Class 6	Coherence time and bandwidth.
Week 3	
Class 7	Propagation Modeling: Fixed-to-Mobile Channels, Mobile-to-Mobile Channels
Class 8	Propagation Modeling: Polarized Channel Modeling, Shadowing and Path-loss models
Class 9	Propagation Modeling: Statistical Characterization of Multipath-Fading Channels
Week 4	
Class 10	Time varying channel models, narrowband and wideband fading models.
Class 11	Baseband equivalent model, discrete-time model.
Class 12	Space-time model, auto- and cross-correlation.
Week 5	
Class 13	PSD, envelope and power distributions
Class 14	Scattering function
Class 15	Flat-fading channels - CSI
Week 6	
Class 16	Capacity with known/partially known/unknown CSI
Class 17	Cell splitting and components, Frequency selective fading channels - time-invariant channels
Class 18	Time-varying channels.
Week 7	
Class 19	Frequency reuse, co-channel interference
Class 20	Error and outage probability
Class 21	Inter-symbol interference
Week 8	
Class 22	Time diversity - repetition coding, Beyond repetition coding.
Class 23	Antenna diversity - SC, MRC, EGC
Class 24	Space time coding, Frequency diversity - fundamentals
Week 9	
Class 25	DSSS, OFDM
Class 26	Time diversity - repetition coding
Class 27	Single-carrier with ISI equalization, DSSS, OFDM
Week 10	
Class 28	Multiantenna techniques
Class 29	MIMO channel capacity and diversity gain, STBC, OSTBC, QOSTBC
Class 30	SM, BLAST, smart antennas, frequency selective MIMO channels
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	RAKE receivers, MC-CDMA, OFDM, Global system for mobile
Class 41	OFDMA, multiuser detection, future wireless communication system
Class 42	LTE, WiMAX, other IEEE standards of wireless communication system

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

TEXT AND REFERENCE BOOKS

1. Wireless Communications by Andrea Goldsmith
2. Wireless Communications by T.S. Rapaport
3. Mobile Cellular Telecommunication Systems - William C.Y Lee.
4. Principles of Mobile Communication- Gordon L. Stüber; Springer
5. Introduction to space-time wireless communications, Cambridge University Press (2003) by A. Paulraj, R. Nabar and D. Gore

*****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	Analyze the random signals using probability theory and random signals.	PO2	C4 A1	1,2,3		4	T, F
CO2	Adapt to the ideas of the moments of random variables in order to perform operations on random variables and manipulate the random variable operations to describe the single and multiple random variable functions.	PO3	P6 C4 A5	1,2,3		5	T, Mid
CO3	Adhere to the ideas of random processes characterization to evaluate the real-life signals and systems involving random processes.	PO4	C4 A4	1,2,5		8	Mid
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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**
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.
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment	20%
	Midterm	10%
	Class Participation	5%
	Class Attendance	5%
Final Exam		60%
Total Marks		100%

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: Radar and Satellite Communication

Level-4, Term-I/II (Spring/ Fall)

COURSE INFORMATION			
Course Code Course Title	: EECE 443 : Radar and 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 PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods

CO1	**Understand** the underlying technology of satellite communications and networking	PO1	C2	1,2, 5		3	T, Mid
CO2	Design appropriate link parameters, orbit, and modulation scheme for	PO3	C6,A3	1,3, 4		4	T, Mid , F
CO3	**Understand** the essential concepts of radar systems	PO2	C2	1,2, 6		3	T, F

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

Radar: An introduction to radar, basic radar block diagram, the origin of radar, application of radar
Radar equation : introduction, detection of signals in noise, Receiver noise and SNR, Probability density function and false alarm, integration of radar pulses, Radar cross section, Information contents in radar signals, radar frequencies, system losses, Introduction to Doppler and MTI radar, delay line cancelers, Doppler filter banks, moving target detector, AMTI, limitation to MTI ,radar detectors, detection criteria, matched –Filter receiver, integrators, automatic detection, signal management, Introduction to radar clutter, surface-clutter radar equation, land and sea clutter, weather clutter, detection of targets in clutter, Radar antenna, antenna parameters, antenna radiation, aperture illumination, reflector antennas, phase shifters, phased arrays, Information of radar signals, basic radar measurements, Pulse compression, accuracy of measurements, target recognition, . CW and FM-CW radar, Radar transmitters, linear beam power tubes, magnetron, Cross-filed amplifier, solid state RF power source, Radar receiver, noise figure, radar display, superheterodyne receiver, duplexers and receiver protectors, Introduction to polarimetric radar and synthetic aperture radar.
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.
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 uniformand pulsed jamming.
VSAT Networks: Technology and recent advancements, Mobile Satellite Networks

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 Radar**
Class 1	An introduction to radar, basic radar block diagram, the origin of radar, application of radar
Class 2	Radar equation : introduction, detection of signals in noise, Receiver noise and SNR, Probability density function and false alarm, integration of radar pulses
Class 3	Radar cross section, Information contents in radar signals, radar frequencies, system losses
Week 2	**Introduction to Doppler and MTI Radar**
Class 4	Introduction to Doppler and MTI radar,delay line cancelers,Doppler filter banks,moving target detector, AMTI, limitation to MTI
Class 5	radar detectors, detection criteria, matched –Filter receiver, integrators, automatic detection, signal management
Class 6	Introduction to radar clutter, surface-clutter radar equation, land and sea clutter, weather clutter, detection of targets in clutter
Week 3	**Antenna**
Class 7	Radar antenna, antenna parameters, antenna radiation, aperture illumination, reflector antennas, phase shifters, phased arrays
Class 8	Information of radar signals, basic radar measurements, Pulse compression, accuracy of measurements, target recognition
Class 9	CW and FM-CW radar.
Week 4	**Radar Transmitter-Receiver**
Class 10	Radar transmitters, linear beam power tubes, magnetron, Cross-filed amplifier, solid state RF power source
Class 11	Radar receiver, noise figure, radar display, superheterodyne receiver, duplexers and receiver protectors
Class 12	Introduction to polarimetric radar and synthetic aperture radar.
Week 5	**Introduction to Satellite**
Class 13	Definition, history, need of satellite communication, how satellite communication works
Class 14	Advantage and disadvantage, application, orbital elements, semi major axis, semi minor axis, mean anomaly, argument of perigee
Class 15	Satellite orbits, Posi grade, retrograde, ascending node, descending node, Geo stationary satellite, Geo synchronous satellite
Week 6	**Orbital Mechanics**
Class 16	Orbital mechanics, equation of orbit, Kepler‘s three law of planetary motion
Class 17	Describing the orbit of a satellite, locating the satellite in the orbit
Class 18	Look angle determination, subsatellite point, elevation angle, azimuth angle
Week 7	**Orbital Mechanics**
Class 19	Solar eclipse
Class 20	Sidereal period
Class 21	Slant range, synodal period
Week 8	**Multiple Access Technique**
Class 22	DMA, FDM-FM-FDMA, Single Channel per carrier
Class 23	TDMA, TDMA frame structure, reference burst, traffic burst, guard time
Class 24	TDMA burst structure, carrier and clock recovery sequence, unique word, TDMA frame efficiency
Week 9	**Demand Assignment**
Class 25	Erlang B formulae
Class 26	Types of Demand Assignment
Class 27	DAMA characteristics (demand assignment), Blocking probability
Week 10	**Satellite Link Design**
Class 28	Introduction, Basic Transmission Theory, Rain Attenuation, System noise temperature and G/T ratio
Class 29	Calculation of system noise temperature, Noise figure, Noise temperature, G/T ratio for earth station and its measurement and

	characteristics
Class 30	Link budget calculation, System availability, mean unavailability, radio-star method
Week 11	**CDMA**
Class 31	Code generator, PN-sequence, Property of PN-sequence
Class 32	Satellite spread spectrum communication,
Class 33	Interference (unintentional and intentional interference)
Week 12	
Class 34	Classification of spread spectrum (Direct sequence spread spectrum and frequency hopping), Direct sequence spread spectrum system
Class 35	Error rate performance in uniform jamming, Error rate performance in pulsed jamming
Class 36	Direct Sequence CDMA
Week 13	**CDMA**
Class 37	Frequency hopping spread spectrum,
Class 38	Jamming Waveform, steps for finding jamming waveform
Class 39	Interference analysis, different types of unintentional interference
Week 14	**VSAT**
Class 40	Characteristics, VSAT network system concept, Service of VSAT
Class 41	Nature of traffic
Class 42	Mobile satellite network and VSAT application

SSESSMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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: Radar and Satellite Communication Laboratory
Level-4, Term-I/II (Spring /Fall)

COURSE INFORMATION

Course Code Course Title	: EECE 444 : Radar and Satellite Communication Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50

PRE-REQUISITE

Course Code: EECE 443
Course Title: Radar and 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 (e.g transmitter, receiver) and calculate the orbital determination for real life applications.	PO3	C3, A3	1,5, 7		5	R, Q, T
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.	PO5	P6, C3	1,2, 6	1	6	R, Q, T
CO3	To perform as a group member and assist others during group projects and presentations.	PO10	A4, P6	2,3		6	R, Q, T

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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 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
Continuous Assessment (70%)	Lab participation and Report	25%
	Labtest-1, Labtest-2	30%
	Project and Presentation	15%
Lab Quiz		30%
Total Marks		100%

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	: EECE 445	Contact Hours	: 3.00
Course Title	: Communication Networks	Credit Hours	: 3.00

PRE-REQUISITE

Course Code: EECE 309
Course Title: Communication Systems I

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	Have the ability to explain the ideas behind network topologies, layered architectural modeling, and media access protocol mechanisms comparison.	PO1	C1			4	T
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.	PO2	C4			4	Mid/F
CO3	Be able to **evaluate** the effectiveness of the network arrangement introduced on the basis of the basic knowledge on routing and subnetting.	PO3	C5, A3	1		5	F/ASG

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 while designing and justifying efficient configurations with diverse routing protocols per IEEE standards.	PO11	P2,A1		1		R, Q, PR,ASG
CO2	Be able to distinguish between two of the types of the random-access protocols analysing their performances via the simulation software.	PO5	C4			6	R, Q, T
CO3	Be able to **reproduce** codes to **solve** problems related to channel coding schemes for real life communication network.	PO12	P3	1			R, PR, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.
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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 <u>Interdisciplinary Courses</u>

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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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_∞ Control, nonlinear control.
TEACHING METHODOLOGY
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method

COURSE SCHEDULE	
Week 1	**Introduction to Compensator**
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**
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**
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**
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_∞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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE 422	Contact Hours	: 3.00
Course Title	: Control System II Laboratory	Credit Hours	: 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	Assessment method
CO1	**Demonstrate** application of safety principles and practices in the project, and evaluate peer team members on the designed control system satisfying specifications.	PO9	A3, P4				PR,Pr
CO2	**Apply** the basic knowledge of root locus to design various types of compensators for control system engineering using software.	PO5	C4	1,2,4		6	R,T,Q
CO3	**Analyze** the z-transform technique, and time and frequency domain response to design the control system in case of digital control engineering.	PO2	C4	1,2,4		2	R,T,Q

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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 Project topic discussion
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	**Lab Test-1:** Present/demonstrate the technical progress of the project
Week8	**Expt-07:** Design of control system for Microprocessor control
Week9	**Expt-08:** Designing the control system for neural network and fuzzy control
Week10	**Expt-09:** Digital servo closed loop speed and position control: transient characteristics and disturbances (a) Motor Shaft Angular Position Control (b) Linear Position Sensing and Control with Error Analysis
Week11	**Lab Test-2**
Week12	Viva
Week13	Quiz test
Week14	Project submission

ASSESSMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 Course Title	: EECE 423 : Numerical Methods	Contact Hours Credit Hours	:3.00 :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	Apply numerical methods and algorithms used in solving mathematical problems, demonstrating an understanding of their accuracy, stability, and convergence properties one for finding root of equations.	PO2	C3	1,2,3		2	Mid
CO2	Utilize numerical methods for diverse mathematical problem-solving, including root finding, interpolation, differentiation, integration, and ordinary differential equations, with critical evaluation of method appropriateness.	PO1	C2	1,2,3		2	T
CO3	Design and implement numerical algorithms, assess their efficiency in solving real-world problems across engineering, physics, and finance, demonstrating theoretical	PO3	C4,A3	1,2,3		5	F

	understanding and practical proficiency						

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning	42
Non-face-to-face learning	21
Revision of the previous lecture at home Preparation for final examination	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.
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**
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**
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**
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

TEAXT 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 Course Title	: EECE 424 : Numerical Methods Laboratory	Contact Hours Credit Hours	: 3.00 : 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	**Apply** basic Algorithms of numerical methods for engineering applications.	PO1	P4	1,2,3		2	R, LT
CO2	**Model** engineering systems using first and second order differential equations, and **solve** the equations numerically using MATLAB software.	PO5	P5	1,2,3		6	R, Q, LT
CO3	**Analyze** numerical problems to **perform** project task with both hand computation and programming applied in MATLAB and C# programming.	PO9	P6				R, Q, LT
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.							

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	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
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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	**Human body**
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
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
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
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

Components		Grading
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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

5.2.4.6. EECE 426: Biomedical Instrumentation Laboratory
Level-4, Term -II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 426 : Biomedical Instrumentation Laboratory	Contact Hours Credit Hours	: 3.00 : 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.	PO9	A4			7	PR, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	Machine Learning based non-invasive approach for blood cholesterol level estimation	
3	Non-invasive Oxygen Saturation Measurement for Hypoxemia Detection Using Pulse Oximetry	
4	Design and Development of a Cost-Effective Continuous Heart Rate Measuring Device using Fingertip to Detect Drowsy Driving	
5	Diabetic retinopathy Detection	
6	Lab Test-01	
7	Extracting SpO2, heart rate, and clinical symptoms by pulse oximetry and machine learning to detect pneumonia using a non-invasive method.	
8	Wearable and Low-Cost Device For Detecting Amyotrophic Lateral Sclerosis (ALS) Using Electromyography (EMG) Signal	
9	EMG Signal Based Intelligent Wheel Chair	
10	Practice Lab	
11.	Lab Test-02	
12.	Quiz	
13.	Viva	
14.	Project Presentation	

ASSESSMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 491: Sonar and Underwater Engineering
Level-4, Term –I/II (Spring/ Fall Term)

COURSE INFORMATION

Course Code	: EECE 491	Contact Hours	: 3.00
Course Title	: Sonar and Underwater Engineering	Credit Hours	: 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	**Understand** the technical, environmental, safety, health, and commercial issues related to the design, installation and operation of underwater or ocean surface systems	PO1	C2	P1 P5 P7		4	T/F
CO2	**Analyze** some simple solution methodologies related to design, installation and operation of underwater or ocean surface systems	PO2	C4	P1 P2 P5		3	Mid/ASG
CO3	**Evaluate** a conceptual solution to complex problems in design, installation and operation of underwater or ocean surface systems	PO3	C5,A3	P1 P2 P3	3	5	Pr/ R

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week 1	**Water as a media of propagation**
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**
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**
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**
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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.**

5.2.4.8 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. 5.			

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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1,Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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.**

5.2.4.9. 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 443 Course Title: Radar and Satellite Communication

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 other electronic warfare equipment.	PO1	C1		P1, P2, P3	3	Test
CO2	Be competent to **analyze** the operational principle and performance of satellite communication system.	PO1	C4		P1, P2, P3	4	Mid Term Exam
CO3	Be proficient in generating the design criteria of semiconductor optical devices.	PO2	C6		P1, P2, P3	4	Final

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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**
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**
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, Airborne Self-Protect Jammer
Class 17	Technology evolution, Airborne Tactical Jamming System
Class 18	Advanced EW technical approaches, Shipboard Self-Defense System
Week 7	**Radar Bands**
Class 19	EW and radar bands
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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.**

5.2.4.10. 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	Becoming proficient in **interpreting** the behaviour of different frequency bands for EW applications.	PO6	A3		P1, P2, P3	7	R
CO2	Attaining knowledge to **follow** basic knowledge of EW signal processing to **design** an EW spectrum receiver.	PO5	C3, P6		P1, P2, P3	6	T
CO3	Developing collaborative nature by **discussing** and **performing** as a group and **organize** project tasks maintaining solidarity during the group projects and presentations.	PO10	A4, P4	A1, A2			PR

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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		
Components		**Grading**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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.**

5.2.4.11. 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	**Understand** the concept of navigation, radio direction finding, automatic direction finder and radio compass.	PO1	C2	1, 2, 5		1-4	T
CO2	Be proficient in **analysing** mathematical concepts of radar, navigation by NDB, VOR, GPS and inertial navigation approaches and be able to establish the solution of complex avionics engineering problem using guidance laws.	PO3	C3, A4	1, 2, 7		5	F, ASG, Pr
CO3	Be competent to **understand** the working principle of doppler navigation, beam configuration and capable to **analyse** the trends of aircraft navigation.	PO1	C3	1, 2, 5		1-4	Mid

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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**
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**
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**
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**
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**
Continuous Assessment (40%)	Class Test & Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
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. 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**

5.2.4.12. 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 controlling equipment by practical demonstration.	PO2	C2,P1,A1			3	R,Q,T
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
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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							
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					 6 6		

Preparation of Quiz Preparation of Presentation Engagement in Group Presentation	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
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
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- 4^{th} 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.**

5.2.4.13 EECE 497: Biomedical Signal Processing
Level-4, Term –I/II (Spring/ Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 497 : Biomedical Signal Processing	Contact Hours Credit Hours	: 3.00 : 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	**Understand** the concept of digital signals and illustrate the idea in biomedical signal processing.	PO1	C1	1		4	T, F
CO2	**Analyze** different biomedical signal characteristics and be able to **design** the practical filters.	PO2	C4	1			F, T, Mid
CO3	**Apply** machine learning algorithm to different numerical techniques and **solve** the practical design problems.	PO3	C3				F, ASG, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.		
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**	
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.)**	
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.)**	
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	
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
Continuous Assessme nt (40%)	Class Test & Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
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, 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**

5.2.4.14 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

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

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**
	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%

Continuous Assessment (40%)	Project and Presentation	25%
Lab Quiz		25%
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**

5.2.4.15 EECE 427: Robotics and Automation
Level-4, Term -I/II (Spring/ Fall Term)

COURSE INFORMATION

Course Code Course Title	: EECE 427 : Robotics and Automation	Lecture Contact Hours Credit Hours	: 3.00 : 3.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

This course equips students with the foundational knowledge and skills to navigate robotics and automation field. Through a blend of theory and practical applications, students will gain a comprehensive understanding of robot design, control systems, and automation. This course prepares students for future advance courses in robotics and automation.

OBJECTIVE

1. Introduce to robotics and automation including robot classification, design and selection, analysis and applications in industry
2. Impart knowledge on the kinematics and dynamic of robot manipulators
3. Educate on various robot localization and path planning/navigation techniques
4. Explain the essentials of feedback control to implement sensor/motor control loops
5. Elucidate robot automation using sensors, actuators, image analysis, and AI
6. Help design, plan, and build interdependent autonomous machines using robotics parts
7. Enable to design intelligent practical robotics systems

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Method
CO1	**Understand** the relationship between mechanical structures of industrial robots and their operational workspace characteristics	PO 1	P1,P2.P3	C2		K1	T, Mid Term, F
CO2	**Solve** kinematic and dynamic modelling problems of simple robot manipulators.	PO 3	P1,P2.P3	C3		K5	T, Mid Term, F

CO3	**Explain** localization and navigation tasks for mobile robots.	PO 2	P1,P2.P3	C2		K2	T, Mid Term, F
CO4	**Apply** knowledge of robot controllers and autonomous systems	PO 2	P1,P2.P3	C3		K3	T, Mid Term, F
CO5	**Design** simple robots	PO 2	P2.P3,P4	C6		K4	T, Mid Term, F
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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 SCHEDULE							
TEACHING METHODOLOGY							
Lecture and discussion, Co-operative and colaborative method, Problem based method							

COURSE CONTENT

History of robotics, elements of robotic systems, mathematics of manipulators, classification of robots. Kinematic modelling, forward and inverse dynamics. Robot path planning, navigation, and localization. Various types of sensor operations for robot sensing. Electrical and mechanical actuators. Robot vision. Linear and non-linear controls, adaptive controls. Microcontroller and embedded systems for robotics, robot programming. AI and machine learning for robot operations. Robot applications for industry 4.0: underwater robotics, unmanned aerial vehicle (UAV), humanoid robots.

COURSE SCHEDULE

Week 1	
Class 1	Brief history of robotics, components of a robot, classification of robots.
Class 2	Kinematics systems; definition of mechanisms and manipulators, robot degrees of freedom.
Class 3	Robot joints, robot coordinates, robot reference frames, programming modes, robot workspace, robot languages, robot applications.
Week 2	
Class 4	Kinematic modelling: translation and rotation representation, coordinate transformation
Class 5	DH parameters, forward and inverse kinematics, solvability, solution methods, closed form solution
Class 6	Jacobian, singularity, static forces in manipulators
Week 3	
Class 7	Dynamic Modelling: Forward and inverse dynamics
Class 8	Equations of motion using Euler-Lagrange formulation
Class 9	Newton Euler
Week 4	
Class 10	Robot path planning and localization: position and orientation planning
Class 11	Trajectory planning, interpolated motion, map generation, road map path planning, obstacle avoidance
Class 12	Robot localization methods, landmark based navigation, multi-agent systems
Week 5	
Class 13	Sensors: non-visual sensors and algorithms, contact and proximity, position, velocity, force, tactile etc.
Class 14	Internal sensors, infrared sensors, sonar, radar, laser range finders.
Class 15	Introduction to cameras, camera calibration, geometry of image formation.
Week 6	
Class 16	Actuators: Electrical- DC motors, servo motors, stepper motors, motor control.
Class 17	Mechanical- hydraulic and pneumatic; transmission- gears, timing belts and bearings.
Class 18	Parameters for selection of actuators.
Week 7	
Class 19	Image processing and analysis with robot vision systems.
Class 20	Image processing and analysis with robot vision systems.

Class 21	Image processing and analysis with robot vision systems.
Week 8	
Class 22	Feedback control in robots, linear control schemes,
Class 23	PID control scheme, force and accelerator control, disturbance
Class 24	Dynamic effects, stability analysis
Week 9	
Class 25	Non-linear and adaptive control
Class 26	Non-linear and adaptive control
Class 27	Non-linear and adaptive control
Week 10	
Class 28	Embedded systems: microcontroller architecture and integration with sensors.
Class 29	Actuators, components, robot operating system (ROS),
Class 30	Introduction to industrial robot programming
Week 11	
Class 31	AI and machine learning (ML)
Class 32	Unsupervised learning, clustering, supervised learning, support vector machine, deep learning
Class 33	ML based robot operations
Week 12	
Class 34	Different aspects of mobile robotics,
Class 35	Underwater robotics- types and classification, environmental factors, hydraulics
Class 36	Underwater manipulators, sensing/surveillance, communications, command/ control, applications.
Week 13	
Class 37	Different aspects of assistive robotics.
Class 38	Unmanned aerial vehicle (UAV)- types and characteristics, propulsion, internal combustion, onboard flight control, payloads.
Class 39	unmanned aerial vehicle (UAV)- sensing/surveillance, communications, command/ control, ground control stations
Week 14	
Class 40	Humanoids: Wheeled and legged, legged locomotion and balance, arm movement, gaze, face and auditory orientation control
Class 41	Motion learning from demonstration, interaction, safety and robustness
Class 42	Different aspects of social robotics and robot safety.

ASSESSMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

TEXT AND REFERENCE BOOKS

1. Robotics, Vision & Control, Peter Corke, Springer Verlag (2011)
2. Introduction to Robotics, John J. Craig, Addison-Wesley Publishing, Inc., 1989 213
3. Introduction to Robotics, P. J. McKerrow, ISBN: 0201182408
4. Modern Robotics: Mechanics, Planning, and Control, Kevin Lynch and Frank Park, Cambridge University Press, 2017. ISBN: 9781107156302
5. Introduction to Robotics: Analysis, Systems, Applications, Saeed Niku, Prentice Hall, 2002
6. Introduction to Robotics, Saeed B. Niku, 2e, Wiley, 2011
7. Online resources or supplementary materials will be shared with the class on a need basis.

5.2.4.16 EECE 428: Robotics and Automation Laboratory
Level-4, Term -I/II (Spring/ Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 428 : Robotics and Automation Laboratory		: 3.00 :1.50
PRE-REQUISITE			
Course Code: EECE 427 Course Title: Robotics and Automation			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
OBJECTIVE			
1. To perform experiments in relevance with the theoretical concepts of the course Robotics and Automation. 2. To conduct design projects to achieve specific program outcomes described in the Course Outline			

No.	Course Outcomes	Corresponding PO	Bloom‘s Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** different kinematics algorithms and **use** programming software to implement them	PO 1	P1, P4	P1,P2,P3		**K1**	Lab Performance Lab Report Lab Test Quiz
CO2	**Experiment** using modern equipment and tools to verify theoretical knowledge and **compare** theoretical and experimental results	PO4	C3, C5	P1,P2,P3		**K8**	Lab Performance Lab Report Lab Test Quiz
CO3	**Design** various types of robots to perform specific tasks with due considerations to public health and safety, societal, cultural, and environmental consideration	PO 3	P7	P2,P3,P4		K5	Lab Performance Lab Report Lab Test Quiz
CO 4	**Demonstrate** application of ethical principles and practices in the project, and evaluate peer team members ethically	PO 8	**A3**	P4,P5,P6		**K7**	Peer evaluation, Report
CO 5	**Work** effectively as an individual and as a team member towards the successful completion of the project	PO 9	**P4**	P4,P5,P6			Viva, Peer evaluation
CO 6	**Report** effectively on the design done for CO4 with presentation, user-manual and detailed report	PO 10	**A3**	P2,P3,P4	**A2, A3**		Video Presentation Project Repor

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.
TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Lecture Practical Total	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

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

COURSE SCHEDULE

Week1	Introduction to Robotics and its major applications Overview on lab experiments, projects, policies, grading; group formation Introduction to ROS.
Week2	Expt-01: Robot kinematics and robot design using ROS
Week3	Expt-02: Design and implementation of a line follower manual robot with obstacle avoidance
Week4	Project Proposal Presentation
Week5	Expt-03: Design and implementation of a map generating autonomous robot
Week6	Expt-04: Design and implementation of an UAV and testing its characteristics
Week7	Project Design Presentation
Week8	Expt-05: Multi-degree of freedom robotic arm manipulator
Week9	Expt-06: Human machine interaction and specific task completion by Humanoids
Week10	Project Progress Presentation
Week11	Lab Test +Quiz
Week12	Viva
Week13	Introduction to Robotics and its major applications Overview on lab experiments, projects, policies, grading; group formation Introduction to ROS.
Week14	Project Presentation

ASSESMENT STRATEGY

Components		Grading
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

TEXT AND REFERENCE BOOKS

1. Robotics, Vision & Control, Peter Corke, Springer Verlag (2011)
2. Introduction to Robotics, John J. Craig, Addison-Wesley Publishing, Inc., 1989 213
3. Introduction to Robotics, P. J. McKerrow, ISBN: 0201182408
4. Modern Robotics: Mechanics, Planning, and Control, Kevin Lynch and Frank Park, Cambridge University
5. Introduction to Robotics: Analysis, Systems, Applications, Saeed Niku, Prentice Hall, 2002
6. Introduction to Robotics, Saeed B. Niku, 2e, Wiley, 2011
7. Online resources or supplementary materials will be shared with the class on a need basis

5.2.4.17 CSE 491: Introduction to Embedded Systems
Level-4, Term –I/II (Spring/ Fall Term)

COURSE INFORMATION			
Course Code Course Title	: CSE 491 : Introduction to Embedded Systems	Contact Hours Credit Hours	: 3.00 : 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 their implementation.	PO5	C5			6	T, Mid, F
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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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**..**

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	**Central Processing Units (CPUs')**
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**
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: CSE 492	Contact Hours	: 3.00
Course Title	: Introduction to Embedded Systems laboratory	Credit Hours	: 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.	PO3	C4, A3		P1, P2 P3	5	PR, Pr R,Q
CO2	Be proficient to **demonstrate** skills on Linux OS in Raspberry pi 3.	PO5	C3		P1, P3, P4	6	R,Q,T
CO3	Be able to **implement** microcontrollers infield and **evaluate** their performance with sensors.	PO2	C5		P1, P2, P4	3	R,Q,T
CO4	Be able to perform individually and as a group during group projects and presentations.	PO9	A5, P6				PR,Pr

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

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 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

<table>
<tr><th colspan="3">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th></tr>
<tr><td rowspan="3">Continuous Assessment (40%)</td><td>Lab participation and Report</td><td>20%</td></tr>
<tr><td>Labtest-1, Labtest-2</td><td>30%</td></tr>
<tr><td>Project and Presentation</td><td>25%</td></tr>
<tr><td colspan="2">Lab Quiz</td><td>25%</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td></tr>
</table>

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 223	Electrical and Electronics Technology	3	2
10	NSE	EECE 224	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 Course Title	: EECE 163 : Electrical Circuit Analysis	Lecture Contact Hours Credit Hours	: 3.00 : 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 and 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, MT

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

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	Topic
Week 1	Lecture 1	Charge and Current, Voltage, Power and Energy
	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
	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
	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
	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
Continuous Assessment (40%)	Test 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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, Thevenin's law, Norton's law)	PO9	P5, A3	1			R, Q, T
CO2	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.	PO5	P6	1		6	R, Q, T
CO3	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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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 163 using different hardware equipment and simulation software.

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 Final Examination	 6 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
	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%

Continuous Assessment (75%)	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 Course Title	: EECE 169 : Electronic Devices and Circuits	Lecture 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			
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 **apply** the knowledge of semiconductor diodes, BJT,	PO3	C5			5	F, ASG

	MOSFET, JFET, Op-Amp etc to solve real life engineering problems such as rectification, switching and amplification						

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	21
Assessment Preparations	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	Lecture	Topics
1	Class 1	Basic ideas and example about Electronics
	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
	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
	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.
	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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: EECE 170 : Electronic Devices and Circuits Sessional	Contact Hours Credit Hours	: 1.50 : 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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	4 5

Preparation of Presentation Engagement in Group Projects	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
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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 and Induction motor**
Class 7	Construction and operating principle of DC motor and Induction motor.
Class 8	Flemings right hand rule and left-hand rule, conversion of energy
Class 9	Differences between generator and motor
Week 4	**DC Motor and Induction motor**
Class 10	Back emf and related equations for DC motor and Induction motor.
Class 11	Speed control, Torque –speed characteristics of different types DC motor and Induction motor.
Class 12	Related mathematical problems of DC motor and Induction motor.
Week 5	**Transformer**
Class 13	Introduction to Transformer and its principle of operations
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 and motor**
Class 19	Synchronous Generator and motor: Operating principle
Class 20	Excitation systems of Synchronous Generator
Class 21	equivalent circuit of synchronous Generator and motor
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**
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

Continuous Assessment (40%)	Class Test & Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 characteristics of electrical machines like dc generator, dc motor, alternator, etc. and **apply** the basic idea of control system through the controlling of water level and water flow by feedback transducer.	PO5	P4	1	1	6	R, Q, LT

CO3	Be able to **perform** project task and **design** electrical machine **adapting** to requirement.	PO10	P6	1	1,3,5		T, PR, Pr

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

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Practical	7 14 21
Self-Directed Learning Preparation of Lab Reports Preparation of Lab Test Preparation of presentation Preparation of Quiz Engagement in Group Projects	 6 5 5 6 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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
	Lab Quiz	25%
	Total Marks	100%

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

(C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.

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 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
1	1	Number base conversion
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
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
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
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
Continuous Assessment (40%)	Test 1-3	20%
	Assignment	5%
	Attendance	5%

	Mid term	10%
Final Exam		60%
Total Marks		100%

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	**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	**Apply** basic Boolean laws and K-map to **reproduce** a simplified and efficient version of large scale complex circuits meeting the	PO10	P3	1,3			R, Q, T

	specified requirements using minimum hardware.						
CO3	**Deconstruct** a device and **demonstrate** skills to troubleshoot a digital circuit.	PO5	A3			6	R, Q, T
CO4	C**onstruct** 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

(C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.

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

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**

Continuous Assessment (40%)	Lab participation and Report	20%
	Lab test	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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	: EECE 165	Lecture Contact Hours	: 3.00
Course Title	: Basic Electrical Technology	Credit Hours	: 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

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	**Topics**
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
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	Super 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	
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	
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
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

<table>
<tr><th colspan="2">Components</th><th>Grading</th></tr>
<tr><td rowspan="4">Continuous Assessment (40%)</td><td>Class Test/ Assignment 1-3</td><td>20%</td></tr>
<tr><td>Class Participation</td><td>5%</td></tr>
<tr><td>Class Attendance</td><td>5%</td></tr>
<tr><td>Mid term</td><td>10%</td></tr>
<tr><td colspan="2">Final Exam</td><td>60%</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td></tr>
</table>

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			
Basic electrical engineering is an introductory course in electrical engineering. Students are introduced to simple applied electrical circuits, theories and practice to impart skill set to have visualization of electrical engineering applications.			
OBJECTIVE			
1. To set a firm and solid foundation in Electrical Engineering with strong analytical skills and conceptual understanding of basic laws and analysis methods in electrical and magnetic Circuits. **2.** To provide students of all branches of engineering with an overview of all the fields of electrical engineering **3.** To prepare students for learning advanced topics in electrical engineering			

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand & apply** Kirchoff's laws, network theorems, time domain analysis for RL & RC series circuit	PO1	C2			1	T, F
CO2	**Understand and analyse** phasor diagram and waveforms for purely resistive, purely inductive and purely capacitive as well as series and parallel R-L, R-C & R-L-C circuits and also circuit Resonance.	PO2	C3	1		6	T, Mid Term Exam, F
CO3	Understand concepts of Real, Reactive & apparent power and Power factor along with 3-phase supply and star and delta connection and their relationships.	PO2	C3	1		3	Mid Term Exam, F, ASG

CO4	Understand construction & working principle of 1-phase and 3-phase transformers. Understand Ideal and practical transformer and auto-transformer and its applications as well.	PO3	C2	1		5	F, ASG
(C = Cognitive, P = Psychomotor, A = Affective Domain; 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.

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

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

COURSE SCHEDULE

Week 1	**Electrical Circuit Laws**
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**
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**
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**
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: EECE 173 : Electrical and Electronics Technology	Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE 159 Course Title: Fundamentals of Electrical Engineering			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
This course gives idea about basic circuit solution methods, introduction to electrical machines, basics of domestic electrical installations, diodes, transducers, amplifier, rectifier etc.			
OBJECTIVE			
1. This course gives idea about basic circuit solution methods, introduction to electrical machines and basics of domestic electrical installations. **2.** Analyze the general and special-Purpose diode circuits. **3.** Design biasing circuits for BJT.			

COURSE OUTCOMES& GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	KP	CP	CA	Assessment Methods
CO1	Understand construction & working principle of 1-phase and 3-phase transformers. Understand Ideal and practical transformer and auto-transformer and its applications as well.	PO3	C2, A2	3			T, F
CO2	Understand generation of rotating magnetic fields. Understand construction and working of 3-phase induction motor, 1-phase induction motor, DC motors& synchronous generators.	PO1	C4	3	1		T, MidTerm, F
CO3	Analyze the general –and special-Purpose diode circuits.	PO1	C4	3	1		Mid Term, ASG, F
CO4	Design biasing circuits for BJT	PO1	C2	3	1		MidTerm, F

(C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.

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

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

COURSE SCHEDULE

Week 1	**DC Generator**
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**
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
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
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	**Construct** DC, AC and electric circuits and justify the basic laws as well as to modify the complex circuits into simple circuits.	PO1	C3	**P1, P2**		**1,2**	R, Q, T
CO2	**Attain** the competency to reproduce the basic filters and to explain their characteristics.	PO1	C4	**P1, P2**		**2**	R, Q, T
CO3	**Demonstrate** the DC and AC machine like motor and generator characteristics with basic component	PO2	C3	P1, P2		**1**	R, Q, T

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

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning Lecture Experiment	 12 28
Self-Directed Learning Preparation of Lab Reports Preparation of Lab-test Preparation of Quiz	 10 10 10

Preparation of Presentation Engagement in Group Projects	5 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	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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	40%
Lab Quiz		40%
Total Marks		100%

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	1,2, 3		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	1,2, 5		3	T/ ASG, MT, F
CO3	Be able to **explain** theories of electronic components and identify its applications in marine electronics sector.	PO3	C3,A4	1,2, 3		5	T/ ASG, F

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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**.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	**Engagement (hours)**
Face-to-Face Learning	
Lecture	56
Practical / Tutorial / Studio	-
Student-Centred Learning	-
Self-Directed Learning	
Non-face-to-face learning	42
Revision of the previous lecture at home	28
Preparation for final examination	28
Formal Assessment	
Continuous Assessment	3
Final Examination	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
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**
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..)**
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**
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
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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:	Marine Electrical and Electronics		
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,P2	1,2,3		6	R, Q, T
CO2	**Interpret** input and output characteristics of different electronic component for specified requirements using both simulating tools and hardware.	PO5	C2,P4	1,2,5		6	R,Q,T
CO3	**Organize** project tasks maintaining solidarity during the group projects and presentations.	PO10	P5EE,A4		1,3		PR, Pr
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.							
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
Continuous Assessment (40%)	Lab Participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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.
4. 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	**- 1,2, 3**	**-**	3	T, F, Q
CO2	**Apply** the circuit theorems to **Solve** the AC and DC circuits	PO2	C3	1,2, 5		3	T, MT, F
CO3	**Analyse** the magnetic circuits and three phase circuits	PO1	C4	1,2, 3		2	MT, F, ASG

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

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**
Week-1	**Laws of electric circuit:** Ohm's Law, Kirchhoff's voltage and current laws, delta-wye transformation.
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
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.
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.
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	1.2.3		7	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,A5		3,5		R, Q, T
CO3	Be able to develop collaborating nature by **completing** a simple project in both software and hardware and **performing** group activities.	PO5	P5, C4	1,2,4,		6E EE E	PR, R, Pr

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

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
7	Quiz+ Viva

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (70%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 223: Electrical and Electronics Technology
Level-2, Term-II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 223 : Electrical and Electronics Technology	Lecture Contact Hours Credit Hours	: 3.00 : 3.00
PRE-REQUISITE			
Course Code: EECE 119 Course Title: Fundamentals of Electrical Circuit Analysis			
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	1,2,3		1	T, F
CO2	I**nterpret** and **analyze** the performance characteristics of different electrical machines e.g. transformers, DC and AC machines	PO2	C4	1,2,3		3	T, F
CO3	**Analyze** basic electronic circuits considering existing system models to explore practical complex engineering problems.	PO2	C4	1,2,3		5	MT, F
CO4	D**esign** various electronic circuits using both passive and active components to solve the real-life engineering problems.	PO3	C6	1,2,4		5	ASG, Pr

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

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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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.

6.5.4. EECE 224: Electrical and Electronics Technology Laboratory
Level-2, Term-II (Fall Term)

COURSE INFORMATION			
Course Code Course Title	: EECE 224 : Electrical and Electronics Technology Laboratory	Contact Hours Credit Hours	: 3.00 : 1.50
PRE-REQUISITE			
Course Code: EECE 223 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

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

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	Lab test-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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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 Course Title	: EECE 191 : 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 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	PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the basics of AC and DC circuits	PO1	C2	1,2,3	-	1	T, F
CO2	**Apply** different laws of circuit theorems for solving various engineering problems.	PO2	C3	1,2,3	-	3	T, F
CO3	**Understand** the behavior of different electrical machines.	PO1	C2	1,2,3	-	3	MT, F
CO4	**Analyze** different circuit-related complex engineer-ing problems efficiently.	PO2	C4	1,2,3	-	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, MT-Mid Term 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.

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
Week 1	**Fundamentals of Electrical Circuit**
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**
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)**
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**
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**
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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: Fundamentals of Electrical Engineering			
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	A4,P3				T, Q, R
CO2	Be able to **understand** the behavior of different electrical machines.	PO10	A2,P3		A1,A3		T, Q, R
CO3	Be able to **analyze** different circuit-related complex engineering problems efficiently.	PO9	A3,P4				T, Q, R

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

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	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
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

Continuous Assessment (40%)	Report	20%
	Class Participation	20%
Final Exam (60%)	Lab Test	20%
	Quiz	30%
	Viva	10%
Total Marks		100%

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	: EECE 291	Contact Hours	: 3.00
Course Title	: Electronic Circuits and Devices	Credit Hours	: 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, Pp-Amps and its applications and characteristics like diodes, BJTs, and FETs.	PO1	C2	1,2,3	-	3	T, F
CO2	Be able to **apply** the established equivalent models to find the important ac parameters for an amplifier.	PO2	C3	1,2,4	-	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.	PO4	C4	1,2,4	-	3	MT, F

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.
(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 the 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**
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
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
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
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
Lecture 33	Mathematical Problems
Week 12	**OP-AMP**
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
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	1,4, 5		5	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	1,2, 3		5	T, Q, R
CO3	Be able to **explain** the concepts of electronic devices, circuits, and uses.	PO9	A3	1,4, 5		5	T, Q, R

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

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	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
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**
Continuous Assessment (40%)	Report	20%
	Class Participation	20%
Final Exam (60%)	Lab Test	20%
	Quiz	30%
	Viva	10%
Total Marks		100%

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 Course Title	: EECE 391 : Digital Electronics	Lecture Contact Hours Credit Hours	: 3.00 : 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	1,2,3	-	3	T, F
CO2	Be able to **understand** the design criterion of combinational and sequential logic circuits as needed.	C2	PO2	1,2,3	-	4	T, F
CO3	Be able to **analyze** the memory elements, state table, and state diagrams of the sequential circuit to achieve quality to apply the logic gates to solve the real-world Problem of electronic circuits.	C4,P3	PO4	1,2,4	-	4	T, F

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

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
Week 1	**Introduction to number systems and codes**

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**
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**
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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,A2	PO3	1,2,4	-	5	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,P4	PO5	1,3,4	-	6	T, Q, R, ASG
CO3	Be able to **create** different digital circuits with ICs to use for our day to day necessities.	A4,P5	PO9	1,5,6	-		T, Q, R

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)

Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centered Learning	 7 35 -
Self-Directed Learning Non-face-to-face learning Revision of the previous and (or) subsequent lecture at home Preparation for 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	Familiarization and use of truth table of basic logic Gates
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
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
Continuous Assessment (40%)	Report	20%
	Class Participation	20%
Final Exam (60%)	Lab Test	20%
	Quiz	30%
	Viva	10%
Total Marks		100%

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	**Apply** basic circuit laws and **conclude** which is the most effective analysis technique to **analyse** and **solve** dc and ac circuit.	PO1	C2	1,2,3		1	T, F
CO2	Familiarization with electronic devices and become expert in **comparing** the input and output characteristics.	PO2	C4	1,2,3		1	T, ASG, F
CO4	Analyze electrical control system, concept of feedback, criteria for sensors and transducers selection and **select** appropriate measurement methods for engineering tasks.	PO2	C4	1,2,3		3	T, F

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	
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	

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	
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	
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	
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%

	Mid term	10%
Final Exam		60%
Total Marks		100%

TEXT AND REFERENCE BOOKS

1.Introductory Circuit Analysis (10th edition)- Robert Boylested
2. Electric Circuits (9th 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 DC, AC and electric circuits and justify the basic laws as well as to modify the complex circuits into simple circuits.	PO9	A4			2	R, Q, T
CO2	Attaining the competency to reproduce the basic filters and explain their characteristics	PO10	P3			3	R, Q, T

CO3	Acquiring the proficiency to demonstrate the DC and AC machine like motor and generator characteristics with basic component	PO9	A3		1	3	R, Q, T

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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	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**
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	40%
Lab Quiz		40%
Total Marks		100%

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 Course Title	: EECE 171 : Basic Electrical and Electronic Circuit	Contact Hours Credit Hours	: 3.00 : 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, **justify** particular circuit concept(s) and theorem(s), and **apply** their corresponding technique to find circuit quantities and simplifying complex circuits.	PO1	C5	1, 2, 3		1-4	T, MT, F
CO2	Manage to **outline** sinusoids, and able to **understand** the current voltage relation of 3 phase circuits for **explaining** circuit parameters, **analyzing** real life power consumptions of transmission lines using AC power knowledge.	PO2	C4	1, 2, 5		1-4	F, ASG, MT
CO3	Be skilful to **explain** the operating principle of some fundamental electronic devices (Diodes, BJTs).	PO1	C2	1, 2, 3		1-4	F, ASG, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE 172	Contact Hours	: 1.50
Course Title	: Basic Electrical and Electronic Circuits Sessional	Credit Hours	: 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	**Assemble** electrical circuits that can **verify** fundamental electrical laws such as KVL, KCL, Ohm's Law, Thevenin's and Norton's theorem.	PO5	P5, A3		1, 2, 5	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, 2, 3	8	R, Q, T
CO3	Be adept to **design** project using analogue RLC filter that can produce desired frequency response.	PO9	P6				R, PR

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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**
Continuous Assessment (75%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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: Basic Electrical and Electronic Circuit
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 DC and AC machines.	PO1	C2	1, 2, 3		1-4	T, F
CO2	**Interpret** and **analyze** the performance characteristics of different electrical machines e.g. transformers, DC and AC machines.	PO2	C4	1, 2, 5		1-4	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	1, 2, 3		1-4	MT, F
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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
Week 2	Single Phase Transformer: Performances and characteristics.
Week 3	DC generators: Principles, types
Week 4	DC generators: Performances and characteristics.
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

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
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE 272	Contact Hours	: 1.50
Course Title	: Electrical Machines and Electronics Sessional	Credit Hours	: 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	**Identify** the characteristics of electrical machines like transformer, DC generator and motor, induction motor, alternator etc. **Compute** the voltage regulation and efficiency, **trace** various curves and **justify** characteristics of these electrical machines under various loading condition.	PO1	C1, C5	1, 2, 3		1-4	R, Q, LT
CO2	**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.	PO4	C4	1, 2, 5		8	R, Q, LT
CO3	**Identify** the characteristics of op-amps and **justify** the mathematical operations through hardware implementation.	PO5	C1, C5	1, 2, 5		6	PR, Pr

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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
Continuous Assessment (40%)	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%
Lab Quiz		25%
Total Marks		100%

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	1,2,3		1	T, F

CO2	Inspect Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuit.	PO2	C4	1,2,3		3	T, F
CO3	Explain the concept of capacitance and inductance and the concept of two terminal linear devices.	PO1	C1	1,2,3		3	Mid Term

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.

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**
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 derrvation
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 numbers of current and voltage source calculation
Class 14	Method of Obtaining Node voltages
Class 15	Various mataematical problems solving 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
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
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	Construct an electronic device for application in real life adapting the desired requirements.	PO2	C4	1,2, 3		3	R,Q,T
CO2	Design electrical circuits by applying the knowledge of basic electrical components and networks.	PO3	C6, A4	1,2, 3		5	R,Q,T
CO3	Compare different circuit theorems and it's application.	PO2	C4	1,2, 3		3	Pr,PR
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain**;** 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.							

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	 30 4

Preparation of Quiz Preparation of Presentation Engagement in Group Projects	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 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**
Continuous Assessment (40%)	Lab participation and Report	10%
	Labtest-1, Labtest-2	30%
Final Assessment (60%)	Project and Presentation	30%
	Lab Quiz	30%
Total Marks		100%

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	**Apply** network theorems to simplify real life complex networks.	PO1	C3	1,2,3		1	T, F
CO2	**Explain** the structure, operating principle and main features of electrical machines and their applications.	PO2	C2	1,2,3		3	T, Mid Term Exam, F
CO3	**Understand** AC circuit concepts and **solve** both single phase and three phase circuit problems.	PO2	C2	1,2,3		3	Mid Term Exam, F, ASG

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

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**
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..)**
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..)**
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.
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	: EECE 3251	Contact Hours	:2.00
Course Title	: Building Services III: Electrical Equipment	Credit Hours	: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	P1, P2, P3		2	ASG,F
2.	**Analyze** different circuit related complex engineering problems efficiently.	PO1	C4	P1, P2, P4		3	Mid ,ASG,F
3.	**Apply** different electrical wiring techniques in practical building design.	PO3	C3, A2	P1, P2, P3		2	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.

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**
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**
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**
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**
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

<table>
<tr><th colspan="3">ASSESSMENT STRATEGY</th></tr>
<tr><th colspan="2">Components</th><th>Grading</th></tr>
<tr><td rowspan="4">Continuous Assessment (40%)</td><td>Class Test/ Assignment 1-3</td><td>20%</td></tr>
<tr><td>Class Participation</td><td>5%</td></tr>
<tr><td>Class Attendance</td><td>5%</td></tr>
<tr><td>Mid term</td><td>10%</td></tr>
<tr><td colspan="2">Final Exam</td><td>60%</td></tr>
<tr><td colspan="2">Total Marks</td><td>100%</td></tr>
<tr><td colspan="3">(CO = Course Outcome, C = Cognitive, P = Psychomotor Domain, A = Affective Domain)</td></tr>
</table>

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			
This course is the basic physics in the field of Waves and Oscillations, Optics and Modern physics. The course will be emphasized the basic concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines.			
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	**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	T, MID, F
CO2	**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	MID, ASG, Pr, F
CO3	**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			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.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	84
Formal Assessment	6
Total	132

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week-1	**Topic**
Class-1	Introductory class: Brief discussion on total syllabus, basic requirements of the course, assessment of the course
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	
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	
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	
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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			
This course is one of the basic physics in the field of structure of matter, heat and thermodynamics and mechanics. The course will emphasize the basic concepts, theories and solve quantitative problems which can be applicable in a wide spectrum of engineering disciplines.			
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	**Define** different basic parameters in the field of electricity and magnetism, thermal physics, quantum mechanics, and photonics such as Electric Flux, Gauss' law, thermometer, thermodynamics laws, entropy, Wave Function, etc.	PO1	C1			1,2	T, MID, F
CO2	**Explain** different basic theories in the field of electricity and magnetism, thermal physics, quantum mechanics, and photonics such as electric field, kinetic theory of gases, Carnot cycle, thermodynamic function, Schrödinger Equation etc	PO1	C2			1	T, MID, F
CO3	**Solve** quantitative problems in the field of electricity and magnetism, thermal physics, quantum mechanics, and photonics such as such as electricity, magnetism, heat and thermodynamics, quantum mechanics, etc.	PO1	C3			1,2	MID, ASG, T, F

(C = Cognitive, P = Psychomotor, and A = Affective Domain; 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.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	42
Self-Directed Learning	84
Formal Assessment	6
Total	132

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week 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	
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	
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
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 emphasize 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	**Define** the different parameters regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	PO1	C1	-	-	1	R, Q, F
CO2	**Describe** the different phenomena regarding Waves and Oscillations, Optics, Mechanics, Electricity, Modern physics and Thermal physics etc.	PO1	C1	-	-	1	R, Q, T, F
CO3	**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.	PO1	C2	-	-	2	R, Q, F
CO4	**Prepare** a report for an experimental work.	PO1	C2			2	R

(C = Cognitive, P = Psychomotor, and A = Affective Domain; 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, resistance of a galvanometer, Electrochemical equivalent (ECE) of copper, comparison of the E.M.F's of two cells, radius of curvature, wavelength of light, focal length of lens, specific rotation of sugar, refractive index of a liquid, thermal conductivity of a bad conductor, temperature co-efficient of resistance, pressure co-efficient of a gas, specific heat of a liquid, acceleration due to gravity, spring constant, rigidity modulus, young's modulus, moment of inertia, conservation of linear momentum, frequency of a tuning fork, surface tension, Planck's constant.

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture Experiment	 7 35
Self-Directed learning Preparation of lab reports Preparation of Lab-test Preparation of Lab Quiz Preparation of presentation	 21 13 9 9
Formal Assessment Continuous assessment Quiz Viva Final Lab examination	 14 1 1 3
Total	112

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
Continuous Assessment (40%)	Class performance/ Assignment	10%
	Report Writing/ Assignment	30%
Final Exam (60%)	Lab test	30%

	Viva	10%
	Quiz	20%
Total Marks		100%

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

(C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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, Cartesian differentiation, 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, Indeterminate form, Partial differentiation. Euler's theorem, Tangent, sub tangent and Normal, sub normal, Maxima and Minima, Curvature, Asymptotes. **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 properties, 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.

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.
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	
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	
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	
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	C1		1	2	T, F
CO2	**Interpret** mathematics, science and engineering such as **calculating** volume and area of any object in vector field.	PO1	C3		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

(C=Cognitive, P=Psychomotor, and A=Affective Domain; 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, 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.	
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	
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	Triple products and multiple products of vectors
Week 2	
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	
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)**
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	

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	
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	
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	
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	
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	
Class 28	Equation of conics
Class 29	Equation of conics
Class 30	Homogeneous equations of second degree
Week 11	
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	
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	
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	
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%

	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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.
3. Vector Analysis (Schaum's Outline Series), by Murray R Spiegel
4. College Linear Algebra by Prof Md Abdur Rahman
5. A Text Book on Coordinate Geometry with Vector Analysis by Rahman & Bhattacharjee

*****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	C1		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	C4		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

(C = Cognitive, P = Psychomotor, and A = Affective Domain**;**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 DE by various methods, Solution of first order but higher degree DE, 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, 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 Non-linear first order Partial Differential Equation(PDE), Standard form Linear Equations (LE) of higher order, Linear PDE with constant coefficients. Equation of second order with variable coefficients, wave equation, particular solutions with boundary and initial condition, Integral surface passing through given curve, Second order PDE and classification to canonical solution, 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

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**
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**
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**
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
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: Math 213 : Complex Variable, Harmonic Function and Statistics	Contact Hours Credit Hours	: 3.00 : 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

(C = Cognitive, P = Psychomotor, and A = Affective Domain; 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.

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

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.
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
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 theorem, z-scores
Class-26	Standard deviation, moments
Class-27	S ewness and kurtosis
Week 10	**Statistics**
Cl ss-28	Elementary probability theory
Class-29	Discontinuous probability distribution, Continuous probability distribution
Cl ss-30	Binomial, 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
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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	**Define/identify** the different parameters and fundamental concepts regarding Inorganic, Organic and Physical chemistry.	PO1	C1			1	T, F
CO2	**Apply** different theory on chemical bonding and hybridization to determine structure of molecules.	PO1	C3			1	T, F, ASG
CO3	**Explain/illustrate/derive** different theories based on colligative properties, chemical equilibrium, chemical kinetics, thermochemistry, electrochemistry, and the mechanism of organic reactions.	PO1	C2			1	T, F, ASG
CO4	**Solve/Analyze** different problems related to inorganic and physical chemistry	PO2	C4			1	ASG, Mid Term Exam, F

(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain; 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. **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.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture Class Performance	42
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**
Class 1	Concepts of atomic structure, Different atom models
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**
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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

7.1.3.2. CHEM 102: Chemistry Sessional
Level-1, Term-I (Spring)

COURSE INFORMATION			
Course Code Course Title	: CHEM 102 : Chemistry Sessional	Contact Hours Credit Hours	: 3.00 : 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	**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.	PO1	C1				R,Q,T
CO2	**Perform** experimentation regarding iodimetric and iodometric method, complexometric titration etc.	PO5	C3, P5			6	R,Q,T
CO3	**Measure** zinc, ferrous content in water sample by using various titrimetric methods.	PO5	C4, P5			6	R,Q,T, Pr

(C = Cognitive, P = Psychomotor, and A = Affective Domain; 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.

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 ($C_2H_2O_4.2H_2O$) 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_2CO_3) Solution.
Class 5	Determination of Calcium (Ca) Content in a Calcium Chloride dihydrate ($CaCl_2.2H_2O$) Solution with Standard Di-Sodium Ethylene DiammineTetraAceticAcid (Na_2-EDTA) Solution.
Class 6	Standardization of Sodium ThiosulphatePentahydrate ($Na_2S_2O_3.5H_2O$) Solution with Standard Potassium Dichromate ($K_2Cr_2O_7$) Solution.
Class 7	Estimation of Copper (Cu) Content in a Copper SulphatePentahydrate ($CuSO_4.5H_2O$) (Blue Vitriol) Solutions by Iodometric Method with Standard Sodium ThiosulphatePentahydrate ($Na_2S_2O_3.5H_2O$) Solution.
Class 8	Standardization of Potassium Permanganate ($KMnO_4$) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) 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
Continuous Assessment (40%)	Lab participation and Report	15%
	Labtest-1, Labtest-2	25%
	Presentation	20%
Lab Quiz		30%
Total Marks		100%

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	A2		1	7	M
CO4	**Analyze** different cultures, civilizations and different social problems and design solutions for those	PO11	P5, C4		1		T,F

(C = Cognitive, P = Psychomotor, and A = Affective Domain**;** 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.

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
1	1.	Definition, nature and scope of sociology
	2.	Sociological imagination
2	3.	Perspectives of sociology
	4.	Orientation of sociological theories
3	5.	Social research and its process
	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
	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
	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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: LANG 102 : Communicative English I	Lecture Contact Hours Credit Hours	: 3.00 : 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	**Listen, understand and speak** English quickly and smartly using the Technics learnt in the class	PO1	C1, C2				Q, F
CO2	**Understand** the techniques of Academic reading and academic writing	PO1	C2				Q, ASG, F
CO3	**Communicate** effectively within the shortest possible time to present ideas and opinions	PO10	A2, P3		A2, A3		Q, ASG, F
CO4	**Develop** competency in oral, written communication/ presentation	PO10	A3, P4		A2, A3		Q, CS, F

(C = Cognitive, P = Psychomotor, and A = Affective Domain; 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

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	122.5

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
Continuous Assessment (40%)	Listening Test	15%
	Descriptive Writing	15%
	Reading Test	10%
Public Speaking and Final Presentation		60%
Total Marks		100%

TEXT AND REFERENCE BOOKS

1. Langan, J. (2005). College Writing Skills with Readings (6th 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, 2nd 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	**Understand** the techniques of academic reading and become acquainted with technical vocabularies	PO1	C2				T,F
CO2	**Understand** the techniques of effective academic writing such as research article/report writing.	PO 1	C2				T, F, Pr
CO3	**Communicate** effectively within the shortest possible time to present any report and research work.	PO10	A3, P3		A2, A3		T,F
CO4	Analyze any problem critically, analyze and interpret data and synthesize information to provide valid conclusions	PO10	A3, P3		A2, A3		T,F

((CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain; 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 semi-formal, Formal/official letters, Official E-mail

Writing	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

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	42
Self-Directed Learning	75
Formal Assessment	5.5
Total	122.5

TEACHING METHODOLOGY

This course is mostly activity based. Students will often be engaged in interactive discussion. The tasks and activities include pair work, group work, brainstorming, guesswork, describing picture/graph/diagrams, word puzzle, making jokes, storytelling, role play, responding to reading, writing and listening texts

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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%

	Mid term	10%
Final Exam		60%
Total Marks		100%
TEXT AND REFERENCE BOOKS		

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.	PO8	A2			5	M
CO2	**Identify** practical and legal problems commonly encountered by engineers in their professional field/industry.	PO8	A3			7	F
CO3	**Develop** foundation knowledge of ethics to be applied in professional fields.	PO8	A6			7	MT, F
CO4	**Understand** the codes of professional conduct and their implications in Mechanical Engineering Life.	PO8	A5				M, F

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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
a. Main Contents: i. Introduction to ethics ii. Importance of Ethics in Mechanical Engineering iii. Engineering Ethics iv. Introduction to Philosophy of Engineering v. Ethical Issues in Engineering Practice b. Detail Contents: Introduction to ethics, history, evolution, need and importance of ethics in Mechanical Engineering technology, ethical terminology; Introduction to the Engineering Ethics: purpose, objectives, scope, methods etc. Introduction to Philosophy of Engineering; Professional Engineering Codes, Codes of Ethics (IEB); Code of Ethics (ASME)Ethical problem solving techniques; Case study methodology, different case studies; The Rights and Responsibilities of Engineers; Ethical Issues in Engineering Practice; Ethics Issues in Mechanical Engineering; Safety, Risk and Liability; Trust and reliability.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	70
Formal Assessment	6
Total	104

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

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
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
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
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	
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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			
To learn the basic theories of economics in critical thinking and problem solving. To introduce the students to identify the basic features of economic development and regarding planning for the economy of the country.			
OBJECTIVE			
1. To help students demonstrate the knowledge of the fundamental concepts of economics. 2. To teach how efficiency in organizational decision-making can be achieved. 3. To help students understand consumer behavior, elasticity of market demand and different market structure. 4. To help students realize the importance of various macroeconomic aggregates such as national income, full employment, unemployment, inflation, productivity and the major challenges associated with the measurement of these aggregates. 5. To help students apply the basic theories of economics to make their project management cost-effective. 6. To help students recognize the basic features of economic development and regarding planning for the economy of the country. 7.			

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	**Apply** the basics of economics in optimization of a firm's decision.	PO1	C2		1	1	T, M
CO3	**Apply** the concepts of consumer behaviour, production process, cost of production and market structure to find the equilibrium that maximizes the welfare of the society.	PO11	C3, P4		1	3	T, M
CO4	**Interpret** the reasoning behind the economic policies of the government to develop the domestic economy as well as the relationship with the global economy.	PO11	C2,P3		1	1	T, F

(C = Cognitive, P = Psychomotor, and A = Affective Domain**;** 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

Main Contents	**Detail Contents**
Short History of the Evolution of Economics Thought	Definition of economics in various predominant schools of economics.
Consumer Theory	• Definition of Utility • Law of diminishing marginal utility. • Indifference Curve & MRS

	• Budget Line & Relative price • Consumer Equilibrium
Theory of Production	• Short-run VS Long-run production function • Stages of production in one-variable input production • Long-run production curve.
Production Possibility Frontier	• PPF Curve. • Applying the PPF to Society's Choices by the Engineers.
Demand & Supply	• Definition. • Law of Demand. • Law of Supply • Movement along the curve & Shift • Equilibrium analysis
Elasticity of Demand	• Different types of elasticity. • Different types of price elasticity. • Relation between AR, MR and elasticity Mathematical Analysis
Cost Analysis	• Determining, Average Cost (AC), Marginal Cost (MC) from Total Cost (TC) • Depreciation & Break-even point • Short-run cost analysis • Long-run cost analysis
Analysis of Market Structure	• Perfectly Competitive Market • Monopoly and Monopolistic Market • Oligopoly (Cournot model & Stackelberg model)
National Income	• Definition of GDP, GNP, NNP, NI • Three approaches GDP calculation. • Shortcoming of GDP calculation.
Circular Flow of National Income	• Three sector Economy (Closed Economy) • Four Sector Economy (Open Economy)
Inflation	• Inflation measuring indices • Calculation of GDP deflator & CPI • Demand-Pull and Cost-Push Inflation
Money	• History of Money • Functions of Money • Fractional Reserve Banking
Monetary policy	• Analysis of Financial Market • Monetary Policy Instruments
Fiscal Policy	• Taxation Structures • Government Spending Multiplier • Tax Multiplier • Income Tax Calculation
Exchange rate	• Definition & Calculation • How exchange rate impacts import & exports • Balance of Payment
Unemployment	• Definition of terms related to unemployment. • Calculation of unemployment rate. • Four fundamental types of unemployment. • Keynes Full Employment Theory • Analysis of labor market through various unemployment theories.

Engineering Economics	• Definition • Single Payment factor • Single Payment factor (Inflation & Tax Adjusted) • Uniform Series factor. • Gradient Series factor
Industrial Economics	• Economics of industrial revolution • Economics of union: Bargaining theories of wages

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning	75
Formal Assessment	5.5
Total	122.5

TEACHING METHODOLOGY

Class Lecture, Pop quiz, Case study, Problem solving

COURSE SCHEDULE

Week	Topic
1-4	Short History of the Evolution of Economics Thought, Importance of Economics in Engineering, National Income, Circular Flow of National Income, Consumer theory, Inflation, Money, Theory of Production, Monetary policy.
5-7	Theory of Production, Fiscal Policy, Production Possibility Frontier, Demand & Supply, Exchange rate.
8-9	Demand & Supply, Elasticity of Demand, Unemployment
10-12	Elasticity of Demand, Cost Analysis, Engineering Economics, Analysis of Market Structure
13	Analysis of Market Structure
14	Industrial Economics

ASSESSMENT STRATEGY

Components		Grading
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

TEXT AND REFERENCE BOOKS

1. Schaum's Outline of Microeconomics – McGraw-Hill by Dominick Salvatore (4rth Ed.)
2. Principle of Economics by N. Gregory Mankiw (8th Ed.)
3. Microeconomics by Robert S. Pindyck and Daniel L. Rubinfeld (8th Ed.)
4. Introduction to Macroeconomics with Applications to Bangladesh Economy by Kazi Iqbal & Amin Bin Hasib
5. Schaum's Outline of Macroeconomics – McGraw-Hill by Eugene A. Diulio (3rd Ed.)
6. Macroeconomics by N. Gregory Mankiw (8th Ed.)
7. Schaum's Outline Engineering Economics – McGraw-Hill by Jose Sepulveda, William Souder & Byron Gottfried
8. Engineering Economics by Niall M. Fraser and Elizabeth M. Jewkes. (5th Ed.)

*****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	A3			7	MID, F, ASG
CO2	**Explain** the economy and patterns of economic changes through qualitative and quantitative analysis.	PO 6	A2			7	MID, F, Pr, R

(C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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

a. Main Contents: Impact of Geography, History, Environment, Economy, Constitution and Culture of Bangladesh in Engineering Application
b. Detail Contents: Bangladesh Geography: Location, Area, Boundary, Physiography, River system, Forest and Climate, Demography of Bangladesh, Maritime zones.

History: 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 .

Environment, Economy and Culture:

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.		
TEACHING LEARNING STRATEGY		
Teaching and Learning Activities		Engagement (hours)
Face-to-Face Learning Lecture Practical / Tutorial / Studio Student-Centred Learning		 28 10 -
Self-Directed Learning Non-face-to-face learning Revision of the previous lecture at home Preparation for final examination		 8 10 18
Formal Assessment Continuous Assessment Final Examination		 3 3
Total		80
TEACHING METHODOLOGY		
Lecture, Tutorial, problem Based Methods		
COURSE SCHEDULE		
Week 1	**Introduction**	
Class 1	Introductory class: Brief discussion on the total syllabus, basic requirements of the course, methods of assessment of the course	
Class 2	Bangladesh Geography: 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**	
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	
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		
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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. Enable 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	**Classify** the growth of technologies with the changing era.	PO2	C4	1		3	ASG, F
CO2	**Contrast** improvement of electrical technology with the impact on environment, human beings and global climates.	PO 7	A2	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.	PO7	A4	2		7	T, Mid Term Exam, F
CO4	**Understand** the legal issues regarding engineering, environment, business and industrial law, law of contract and elements for valid contract provided by the government..	PO6	A5	3			ASG, Pr, R

(C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.

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
Week 1	**Environment, society and development**
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**
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,
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**
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: GELM 275 : Leadership and Management	Contact Hours Credit Hours	: 2.00 : 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 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	**Understand** the fundamental concepts of leadership and management skills	PO 9	A1, P1				F
CO2	**Apply** the role and contribution of a leader in achieving organizational goals	PO9	A2, P2				PR
CO3	**Understand** the contribution of leadership traits and management skills in decision making and solving real life problems	PO 9	A2, P2				M, F

(C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.

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

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.
	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	**Leadership & Motivation**: Motivation, Maslow's hierarchy needs; theory of X & Y; motivators and hygiene factors; goal setting theory; reinforcement theory; equity theory; expectancy theory
	Lec 4	
3	Lec 5	**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).
	Lec 6	
4	Lec 7	**Case Study – I : Engineer as Great Leaders**
	Lec 8	
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).
	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.
	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		
Components		Grading
Continuous Assessment (40%)	Class test 1-2	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: GERM-352 : Fundamentals of Research Methodology (Sessional)	Contact Hours Credit Hours	: 2.00 : 1.00

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.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	**Understand** the research fundamentals and **identify** problem statement and research	PO 12	C2	-			ASG, R, Lab Quiz

	questions/ objectives.						
CO2	**Develop** writing and presentation skill, and **demonstrate** ethical considerations in conducting research.	PO 7	C3	-		7	Pr, Lab Quiz
CO3	**Formulate** and **compose** a research proposal considering research activities/design, background studies, and following standard guidelines.	PO 10	C6	1, 2	1		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; 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.

TEACHING LEARNING STRATEGY

Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	
Lecture	7
Practical / Tutorial / Studio	7
Student-Centred Learning	7
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	53

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	Foundations of Research: Meaning of Research; Definitions of Research; Objectives of Research.

2	Lec 2	Motivation in Research; General Characteristics of Research; Criteria of Good Research.
3	Lec 3	Types of Research; Concept of theory, empiricism, deductive and inductive theory; Characteristics of scientific method.
4	Lec 4	Problem Identification & Formulation: Meaning & need of Review of Literature; How to Conduct the Review of literature.
5	Lec 5	Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.
6	Lec 6	Research Design: Concept and Importance in Research – Features of a good research design, Breakdown of a research paper.
7	Lec 7	Research Misconduct and Ethics: Understand the research misconduct; type of research misconduct; Ethical issues in conducting research.
8	Lec 8	Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
9	Lec 9	Use of Tools / Techniques for Research: Layout of a Research Paper; Methods to search required information effectively.
10	Lec 10	Reference Management Software like Zotero/Mendeley; Software for paper formatting like LaTeX/MS Office.
11	Lec 11	Software for detection of Plagiarism. Time management and developing Gantt Charts.
12	Lec 12	Research paper writing Techniques to present research paper
13	Lec 13	Research proposal writing Thesis book writing
14	Lec 14	Final Proposal/Paper summary Submission and Presentation

ASSESSMENT STRATEGY

Assessment Criteria

Components	**Grading**
Attendance + Class performance	10%
Report	20%
Lab Quiz	30%
Final Paper/Proposal	40%
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	C2		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	C2	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	C2		2	1	MT, F
CO4	**Apply** the risk analysis, cost-volume profit, budgeting, standard costing and variance analysis for any project.	PO 11	C3		3	7	T, F
(CO = Course Outcome, C = Cognitive, P = Psychomotor, and A = Affective Domain; 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.	
TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning	28
Self-Directed Learning Non-face-to-face learning Revision	 56 14
Formal Assessment	4
Total	104
TEACHING METHODOLOGY	
Lecture and Discussion, Co-operative and Collaborative Method, Problem Based Method	
COURSE SCHEDULE	

Week 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	
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	
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	
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**
Continuous Assessment (40%)	Class Test/ Assignment (1-3)	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Examination		60%
Total Marks		100%

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 Course Title	: GEA-201 : Principles of Accounting	Lecture Contact Hours Credit Hours	: 2.00 : 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

(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**
Week-1	
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	
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	
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	
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
Continuous Assessment (40%)	Class Test	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
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.**

7.1.4.12. BAN-101: Bangla Language and Literature
Level-x, Term x

COURSE INFORMATION

Course Code	: BAN-101	Lecture Contact Hours	: 2.00
Course Title	: Bangla Language and Literature	Credit Hours	: 2.00

PRE-REQUISITE

None

CURRICULUM STRUCTURE

Outcome Based Education (OBE)

SYNOPSIS/RATIONALE

The Bangla Language and Literature course is designed for the students to develop their basic competence in Bangla communication skills for academic purposes especially in reading and writing. The course incorporates a wide range of reading Bangla Literature 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. Upon completion of this course, students are expected to be able to communicate effectively at various situations, participate in group activities and prepare formal speech for academic, professional and social purposes.

OBJECTIVE

1. To develop the basic skills of Bangla language to communicate effectively and professionally.
2. To improve students' Bangla pronunciation in order to improve their level of comprehensibility in both speaking and listening.
3. To give the students exposure to different types of texts in Bangla in order to make them informed using different techniques of reading.
4. To gain an understanding of the underlying writing well-organized paragraphs and also to teach how to edit and revise their writing.

COURSE OUTCOMES & GENERIC SKILLS

No.	Course Outcomes	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Understand the techniques of Bangla academic reading and become acquainted with technical vocabularies	PO1	C2			7	T, F
CO2	Communicate effectively within the shortest possible time to present ideas and opinions	PO10	A2, P3		A2, A3		T, ASG, F
CO3	Develop competency in oral, written communication/ presentation	PO10	A3, P4		A2, A3		Mid, 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

ক। সাহিত্য (প্রবন্ধ, গল্প ও কবিতা)- ৪০% নম্বর

খ। ব্যাকরণ, ভাষা শিক্ষা ও বিরচন - ৬০% নম্বর

(প্রবন্ধ, গল্প ও কবিতাসমূহ ঢাকা বিশ্ববিদ্যালয় এবং ইউজিসি'র সি-লবাস হ-ত সংগৃহীত)

গ। **নির্বাচিত প্রবন্ধ**

(১) বাঙ্গালা ভাষা - বঙ্কিমচন্দ্র চট্টোপাধ্যায়

ঘ। **নির্বাচিত গল্প**

(১) নয়নচারা - সৈয়দ ওয়ালীউল্লাহ

ঙ। **নির্বাচিত কবিতা**

(১) বি-দ্রাহী - কাজী নজরুল ইসলাম

(২) বঙ্গভাষা - মাইকেল মধুসূদন দত্ত

চ। **ব্যাকরণ ও ভাষা শিক্ষা**

(১) প্রমিত বাংলা বানা-নর নিয়ম।

(২) অশুদ্ধি সং-শাধন।

(৩) বাগ্ধারা।

(৪) প্রবাদ প্রবচন।

(৫) এক কথায় প্রকাশ।

(৬) প্রশাসনিক পরিভাষা।

(৭) প্রায় স-মাচ্চারিত ভিন্নার্থক শব্দ ।

(৮) বিভিন্ন শ-ব্দর বিশিষ্টা-র্থ প্র-য়াগ ।

ছ। **উচ্চারণবিধি**

জ। **বিরচন**

(১) ইং-রজি থে-ক বাংলা অনুবাদ/অনু-চ্ছদ রচনা।

(২) ভাব সম্প্রসারণ/সারাংশ/সারমর্ম।

(৩) পত্র/প্রতিবেদন রচনা ।

(৪) প্রবন্ধ রচনা ।

CO-PO MAPPING

(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 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
Week-1	
1	প্রবন্ধ: বাঙ্গালা ভাষা
2	প্রবন্ধ: বাঙ্গালা ভাষা
Week-2	
3	গল্প: নয়নচারা
4	গল্প: নয়নচারা
Week-3	
5	কবিতা: বঙ্গভাষা
6	কবিতা: বঙ্গভাষা
Week-4	
7	কবিতা: বি-দ্রাহী
8	কবিতা: বি-দ্রাহী
Week-5	
9	প্রমিত বাংলা বানা-নর নিয়ম
10	প্রমিত বাংলা বানা-নর নিয়ম
Week-6	

11	অশুদ্ধি সং-শাধন
12	অশুদ্ধি সং-শাধন
Week-7	
13	উচ্চারণ বিধি
14	উচ্চারণ বিধি
Week-8	
15	প্রবাদ প্রবচন
16	এক কথায় প্রকাশ
Week-9	
17	প্রশাসনিক পরিভাষা
18	বিভিন্ন শ-ব্দর বিশিষ্টা-র্থ প্র-য়াগ
Week-10	
19	বাগ্ধারা
20	প্রায় সমুচ্চারিত ভিন্নার্থক শব্দ
Week-11	
21	ইং-রজি থে-ক বাংলা অনুবাদ/অনু-চ্ছদ রচনা
22	ইং-রজি থে-ক বাংলা অনুবাদ/অনু-চ্ছদ রচনা
Week-12	
23	ভাবসম্প্রসারণ/সারাংশ/সারমর্ম
24	ভাবসম্প্রসারণ/সারাংশ/সারমর্ম
Week-13	
25	পত্র/প্রতিবেদন রচনা
26	পত্র/প্রতিবেদন রচনা
Week-14	
27	প্রবন্ধ রচনা
28	প্রবন্ধ রচনা

ASSESSMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Class Test	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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

TEXT AND REFERENCE BOOKS

1. বাংলা ব্যাকরণ - ড. শাহজাহান মুনীর, স্টুডেন্টস পাবলিকেশনস।
2. প্রবন্ধসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।
3. গল্পসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।
4. কবিতাসংগ্রহ - ঢাকা বিশ্ববিদ্যালয়।
5. বাংলা বানান অভিধান - বাংলা একাডেমি কর্তৃক প্রকাশিত।
6. বাংলা উচ্চারণ অভিধান - বাংলা একাডেমি কর্তৃক প্রকাশিত।
7. প্রমিত বাংলা ব্যাকরণ ও নির্মিতি (তৃতীয় খণ্ড) - ড. হায়াৎ মামুদ ও ড. মোহাম্মদ আমীন।
8. বাংলা ভাষার প্রয়োগ ও অপপ্রয়োগ - বাংলা একাডেমি কর্তৃক প্রকাশিত।

*****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 Course Title	: CSE 109 : Computer Programming	Contact Hours Credit Hours	: 3.00 : 3.00

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. 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, A2	1,3	-	5	T, F, MT
CO4	**Develop** the communication skill by presenting topics on programming phenomena.	PO1	C2	-	-	3	PR, Q

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

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	 2

Final Examination	3
Total	131

TEACHING METHODOLOGY

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

COURSE SCHEDULE

Week	Lecture	Topics
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
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
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
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 Lec 33	File I/O, header files, preprocessors, error handling
11	Lec 28 Lec 29 Lec 30	Introduction to C++: Basic Ideas of OOP- encapsulation, inheritance and polymorphism
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
Continuous Assessment (40%)	Test 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 2	C3	1	-	2	O, E, ASG
CO2	Practically **analyse** the fundamental principles, typical characteristics and mechanisms of a structured programming language.	PO5	C4, P3	3	-	6	O, E, ASG, Q
CO3	**Construct** or **develop** complete programs for simple to moderate problems individually.	PO3	C6,A3	1, 3		3	O, E, ASG
(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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							
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
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
3	Lab 3	Control Structure: if-else, switch case, nested if-else, loop, nested loop
4	Lab 4	Control Structure: loop, nested loop
5	Lab 5	Array: one-dimensional array, multi-dimensional array, character array/ string
6	Lab 6	Function: Function definition, function declaration, function call
7	Lab 7	Online – 1
8	Lab 8	Pointer: Different types of pointers, pass pointer as arguments, call by value vs call by reference
9	Lab 9	Dynamic Memory Allocation: Malloc, calloc, free, realloc
10	Lab 10	User defined data types: Structure, union, enumeration
11	Lab 11	File I/O, header files, preprocessors, error handling
12	Lab 12	Introduction to C++: Classes and objects;
13	Lab 13	Encapsulation, Access Specifiers
14	Lab 14	Online – 2

ASSESSMENT STRATEGY

Components		**Grading**
Continuous Assessment (40%)	Lab Test	20%
	Class Participation	5%
	Class Attendance	5%
	Assignment	10%
Online Test – 1		20%
Online Test – 2		20%
Viva/ Quiz		20%
Total Marks		100%

REFERENCE BOOKS

1. Teach Yourself C (3rd Edition) by Herbert Schildt
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 Course Title	: CSE 371 : Microprocessors and Interfacing	Lecture Contact Hours Credit Hours	: 3.00 : 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	**Describe** the mechanism of internal blocks of various microprocessors along with their basic architectures, instructions set and **illustrate** their differences.	PO1	C1	P1, P2, P3		2	T, Mid Term Exam
CO2	**Develop** ideas on memory addressing, software interrupts, hardware interrupts and **estimate** their effects by programming with a compiler.	PO2	C1	P1, P2, P3		4	T, Mid Term Exam,F
CO3	I**llustrate** embedded systems, their application and incorporate them with the idea of IoT.	PO1	C4	P1, P2, P3		3	T,F
CO4	C**onstruct** systems based on their interfacing with microcontrollers and microproc-essors like keyboard interfacing and display interfacing and **solve** real-life engineering problems.	PO3	C6, A3	P1, P2, P4		5	F, ASG

(CO = Course Outcome, C = Cognitive Domain, P = Psychomotor Domain, A = Affective Domain; 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.		
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 Microprocessor**	
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.	
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**
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**
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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
Total Marks		100%

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 Course Title	: CSE 372 : Microprocessors and Interfacing Laboratory	Contact Hours Credit Hours	: 3.00 : 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	**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	P6,A4		1,2		R,Q,T
CO2	**Build** communication between the real world and other devices with microprocessors.	PO9	A2, P5				R,Q,T

CO3	Differentiate between different instruction sets and demonstrate skills to manipulate the versatility of used devices.	PO5	C5,P1	1,2,3		6	R,Q,T
CO4	Construct different types of digital circuits incorporating modern tools for a specific operation which will be efficient, economic and user friendly.	PO10	P6,A4		1,2		PR, Pr, Q

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 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**
Continuous Assessment	Lab participation and Report	20%
	Labtest-1, Labtest-2	30%
	Project and Presentation	25%

Lab Quiz	25%
Total Marks	100%
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)

COURSE INFORMATION			
Course Code Course Title	ME 283 Fundamentals of Mechanical Engineering	Contact Hours Credit Hours	3.00 3.00
PRE-REQUISITE			
None			
CURRICULUM STRUCTURE			
Outcome Based Education (OBE)			
SYNOPSIS/RATIONALE			
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.			
OBJECTIVE			
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			

LEARNING OUTCOMES & GENERIC SKILLS

No.	Course Outcome	Corresponding PO	Bloom's Taxonomy	CP	CA	KP	Assessment Methods
CO1	Identify various sources of energy	PO1	C1	1,2,3		3	Q, ASG, F
CO2	Explain internal combustion engines, turbines, refrigeration and air conditioning system, different materials, fluid machineries etc. as well as Robotics, MEMs etc	PO1	C3	1,2,3		3	Q, ASG, F
CO3	Explain various engineering measurement units and their conversion for solving problems using various charts	PO1	C3	1,2		3	Q, ASG, F

(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)

COURSE CONTENT

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 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.

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
Continuous Assessment (40%)	Class Test/ Assignment 1-3	20%
	Class Participation	5%
	Class Attendance	5%
	Mid term	10%
Final Exam		60%
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. 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	Compute the various properties of fuels	PO 1	C3	1,2		1	ASG, R, F, Pr
CO2	Identify various component of engine and conduct performance analysis	PO 1	C2	1,2		1	ASG, R, F, Pr
CO3	Compute performance of fluid machineries like pump and turbine	PO 1	C3	1,3		1,2	ASG, R, F, Pr
CO4	Compute psychrometric properties of air and performance of refrigeration system	PO 1	C3	1,3		1,2	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

TEACHING LEARNING STRATEGY	
Teaching and Learning Activities	Engagement (hours)
Face-to-Face Learning Lecture	 14
Practical	28
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		
Components		**Grading**
Continuous Assessment (40%)	Presentation	20%
	Class Participation and Report	20%
Final Examination		60%
Total Marks		100%

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