MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)

SYLLABUS OF

BACHELOR OF SCIENCE IN ELECTRICAL, ELECTRONIC & COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRICAL, ELECTRONIC & COMMUNICATION ENGINEERING (EECE)

JANUARY 2019

COMMITTEE FOR SYLLABUS REVIEW – EECE DEPT, MIST

The under-graduation course curriculum of the department of Electrical, Electronic & Communication Engineering (EECE) of Military Institute of Science and Technology (MIST) has been reviewed by the committee as mentioned below and will be implemented from Level-1 of academic session 2018-19 (Batch EECE-17).

A. President

____

Brigadier General A K M Nazrul Islam, PhD
Head of EECE Department
Military Institute of Science and Technology

B. Internal Members

1.

____

Air Commodore Md Afzal Hossain, ndc, psc
Dean, ECE & Head, Dept. of CSE
Military Institute of Science and Technology

2.

____

Brigadier General Md Shahidul Alam
Senior Instructor, EECE Department
Military Institute of Science and Technology

3.

____

Air Commodore Mohammed Hossam-E-Haider, PhD (LPR)
Professor, EECE Department
Military Institute of Science and Technology

4. ____

Colonel Md Golam Mostafa
Senior Instructor, EECE Department
Military Institute of Science and Technology

5. ____

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Senior Instructor, EECE Department
Military Institute of Science and Technology

6. ____

Colonel Molla Md Zubaer, te
Senior Instructor, EECE Department
Military Institute of Science and Technology

7. ____

Gp Capt Md Abdul Halim, psc
Senior Instructor, EECE Department
Military Institute of Science and Technology

8. ____

Commander K M Tanveer Anwar(L), BN
Instructor Class ‘A’, EECE Department,
Military Institute of Science and Technology

9. ____

Lieutenant Colonel Md. Tawfiq Amin, PhD, EME
Instructor Class ‘A’, EECE Department
Military Institute of Science and Technology

10.

Major Md. Ali Azam Khan, EME
Instructor Class ‘B’, EECE Department
Military Institute of Science and Technology

11.

Wg Cdr Nurul Huda
Instructor Class ‘A’, Science and Hum Department
Military Institute of Science and Technology

12.

Major Palash Kumar Sarker, PhD, Sigs
Instructor Class ‘B’, Science and Hum Department
Military Institute of Science and Technology

13.

Lieutenant Commander S M Anisur Rahman, (H-3), BN
Instructor Class ‘B’, CSE Department
Military Institute of Science and Technology

C. <u>BUP Members</u>

1.

Commodore Syed Salahuddin Ahmed (S), NUP, ndu, afwc, psc, BN
Dean, Office of the Evaluation, Faculty & Curriculum Development
Bangladesh University of Professionals (BUP)

2. ____

Brigadier General A K M Iqbal
Inspector of Colleges
Bangladesh University of Professionals (BUP)

3. ____

Brigadier General Md Wahid-Uz-Zaman, ndc, psc, TE
Dean, Faculty of Science and Technology (FST)
Bangladesh University of Professionals (BUP)

D. <u>External Members</u>

1. ____

Dr. M. Rezwan Khan
Professor
Department of Electrical and Electronic Engineering
Bangladesh University of Engineering and Technology

2. ____

Dr. Satya Prasad Majumder
Professor
Dean, Faculty of EEE
Bangladesh University of Engineering and Technology

3. ____

Dr. Anisul Haque
Professor
Department of Electrical and Electronic Engineering
East West University

4. ____

Dr. Md. Shafiqul Islam
Professor
Head of the Department
Department of Electrical and Electronic Engineering
Bangladesh University of Engineering and Technology

5. ____

Dr. Subrata Kumar Aditya
Professor
Department of Electrical and Electronic Engineering
Dhaka University

6. ____

Dr. Abdul Hasib Chowdhury
Professor
Department of Electrical and Electronic Engineering
Bangladesh University of Engineering and Technology

E. Members (External: Professional Organization/ Industry)

1. ____

Engr. Dr. Rimi Rashid
Senior Engineer
Bangladesh Atomic Energy Commission (BAEC)

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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) that 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. The motto of MIST is ―Technology for Advancement. Founded on 19 April 1998, MIST started its journey on 31 January 1999 by offering a four-year bachelor's degree on Civil Engineering. Bachelor degree on Computer Science Engineering course started on 2001**.** Bachelor courses on Electrical, Electronic & Communication Engineering and Mechanical Engineering started its journey from 2003. Bachelor of Science program on Aeronautical Engineering (AE) and Naval Architecture and Marine Engineering (NAME) program were started from 2008-2009 and 2012-2013 respectively. Besides, four new departments started their academic session from 2014-2015 i.e. Nuclear Science & Engineering (NSE), Biomedical Engineering (BME), Architecture (Arch) and Environmental, Water Resources & Coastal Engineering (EWCE).

1.2 Vision and Mission of MIST

Vision: To be a centre of excellence for providing advanced quality education in the field of scientific, engineering and technology advanced to create diverse quality leaders and professionals and conduct innovative research to meet the national and global needs and challenges.

Mission: MIST is working on following missions:

a. To develop as a Centre of Excellence for providing comprehensive education and conducting creative and innovative research in diverse disciplines of engineering, technology, science, management and related fields.

b. To produce technologically advanced intellectual leaders and professionals with high moral and ethical values to meet the national and global needs for sustainable socio- economic development.

c. To provide consultancy, advisory and testing services to government, industrial, educational and other organizations to render technical support for widening practical knowledge and to contribute in sustainable socio-economic advancement.

d. To extend collaborative and research activities with national and international communities for life-long learning and long term interaction with the academician and industry.

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. **Integrity and Respect-**We embrace honesty, inclusivity, and equity in all that we do.
b. **Honesty and Accountability-**Our actions reflect our values, and we are accountable for both.
c. **Dedication to Quality and Intellectual Rigour-**We strive for excellence with energy, commitment and passion.
d. **Pursuit of Innovation-**We cultivate creativity, adaptability and flexibility in our students, faculty and staff.

1.4 Eligibility of Students for Admission in MIST

The students must fulfill the following requirements:

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

(1) The applicant must have passed SSC/equivalent examination in Science Group obtaining GPA 4.00 (without fourth subject) in the scale of 5.0 and in HSC/Equivalent examination from Board of Intermediate and Secondary Education/Madrasa Education Board/Technical Education Board in science group the applicant must have obtained minimum 'A+' (Plus) in any TWO(2) subjects out of FIVE (5) subjects including Mathematics, Physics, Chemistry, English, and Bengali and 'A' in rest THREE (3) subjects.
(2) The applicant must have qualified in minimum five subjects including Mathematics, Physics, Chemistry and English Language with minimum 'B' in average in GCE 'O' Level and in 'A' level he/she must have obtained minimum 'A' in ONE subject out of three subjects including Mathematics, Physics, and Chemistry with and minimum 'B' in rest TWO subjects.
(3) Applicants who have passed HSC or Equivalent examination in the current year or one year before the notification for admission can apply.
(4) Sex: Male and Female.

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 AFD of the Government of the People's Republic of Bangladesh. Applicants must fulfill the following requirements:

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

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

(3) Sex: Male and Female.

In the event of non-availability of foreign students, Bangladeshi civil candidates will fill up the vacancies.

1.5 Number of Seats.

The highest number of seats for 04(Four) years Bachelor Degree in Engineering programmes (Unit – A) and 5 (Five) years Bachelor Degree of Architecture programmes are as follows:

Allocation of Seats

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

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

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

1.6 Admission Procedure

1.6.1 Syllabus for Admission Test. Admission test will be conducted on the basis of the syllabus of Mathematics, Physics, Chemistry and English (comprehension and functional) subjects of HSC examinations of all boards of secondary and higher secondary school certificates. Admission test will be conducted out of 200 marks and the distribution of marks is given below:

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

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

1.6.3 <u>Medical Checkup</u>. Civil candidates selected through admission test will go for medical checkup in MIST/CMH. If the medical authority considers any candidate unfit for study in MIST due to critical/contagious/mental diseases as shown in medical policy of MIST will be declared unsuitable for admission.

1.7 Students Withdrawal Policy

1.7.1 For Poor Academic Performance.

The under graduate (B.Sc) Engineering programs for all engineering disciplines are planned for 04 regular levels, comprising of 08 regular terms for Architecture programme it is planned for 3 & 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/self-study (for graduating student) examination as per examination policy.

b. Students may also retake the failed subject/course in regular term/short term as per Examination policy.

c. Maximum grading for supplementary/self study examination etc. of failed subjects will be B+ as per examination policy.

d. 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.

e. 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 , MIST.

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

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

g. Whatever may be the cases, students have to complete the whole undergraduate Program within 06 (six) academic years from the date of registration.

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

1.7.2 Withdrawal on Disciplinary Ground

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

(1) Communicating with fellow students for obtaining help in the examination.

(2) Copying from another student's script/ report /paper.

(3) Copying from desk or palm of a hand or from other incrimination documents.

(4) Possession of any incriminating document whether used or not.

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

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

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

1.7.3 Withdrawal on Own Accord.

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

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

CHAPTER 2

RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME AT MIST

Introduction

2.1 MIST has introduced 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 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 5 in each term. However, with the recommendation of course coordinator and Head of the Department, Commandant MIST may allow relaxation in this regard. This relaxation is to be reported to Academic Council of MIST.
- **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 and Fall) in an academic year. In addition to these two regular terms there will be a short term after the Fall Term of each academic session. During the short term, students can take only failed courses to cover up the credit deficiencies.

2.6 Respective departments will take the decisions about courses to be offered during each short term depending upon the availability of course teachers and number of students willing to take a particular course.

Duration of Terms

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

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

2.8 The duration of a Short Term will be around 7 weeks of which about 6 weeks will be spent for class lectures and one week for Term Final Examination. The duration for Short Term and Examination will be as under:

Ser	Events	Durations
1.	Classes	6 weeks
2.	Final Examination	1 week
Total		**7 Weeks**

Course Pattern and Credit Structure

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

Course Designation System

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

a. The left most digit corresponds to the year in which the course is normally taken by the students. The second digit is reserved for departmental use. It usually identifies a specific area/group of study within the department.

b. The right most digit is an odd number for theoretical courses and an even number for sessional courses.

2.11 The course designation system is illustrated as Follows:

EECE 101 **Electrical Circuits I**

Course Title

Odd digit designates a theoretical course

Reserved for departmental use

Signifies 1st Year/ 1st Level course

Department Identification

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

Course Title
Even digit designates a sessional course
Reserved for departmental use
Signifies 2^{nd} Year/ 2^{nd} Level course
Department Identification

EECE 201 **Electronics-I**

Course Title
Odd digit designates a theoretical course
Reserved for departmental use
Signifies 1^{st} Year/ 1^{st} Level course
Department Identification

EECE 202 **Electronic Circuits& Simulation Laboratory I**

Course Title
Even digit designates a sessional course
Reserved for departmental use Signifies 2^{nd}
Year/ 2^{nd} Level course Department
Identification
Department Identification

Assignment of Credits

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

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

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

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

Types of Courses

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

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

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

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

Course Offering and Instruction

2.14 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.

2.15 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

2.16 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's Adviser

2.17 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.

2.18 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.

2.19 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 term. The adviser may permit the student to drop one or more courses based on previous academic performance.

Course Registration

2.20 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.

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

2.22 Pre-conditions for Registration.

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

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

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

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

2.24 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

2.25 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.

2.26 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 Comdt, a lesser number of credit hours to suit individual requirements. Such cases are also applicable to students of Level 4 requiring less than 15 credit hours for graduation.

Course Add/Drop

2.27 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 and only during the first week of a short term. Dropping a course is permitted within the first four weeks of a regular term and two weeks of a short term.

2.28 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 made for distribution to the concerned adviser, Head, Dean, Controller of Examinations and the student.

2.29 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

2.30 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

2.31 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 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:

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
Incomplete	I	-

Withdrawal	W	-
Capstone Project/Thesis continuation	X	-

* 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

2.32 Theory. Forty percent (40%) of marks of a theoretical course shall be allotted for continuous assessment, i.e. quizzes, home assignments, class tests, observations/ class participation and class attendance. This marks must be submitted to Office of the Controller of Examinations before commencement of 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 Test/ Assignment	20%
Mid Term Assessment (Exam/Project)	15%
Final Examination (Section A & B)	60%
Total	**100%**

2.33 Sessional/Practical Examinations. Sessional courses are designed and conducted by the concerned departments. Examination on 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 sessional courses on the basis of the followings (all or as decided by the Examination Sub-Committee):

a.	Conduct of Lab Tests/Class Performance	25%
b.	Report Writing/ Programming	15%
c.	Mid-Term Evaluation (exam/project/assignment)	20%
d.	Final Evaluation (exam/project/assignment)	30%
e.	Viva Voce	10%
	Total percentage	**100%**

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

a.	Class performance/observation	10
b.	Written Assignment	15
c.	Oral Performance	25
d.	Listening Skill	10
e.	Group Presentation	30
f.	Viva Voce	10
	Total percentage	**100%**

2.35 <u>Class Attendance</u>.

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

<u>Collegiate and Non-collegiate</u>

2.36 Students having class attendance of 90% or above in individual subject will be treated as collegiate and less than 90% and up to 75% will be treated as non-collegiate in that subject. The non-collegiate student(s) may be allowed to appear in the examination subject to payment of non-collegiate fee/fine of an amount fixed by MIST/BUP. Students having class attendance below 75% will be treated as dis-collegiate and will not be allowed to appear in 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.

<u>Calculation of GPA</u>

2.37 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 $C_1, C_2, \ldots, C_n$ and his grade points in these courses are $G_1, G_2, \ldots, G_n$ respectively then

$$GPA = \frac{\sum_{i=1}^{n} CiGi}{\sum_{i=1}^{n} Ci}$$

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 $TC_1, TC_2, \ldots, TC_n$ and his GPA in these terms are GPA_1, GPA_2, GPA_n respectively then

$$CGPA = \frac{\sum_{i=1}^{n} TCiGPAi}{\sum_{i=1}^{n} TCi}$$

Numerical Example

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

Course	Credits, C_i	Grade	Grade, G_i	Points, C_I*G_i
EECE 102	1.50	A-	3.50	5.250
EECE 105	3.00	A+	4.00	12.000
CHEM 101	3.00	A	3.75	11.250
MATH 111	3.00	B	3.00	9.000
HUM 127	3.00	B-	2.75	8.250
HUM 177	3.00	B	3.00	9.000
PHY 111	3.00	A+	4.00	12.000

CSE 109	1.50	A	3.75	5.625
Total	21.00			72.375

GPA = 72.375/21.00 = 3.45

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

Level	Term	Credit Earned, TC_I	Hours GPA Earned, GPA_i	GPA_i*TC_i
1	1	21.00	3.73	78.330
1	2	20.50	3.93	80.565
2	1	19.75	3.96	78.210
2	2	20.25	4.00	81.000
Total		**81.50**		**318.105**

CGPA = 318.105/81.50 = 3.90

Minimum Earned Credit and GPA Requirement for Obtaining Degree

2.38 Minimum credit hour requirements for the award of bachelor‘s degree in engineering (B.Sc. Engineering) and other discipline will be decided as per existing rules. The minimum CGPA requirement for obtaining a Bachelor‘s degree in engineering and other discipline is 2.20.

Minimum Earned Credit and GPA Requirement for Obtaining Degree

2.39 Minimum credit hour requirements for the award of bachelor's degree in engineering (B.Sc. Engineering) and other discipline will be decided as per existing rules. The minimum GPA requirement for obtaining a Bachelor's degree in Engineering and Architecture is 2.20.

Impacts of Grade Earned

2.40 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.

2.41 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.

2.42 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.

2.43 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.

2.44 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

2.45 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	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

2.46 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 of15 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.

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

Performance Evaluation

2.48 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.

2.49 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.

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

Application for Graduation and Award of Degree

2.51 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

2.52 A student must complete his studies within a maximum period of six years for engineering and seven years for architecture.

Attendance, Conduct and Discipline

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

2.54 **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.

2.55 **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

2.56 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

2.57 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

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

Types of Different Examination

2.59 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 22wk 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. **Short Term Examination:** Short Term may be conducted after one week completion of Term 2 final examination. Students will be allowed to take maximum three theoretical courses in the Short Term. Examination will be conducted at the end of Short Term (6^{th} week class). However, Head of concerned department with the approval of Commandant may decide to take Supplementary examination instead of Short Term. No Laboratory/Sessional Courses can be taken in short term.

c. **Supplementary Examination:** It will take place once in a year, after each term-I final break. It should be completed within first 3 weeks of a new term. Students will be allowed to appear this examination for one subject at a time. Graduating students will be allowed to appear maximum two subjects during supplementary examination in their last Term. However, Head of the concerned department with the approval of Commandant may decide to take another Supplementary Examination instead of Short Term. In that case, a student will be allowed to take only one failed course in the particular Supplementary Examination. This examination will be conducted in the previous week of the beginning of Term I. If any student fails in a course, he can clear the course retaking it 2nd 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 regular or short term for appearing third time. But if anyone fails even after appearing third time, he has to take approval from Academic Council of

MIST for appearing last time in a course. Highest achieved grade for all courses of Supplementary Examination will be B+.

d. **Improvement Examination:** It will be taken during supplementary and short term examination. Questions will be same as the question of the regular examination of that Short Term Final Examination (if any). Student can take two subject at a time 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 then '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.

e. **Self-Study Course Examination:** Only graduating students (level-4) will be allowed to appear at Self Study course examination. It will be taken with Term Final Examination. No regular class will be arranged for this, but teachers will be assigned for supervising and guiding the students for study, conducting class test/quiz and regular assessment for 30% marks. Maximum two theory courses may be taken as self-study course by a student. Highest achieved grade for these courses will be B+. In that case a student will be allowed to take maximum 24 credit instead of 15 in the last Term of his/her graduation.

f. **Special Referred Examination:** Since course system has started from 1st Term of 2018, for all casualty cases like referred, backlog, failed courses, level repeat students were be given chance to clear their respective all failed courses by appearing in this examination. It was held after the confirmation of the result of Term-II Final Examination of 2017 and before starting of the class of the Term-I of 2018. Students of all levels, failed in any courses even after appearing in Special Referred Examination-1, were allowed to re-appear again in the failed courses during Special Referred Examination-2 was held during Mid Term break of Term-1 of 2018. Student of Level-4 of 2017, failed in any courses even after appearing in these two referred examinations, were allowed to clear failed courses as a last chance, during Term-1 final examination of 2018 (as a Special Referred Examination-3). Students of other levels, failed in any courses even after appearing in two Special Referred Examinations, were allowed to clear these failed courses as per normal rules of course system (either by retaking these courses or appearing at the supplementary Examination). Highest grade for courses in all these examinations was 'B+'.

Rules of Different Examinations

2.60 Term Final Examination. Following rules to be followed:

a. Registration to be completed before commencement of the class. 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 one week of the term.

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

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

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

2.61 Short Term Examination. Following rules to be followed:

a. Short Term for period of 6 weeks may be offered by a department after one week of completion of Term II Final Examination.

b. Short Term Final Examination is to be conducted on 7th week of Short Term.

c. Only repeat course can be offered, not any fresh course.

d. Classes will be arranged for the students who register a failed course in the Short Term.

e. After 6 (six) weeks of class, in the 7th week short Term Examination will be held. Academic calendar for this Short Term will be declared by the Department during the Mid-Term break of Term-II.

f. One student can take only three (failed/improvement) courses at a time in the Short Term.

g. Students will have to complete registration of course for Short Term by paying all the fees, before starting of the Term-II final Exam.

h. Graduating students may register for Short Term examinations after finalization of result of T-II final examination.

j. Maximum grading will be ‘B+’.

k. Question Setting, Moderation, Result Publication will be done following the same rules of Term Final Exam as per Exam Policy. Separate Tabulation sheet will be made for this examination.

l. However, Head of concerned department with the approval of Commandant may decide to take Supplementary Examination instead of Short Term.

2.62 Supplementary Examination. Following rules to be followed:

a. After the final break of every Term-I, Supplementary Examination will be held (once in a year).

b. Examination will be taken on 60% marks like Term Final examination. Remaining 40% marks on continuous assessment earned previously in that particular course will be counted. If a student fails in a course more than once in regular terms, then best one of all continuous assessment marks will be counted.

c. A student will be allowed to take one course at a time for each supplementary examination, but in the graduating Term one student can take two courses if required.

d. Highest grade of supplementary examination will be ‘B+’.

e. Registration for supplementary courses to be done during the mid-term break of Term 1, paying the required fees.

f. Examination will be completed after Term I End break within three weeks of Term II.

g. If any student fails in a course, he can clear the course retaking it 2nd time or, he can clear the examination appearing at the supplementary examination as well. But anyone fails twice in a course consecutively, he has to take approval of Academic Council of MIST for appearing third/last time in a course and need to pay extra financial penalty.

h. If anyone fails in the sessional course, that course cannot be cleared in the Supplementary examination.

j. Question setting, Moderation, Result Publication will be done following the same rules of Term Final Examination as per Examination Policy.

k. However, Head of the concerned department with the approval of Commandant may decide to take another Supplementary Examination instead of Short Term. In that case, a student will be allowed to take only one failed course in that particular Supplementary Examination. This examination will be conducted in the previous week of the beginning of Term 1. Registration of that Supplementary Examination should be completed during registration of Short Term course.

2.63 Improvement Examination. Following rules to be followed:

a. 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.

b. Highest grade of Improvement examination will be ‘B+’.

c. 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.

d. For Improvement examination, registration is to be done before Term 2 Final Examination with the Short Term Courses or, during the registration of Supplementary Courses by paying all the fees.

e. Improvement examination to be taken during the supplementary and short term examinations.

f. Choice of Improvement course is restricted within the offered courses of that Short Term by the Departments and in two courses at a time.

g. Question Setting, Moderation and Result Publication to be done with courses of regular Term Final Examination.

2.64 Self-Study Course and Examination. Following Rules to be followed:

a. An irregular student for completion of his graduation, can take maximum two repeat courses as self-study course in the graduating Term if he desires and is accepted by department.

b. One student can take maximum 24 credit hours course in the graduating Term to complete his graduation.

c. Registration for self-study course by paying all fees, must be completed with other course of regular Term.

d. To run the self-study course, concerned Department will assign one teacher each for every self-study course offered. No regular theory class will be held, but that assigned teacher will take necessary class Tests, Quiz Test and give attendance and observation marks to give 30% marks at the end of the Term. For remaining 70% marks written examination will be taken with the Term Final Examination.

e. Assigned teacher for self-study examination will be responsible for setting questions of 70% marks and other examination formalities.

f. Question Setting, Moderation, and Result Publication to be done with courses of Term Final Examination.

g. Grading of Self Study course and examination will be maximum ‘B+’.

2.65 Irregular Graduation

If any graduating student clears his/her failed course in Term-1 and his graduation requirements are fulfilled, his graduation will be effective from the result publication date of Term-1 and that student will be allowed to apply for provisional certificate.

CHAPTER 3

DEPARTMENT OF ELECTRICAL, ELECTRONIC & 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 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 knowledge on various subjects of electrical and electronics. The new generation of electrical engineers is encouraged to undertake research and development activities in the above areas and this department is committed to the study and analysis of fundamental as well as applied problems. Problems of military and national importance have consequently received great emphasis in the activities of this department. In addition to the above, presently this department is providing opportunity for postgraduate studies and research leading to higher degrees i.e. Ph.D. in EECE discipline.

3.2 Vision and Mission of the Program

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

Mission:

1. To provide comprehensive education in electrical, electronic and communication engineering and conduct research.
2. To produce technologically advanced graduates and professionals with high moral and ethical values to meet the domestic and global needs in the field of electrical, electronic and communication engineering.
3. To conduct collaboration and research activities with national and international academia and industry.
4. To provide consultancy, advisory and testing services to public and private organizations including personal in the areas of electrical, electronic and communication engineering.

3.3 Program Educational Objectives (PEOs):

No	PEO Statement
PEO-1	Provide graduates mathematical, scientific and engineering fundamentals and advanced knowledge of understanding in the sector of electrical, electronic and communication engineering including analysis techniques, design, developments and implementation methodologies.
PEO-2	Integrate technical and communicative knowledge with professional and industry based education to build up successful professional careers in industry, government and academia.
PEO-3	Expose graduates problem solving skills and research based education for life-long learning to adapt the innovation and changes.
PEO-4	Make the graduates capable of working in the broader area of technology having the capability and responsibility of leadership and teamwork.
PEO-5	Enable the graduates to establish and run sustainable business enterprises along diverse career paths by creating, selecting, applying appropriate and modern technologies and tools.
PEO-6	Contribute the educational, cultural, social, technological and economic development of society through the ethical application of their knowledge and skills.

3.4 Program Outcomes

Based on the suggestion of Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh, the Bachelor in Electrical, Electronics and Communication Engineering (EECE) program will have following learning outcomes:

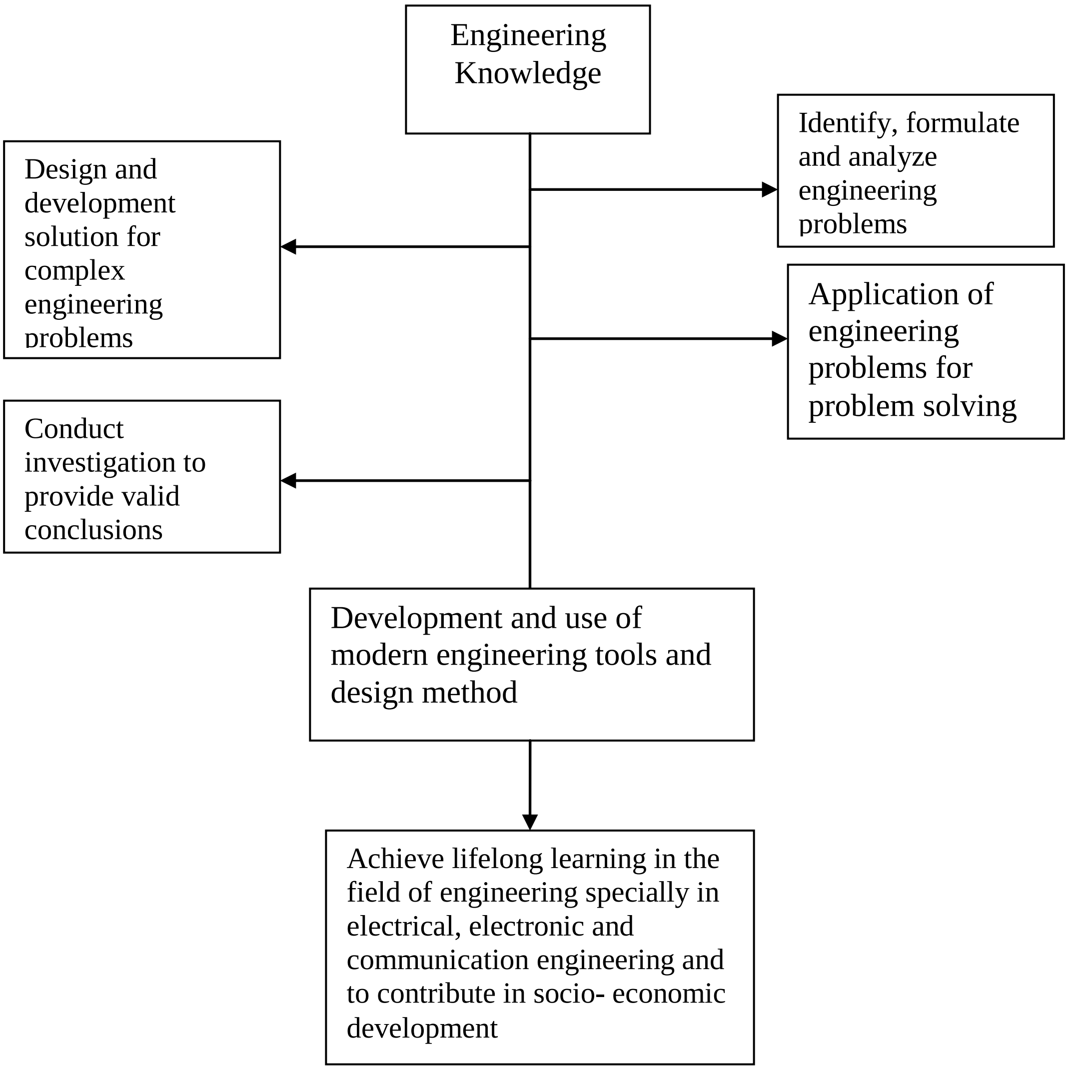
1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.
4. **Investigation:** Conduct investigations of complex problems, considering 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 activities with an understanding of the limitations.
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.
7. **Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.
9. **Individual work and teamwork:** Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.
10. **Communication:** Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multi disciplinary environments.
12. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

3.5 <u>Generic Skills</u>

1. 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.
2. Define and use appropriate research methods and modern tools to conduct a specific project.
3. Learn independently, be self- aware and self- manage their time and workload.
4. Apply critical thinking to solve complex engineering problems
5. Analyze real time problems and justify the appropriate use of technology
6. Work effectively with others and exhibit social responsibility

3.6 Curriculum/ Skill mapping



CHAPTER 4

COURSE CURRICULUM FOR BACHELOR DEGREE IN EECE

4.1 Course Schedule

Keeping the above mentioned program outcome, the course schedule 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		Optional Courses	Total
				Dept	Non-Dept		
L-1 T-I	3.00	3.00	6.00+1.50	3.00+1.50	-	-	18.00
L-1 T-II	3.00	4.00	3.00+1.50	3.00+1.50	3.00+1.00	-	20.50
L-2 T-I	5.00+1.50	3.00	-	6.00+1.50	3.00+1.50	-	21.00
L-2 T-II	-	3.00	-	9.00+4.50	3.00	-	19.50
L-3 T-I	-	-	-	15.00+6.50	-	-	21.50
L-3 T-II	-	-	-	15.00+8.50	-	-	23.50
L-4 T-I	-	-	-	3.00+6.00	-	9.00+1.50	19.50
L-4 T-II	-	-	-	3.00	-	12.00+ 1.50	16.50
% of Total Course	7.81%	8.12%	7.50%	54.38%	7.19%	15%	100%
Total Credit Hr	12.50	13.00	12.00	87.00	11.50	24.00	160.00

Table: Summary of Course Curriculum

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	15.00	6.00	15.00	3.00	21.00	18.00
L-1 T-II	16.00	9.00	16.00	4.50	25.00	20.50
L-2 T-I	17.00	8.00	17.00	4.00	25.00	21.00
L-2 T-II	15.00	9.00	15.00	4.50	24.00	19.50
L-3 T-I	15.00	13.00	15.00	6.50	28.00	21.50
L-3 T-II	15.00	16.00	15.00	7.50+1.00 (4weeks)	31.00	23.50
L-4 T-I	12.00	15.00	12.00	7.50	27.00	19.50
L-4 T-II	12.00	9.00	12.00	4.50	21.00	16.50
Total	117.00	85.00	117.00	43.00	202.00	160.00

4.3 Final Year

Final Year Thesis and Capstone Project

Thesis and Capstone project will have to be undertaken by students under separate supervisors in partial fulfillment of the requirement of his/her degree. Credits allotted to the thesis will be 4.50 and to the Capstone project will be 4.50 corresponding to 09 contact hours and 09 contact hours respectively. Topic and advisor selection of capstone project must be finalized within level-3, term-2.

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	3.00	3.00
PHY 111	Physics I (Waves and Oscillation, Optics and Thermal Physics)	Theory	3.00	3.00
MATH 111	Differential and Integral Calculus	Theory	3.00	3.00
CHEM 101	Chemistry-I	Theory	3.00	3.00
HUM 127	Sociology and Engineering Ethics/ Moral Philosophy	Theory	3.00	3.00
		Subtotal (Theory)	**15.00**	**15.00**

EECE 102	Electrical Circuits and Simulation Lab-I	Sessional	3.00	1.50
CHEM 114	Inorganic and Quantitative Analysis Lab	Sessional	3.00	1.50
		Subtotal (Sessional)	**6.00**	**3.00**
		Total = Contact hours: 21.00; Credits: 18.00		

LEVEL 1, TERM-II

Course No	Course Name	Type of Course	Contact hours	Credits
EECE 105	Electrical Circuits II	Theory	3.00	3.00
PHY 113	Physics II (Electricity and Magnetism, Modern Physics and Mechanics)	Theory	3.00	3.00
MATH 115	Vector analysis, Matrices and Geometry	Theory	4.00	4.00
CSE 109	Computer Programming	Theory	3.00	3.00
HUM 177	Fundamental of Economics	Theory	3.00	3.00
		Subtotal (Theory)	**16.00**	**16.00**
EECE 106	Electrical Circuit and Simulation Lab -II	Sessional	3.00	1.50
PHY 114	Physics II Laboratory	Sessional	3.00	1.50
CSE 110	Computer Programming Laboratory	Sessional	3.00	1.50
		Subtotal (Sessional)	**9.00**	**4.50**
		Total = Contact hours: 25.00; Credits: 20.50		

LEVEL 2, TERM-I

Course No	Course Name	Type of Course	Contact hours	Credits
EECE 201	Electronics-I	Theory	3.00	3.00
EECE 203	Electrical Machines-I/ Energy Conversion-I	Theory	3.00	3.00
ME 263	Fundamental of Mechanical Engineering	Theory	3.00	3.00
Math 211	Ordinary and Partial Differential Equation	Theory	3.00	3.00
HUM 279	Financial and Managerial Accounting	Theory	3.00	3.00
HUM 235	Communicative English	Theory	2.00	2.00
		Subtotal (Theory)	**17.00**	**17.00**
EECE 202	Electronics Circuit and Simulation Lab	Sessional	3.00	1.50
ME 264	Fundamental of Mechanical Engineering Lab	Sessional	2.00	1.00
HUM 272	Developing English Skills Laboratory	Sessional	3.00	1.50
		Subtotal (Sessional)	**8.00**	**4.00**
		Total = Contact hours: 25.00; Credits: 21.00		

LEVEL 2, TERM-II

Course No	Course Name	Type of course	Contact hours	Credits
EECE 205	Electrical Machines-II/ Energy Conversion-II	Theory	3.00	3.00
EECE 207	Electronics II	Theory	3.00	3.00

EECE 217	Engineering Electromagnetic	Theory	3.00	3.00
MATH 213	Complex Variables and Statistics	Theory	3.00	3.00
IPE 293	Industrial Management	Theory	3.00	3.00
		Subtotal (Theory)	**15.00**	**15.00**
EECE 206	Electrical Machines Laboratory/ Energy Conversion Laboratory	Sessional	3.00	1.50
EECE 208	Electronics Circuit and Simulation Laboratory II	Sessional	3.00	1.50
EECE 212	Numerical Technique Laboratory	Sessional	3.00	1.50
		Subtotal (Sessional)	**9.00**	**4.50**
	Total = Contact hours: 24.00; Credits: 19.50			

LEVEL 3, TERM-I

Course No	Course Name	Type of course	Contact hours	Credits
EECE 301	Continuous Signals and Linear Systems	Theory	3.00	3.00
EECE 303	Digital Electronics	Theory	3.00	3.00
EECE 305	Power System I	Theory	3.00	3.00
EECE 313	Electrical Measurement, Instrumentation and Sensors	Theory	3.00	3.00
EECE 315	Electrical Properties of Material	Theory	3.00	3.00
		Subtotal (Theory)	**15.00**	**15.00**
EECE 304	Digital Electronics Laboratory	Sessional	3.00	1.50
EECE 306	Power System I Laboratory	Sessional	3.00	1.50
EECE 314	Electrical Measurement, Instrumentation and Sensors Lab	Sessional	3.00	1.50
EECE 322	Electrical Service Design & CAD Laboratory	Sessional	4.00	2.00
		Subtotal (Sessional)	**13.00**	**6.50**
	Total = Contact hours : 28.00 ; Credits : 21.50			

LEVEL 3, TERM-II

Course No	Course Name	Type of course	Contact hours	Credits
EECE 307	Microprocessors and Interfacing	Theory	3.00	3.00
EECE 309	Communication Theory	Theory	3.00	3.00
EECE 311	Digital signal Processing-I	Theory	3.00	3.00
EECE 317	VLSI I	Theory	3.00	3.00
EECE 319	Solid State Devices	Theory	3.00	3.00
		Subtotal (Theory)	**15.00**	**15.00**
EECE 308	Microprocessor and Interfacing Laboratory	Sessional	3.00	1.50
EECE 310	Communication Laboratory	Sessional	3.00	1.50

EECE 312	Digital signal Processing-I Lab	Sessional	3.00	1.50
EECE 318	VLSI I Lab	Sessional	3.00	1.50
EECE 330	Industrial Training	Sessional	1.00 (6Weeks)	1.00
EECE 350	Capstone Project	Sessional	3.00	1.50
		Subtotal (Sessional)	**12.00+1.00 (6weeks)**	**7.00**
				Total = Contact hours : 31.00; Credits : 23.50

EECE 330 (Industrial Training/attachment) will be conducted at any convenient time after the term end exam of term-2 for a duration of 06 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	3.00	3.00
EECE 4**	Elective I	Theory	3.00	3.00
EECE 4 **	Elective II	Theory	3.00	3.00
EECE 4 **	Elective III	Theory	3.00	3.00
		Subtotal (Theory)	**12.00**	**12.00**
EECE 400	Thesis		3.00	1.50
EECE 450	Capstone Project		6.00	3.00
EECE 402	Control System I Laboratory	Sessional	3.00	1.50
EECE 4 **	Elective II Laboratory	Sessional	3.00	1.50
		Subtotal (Sessional)	**15.00**	**7.50**
				Total = Contact hours : 27.00; Credit hours : 19.50

LEVEL 4, TERM-II

Course No	Course Name	Type of course	Contact hours	Credits
EECE 4 **	Elective III	Theory	3.00	3.00
EECE 4 **	Elective IV	Theory	3.00	3.00
EECE 4 **	Elective V	Theory	3.00	3.00
EECE 4 **	Elective VI	Theory	3.00	3.00
		Subtotal (Theory)	**12.00**	**12.00**
EECE 400	Thesis		6.00	3.00
EECE 4 **	Elective III Laboratory	Sessional	3.00	1.50
		Subtotal (Sessional)	**9.00**	**4.50**
				Total = Contact hours : 21.00 ; Credits : 16.50

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	3.00	3.00
2	EECE 473	Power Electronics	4-I/ 4-II	3.00	3.00
3	EECE 474	Power Electronics Laboratory	4-I/ 4-II	3.00	1.50
4	EECE 475	Power Plant Engineering	4-I/ 4-II	3.00	3.00
5	EECE 477	Power System Protection	4-I/ 4-II	3.00	3.00
6	EECE 483	High Voltage Engineering	4-I/ 4-II	3.00	3.00
7	EECE 478	Power System Protection Laboratory	4-I/ 4-II	3.00	1.50
8	EECE 484	High Voltage Engineering Laboratory	4-I/ 4-II	3.00	1.50
9	EECE 479	Power System Reliability	4-I/ 4-II	3.00	3.00
10	EECE 481	Power System Operation and Control	4-I/ 4-II	3.00	3.00
11	EECE 485	Electrical Machines III / Energy Conversion III	4-I/ 4-II	3.00	3.00

Electronics

Ser. No.	Course Code	Course Name	Level	Contact Hour	Credit Hour
1	EECE 451	Processing and Fabrication Technology	4-I/ 4-II	3.00	3.00
2	EECE 453	Analog Integrated Circuits	4-I/ 4-II	3.00	3.00
3	EECE 455	Compound Semiconductor and Hetero-junction Devices	4-I/ 4-II	3.00	3.00
4	EECE 457	VLSI II	4-I/ 4-II	3.00	3.00
5	EECE 458	VLSI II Laboratory	4-I/ 4-II	3.00	1.50
6	EECE 459	Optoelectronics	4-I/ 4-II	3.00	3.00
7	EECE 461	Semiconductor Device Theory	4-I/ 4-II	3.00	3.00
8	EECE 473	Power Electronics	4-I/ 4-II	3.00	3.00
9	EECE 474	Power Electronics Laboratory	4-I/ 4-II	3.00	1.50

Communication

Ser. No.	Course Code	Course Name	Level	Contact Hour	Credit Hour
1	EECE 403	Telecommunication Engineering	4-I/ 4-II	3.00	3.00
2	EECE 431	Digital Signal Processing II	4-I/ 4-II	3.00	3.00
3	EECE 433	Microwave Engineering	4-I/ 4-II	3.00	3.00
4	EECE 434	Microwave Engineering Laboratory	4-I/ 4-II	3.00	1.50
5	EECE 435	Optical Fiber Communication	4-I/ 4-II	3.00	3.00

6	EECE 437	Digital Communication	4-I/ 4-II	3.00	3.00
7	EECE 438	Digital Communication Laboratory	4-I/ 4-II	3.00	1.50
8	EECE 439	Mobile Cellular Communication	4-I/ 4-II	3.00	3.00
9	EECE 441	Random Signals and Processes	4-I/ 4-II	3.00	3.00
10	EECE 443	Satellite Communication	4-I/ 4-II	3.00	3.00
11	EECE 444	Satellite Communication Laboratory	4-I/ 4-II	3.00	1.50
12	EECE 445	Communications Network	4-I/ 4-II	3.00	3.00
13	EECE 446	Communications Network Laboratory	4-I/ 4-II	3.00	1.50

Interdisciplinary

Ser. No.	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 429	Radar Engineering	4-I/ 4-II	3.00	3.00
8	EECE 430	Radar Engineering 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	Electronics Warfare	4-I/ 4-II	3.00	3.00
12	EECE 494	Electronics 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	Microprocessor System Design	4-I/ 4-II	3.00	3.00
18	CSE 492	Microprocessor System Design Laboratory	4-I/ 4-II	3.00	1.50

CHAPTER – 5

5. COURSE DESCRIPTION

5.1 Core Courses Offered

5.1.1. EECE 101: Electrical Circuits I

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of electrical circuit components as well as the analysis of DC circuits.

Course Contents:
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 super node and super mesh.
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.
Magnetic quantities and variables: Flux, permeability and reluctance, magnetic field strength, magnetic potential, flux density, magnetization curve.
Laws in magnetic circuits: Ohm's law and Ampere's circuital law. Magnetic circuits: Series, parallel and series-parallel circuits.

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 (CO):
Upon completion of the course, the students will be able to:
1. **Apply** different laws of circuit theorems to solve various engineering problems.
2. **Analyze** different circuit related complex engineering problems efficiently.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** different laws of circuit theorems to solve various engineering problems.	√											
2. **Analyze** different circuit related complex engineering problems efficiently.		√										
3. **Design** different elementary circuit related projects using circuit theorems and components.			√									

Lecture Schedule:

Week 1	**Circuit Variables And Elements**	CT 1
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage	
Class 2	Power and energy, Active elements, Passive elements, Independent and Dependent source	
Class 3	Ohm's law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh	
Week 2	**Series and Parallel DC Circuits**	
Class 4	Series-parallel connection	
Class 5	KCL, KVL, Analysis of equivalent resistance of electrical circuit	
Class 6	Analysis of voltage, current and power	
Week 3	**Current Divider Rule and Voltage Divider Rule**	
Class 7	Analysis of current in different branches	
Class 8	Analysis of voltage in different parts of circuit	
Class 9	Practice mathematical problems related to current divider and voltage divider rule.	
Week 4	**Y-Δ and Δ-Y conversion**	CT 2
Class 10	Y to Δ conversion derivation	

Class 11	Analysis of electrical circuits with Y-Δ connection	
Class 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 mathematical 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	CT 3
Class 23	Application of Superposition Theorem	
Class 24	Related problem analysis.	
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 capacitorand construction and types of capacitor	
Class 32	Inductance, Inductance voltage	
Class 33	Transient response of capacitive networks	CT 4
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.	

Text and Ref Books:

1. Fundamentals of Electric Circuit- Alexander & Sadiku.
2. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
3. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson; Prentice Hall of India Private Ltd.
4. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.

*****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

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: Electrical Circuit I (EECE 101).
Rationale:
To learn and familiarize the basics of electrical circuit components as well as the analysis of DC circuit practically.

Course Contents:
In this course students will get a hands on experience about electrical circuits. They will observe the uses of electrical circuits practically. They will also simulate and analyze different electrical circuits and find out different values of elements inside the circuits using PSpice**.**

Objective:

1. To learn about IC use 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 (CO)
Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic electrical components and networks practically.
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different elementary circuit related projects using circuit theorems and components and make a presentation.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the knowledge of basic electrical components and networks practically.				√								
2. Analyze the differences between theoretical knowledge with the practical observations.			√									
3. Design different elementary circuit related projects using circuit theorems and components and make a presentation.					√					√		

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Construction and operation of simple electrical circuits	
2.	Verification of KVL	
3.	Verification of KCL	
4.	Verification of Superpositon	
5.	Verification of Thevenin's theorem	
6.	Lab Test-01	
7.	Introduction to PSpice	
8.	Simulating circuits with dependent sources in PSpice	
9.	Determination of equivalent resistance and circuit analysis and resistance sweeping.	
10.	First order transient and various aspects of transient analysis	
11.	Quiz test	
12.	Practice Lab-02	
13.	Lab Test-02	
14.	Viva	

Text and Ref 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.**

5.1.3. EECE 105: Electrical Circuit II

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-II
Pre-requisite: EECE 101 (Electrical Circuit I)
Rationale:
To learn and familiarize the basics of electrical AC circuit as well as the analysis of different AC networks.

Course Contents:
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.

Objective:
1. To learn the basic ac 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 understand the concept of active, reactive and apparent powers, power factor and resonance in series and parallel circuits.
4. To be able to apply the basics of transient circuit in alternating current analysis.
5. To understand the ac circuit and their practical applications in day to day life uses.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Analyze** the properties of AC values (waveforms, temporal and mean values of voltage, current and power) of series and parallel RL, RC and RLC circuits.
2. **Apply** phasor algebra and symbolic method to present and calculate electrical values in AC networks.
3. **Compute** the electrical quantities in magnetically coupled circuits, three-phase AC systems: balanced and unbalanced circuits.
4. **Describe** the behavior of RLC resonance circuit and different types of passive filters.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.
Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	

	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze the properties of AC values (waveforms, temporal and mean values of voltage, current and power) of series and parallel RL, RC and RLC circuits.	√											
2. Apply phasor algebra and symbolic method to present and calculate electrical values in AC networks.	√	√										
3. Compute the electrical quantities in magnetically coupled circuits, three-phase AC systems: balanced and unbalanced circuits.	√	√										
4. Describe the behavior of RLC resonance circuit and different types of passive filters.	√	√	√									

Lecture Schedule:

Week 1	**Circuit Variables And Elements**	CT 1
Class 1	Introduction**,** Lumped circuits: Circuit elements	
Class 2	Basic idea about ideal sources (independent and dependent)	
Class 3	Linear passive parameters R, L and C,Kirchoff's Laws.	
Week 2	**Series and Parallel AC Circuits**	
Class 4	Analysis of series and parallel circuits	
Class 5	Network reduction; voltage and current division	
Class 6	Basic idea about Source transformation	
Week 3	**Source Transformation**	
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	**Phasor Algebra**	CT 2
Class 10	Introduction: Concept of phasor and complex impedance / admittance (Lec-01)	
Class 11	Introduction: Concept of phasor and complex impedance / admittance (Lec-02)	
Class 12	Solution of simple series and parallel circuits	
Week 5	**Finding out different Electrical Quantitites**	
Class 13	Theory of Active power, reactive power, apparent power (volt ampere)	
Class 14	Mathematical Problems of Active power, reactive power, apparent power (volt	

	ampere)	
Class 15	Power factor and energy associated with these circuits	
Week 6	**Nodal and Mesh Analysis**	
Class 16	Concept of complex power, impedance triangle and power triangle associated with complex circuits.	
Class 17	Resonance in series circuits and the behavior of series resonant circuit	
Class 18	Resonance in parallel circuits and the behavior of parallel resonant circuit	
Week 7	**Mesh Analysis**	
Class 19	Q factor, half-power frequencies and bandwidth of resonant circuits.(Lec-01)	
Class 20	Q factor, half-power frequencies and bandwidth of resonant circuits. (Lec-02)	
Class 21	Introduction to Superposition theorem	
Week 8	**Network Theorem**	
Class 22	Reciprocity Theorem	
Class 23	Superposition Theorem	
Class 24	Thevenin and Norton's Theorem	
Week 9	**Network Theorem**	
Class 25	Tie-set and Cut- set schedules	
Class 26	Formulation of equilibrium equations in matrix form	
Class 27	Solution of resistive networks	CT 3
Week 10	**Variable Impedance Load**	
Class 28	Maximum power transfer theorems for variable resistance load	
Class 29	Variable impedance load– Statement and applications	
Class 30	Introduction: Graph of a network, Concept of tree and co-tree, incidence matrix	
Week 11	**Frequency Response and Transient Analysis**	
Class 31	Frequency Response of RL,RC and RLC circuits (Lec-01)	
Class 32	Frequency Response of RL,RC and RLC circuits(Lec-02)	
Class 33	Transient response of RL,RC and RLC series and parallel circuits free response – step and sinusoidal responses	CT 4
Week 12	**Damping Factor and Non-Sinusoidal Waves**	
Class 34	Frequency: Damped Frequency	
Class 35	Damping Factor and Logarithmic Decrement	
Class 36	Response of circuits for non-sinusoidal periodic inputs	
Week 13	**Passive Filters and Three Phase Circuits**	
Class 37	Passive Filters	
Class 38	Magnetically Couples Circuits	
Class 39	Analysis of three phase circuits: Three phase supply	
Week 14	**Balanced and Unbalanced Circuits**	
Class 40	Balanced and Unbalanced Circuits, Power calculation (Lec-01)	
Class 41	Balanced and Unbalanced Circuits, Power calculation (Lec-02)	
Class 42	Open Discussion	

Text and Ref Books:

1. Alternating-Current Circuits by Russell M.; Corcoran, George F. Kerchner.
2. Fundamentals of Electric Circuits by Charles Alexander, Matthew Sadiku.

*****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

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-1, Term-II
Pre-requisite: Electrical Circuit II (EECE 105).
Rationale:
To learn and familiarize the basics of electrical circuit components as well as the analysis of AC circuit practically.

Course Contents:
Students will perform experiments to verify practically the theories and concepts learned in EECE 105. They will also do simulation laboratory based on EECE 105 theory courses. Students will verify the theories and concepts learned in EECE 105 using simulation software like Pspice and Matlab. Students will also perform specific design of AC circuits theoretically and by simulation.

Objective:
1. To understand the concept of circuit laws practically.
2. To know about design and implementation of any desired circuit.
3. To learn to generate desired output of any circuit
4. To compare the theoretical and practical values of circuit.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Apply** the knowledge of basic electrical components and networks practically. The outcome of Simulation laboratory is to impart hands on experience in modeling the design using such tools as PSpice
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**

1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1. Apply the knowledge of basic electrical components and networks practically. The outcome of Simulation laboratory is to impart hands on experience in modeling the design using such tools as PSpice				√								
2. Analyze the differences between theoretical knowledge with the practical observations of various electrical circuits			√									
3. Design different elementary circuit related projects using circuit theorems and components.					√					√		

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Familiarization with alternating current (ac) waves	
2.	Study of R-L-C series circuit	
3.	Different types of filters and its characteristics with different input frequency	
4.	Series Resonance and Parallel Resonance	
5.	Practice Lab-01	
6.	Lab Test-01	
7.	Analysis of AC Circuits, Observing variables as functions of time using transient analysis (Mutual inductance)	
8.	Sub-Circuits using Net listing and Schematics and Three Phase Circuits	
9.	AC Transient Analysis	
10.	Steady-State AC analysis and Frequency response	
11.	Lab Test-02	
12.	Quiz test	
13.	Viva	
14.	Project show	

Text and Ref Books:

1. Circuits & Network Analysis & Synthesis by A.Sudhakar & ShyanmugamS.Palli.

2. Electric Circuits by Joseph Edminster, Schaum's Outline Series.

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

5.1.5. EECE 201: Electronics-I

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: Electrical Circuit Analysis

Rationale:
To teach the students the concepts, principles and working of basic electronic 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.

Course Contents:
P-N junction as a circuit element: Intrinsic and extrinsic semiconductors, operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode, simplified dc and ac diode models, dynamic resistance and capacitance.
Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor, characteristics of a zener diode, zener shunt regulator, clamping and clipping circuits.
Bipolar junction transistor (BJT) as a circuit element: Bipolar junction transistor current components, BJT characteristics and regions of operation, BJT as an amplifier, biasing the BJT for discrete circuits, small signal equivalent circuit models, BJT as a switch. Single stage mid-band frequency
BJT amplifier circuits: Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits.
Metal-oxide-semiconductor field-effect-transistor (MOSFET) as circuit element: Structure and physical operation of an enhancement MOSFET, threshold voltage, Body effect, current- voltage characteristics of an enhancement MOSFET, biasing discrete and integrated MOS amplifier circuits, single-stage MOS amplifiers, MOSFET as a switch, CMOS inverter.
Junction field-effect-transistor (JFET): Structure and physical operation of JFET, transistor characteristics, and pinch-off voltage. Differential and multistage amplifiers: Description of differential amplifiers, small-signal operation, differential and common mode gains, RC coupled mid-band frequency amplifier.

Objective:
1. To understand the basics of electronic devices like diode, Transistor, MOSFET etc and its applications.
2. To become skilled at designing different electronic circuits like rectifier, amplifiers etc. using electronic devices.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Explain** the basic operation of diodes, BJT, MOSFET, JFET and their characteristics to solve engineering problems.
2. **Compare** the characteristics of different types of diodes and transistors.
3. **Apply** the knowledge of semiconductor diodes, BJT, MOSFET and JFET to solve real life engineering problems such as rectification, switching and amplification.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the basic operation of diodes, BJT, MOSFET, JFET and their characteristics to solve engineering problems.	√											
2. Compare the characteristics of different types of diodes and transistors.	√	√										
3. Apply the knowledge of semiconductor diodes, BJT, MOSFET and JFET to solve real life engineering problems such as rectification, switching and amplification.	√		√									

Lecture Schedule:

Week 1	**Introduction to Electronics**	CT 1
Class 1	Basic idea about Electronics	
Class 2	Examples of electronic devices and comparison with electrical equipments.	
Class 3	Introduction to semiconductor devices and its classifications	
Week 2	**Semiconductor diodes**	
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**	
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 maths of zener diode	
Class 9	Applications of diode	
Week 4	**Diode Rectifier**	CT 2
Class 10	Diode rectifiers	
Class 11	Ripple factor and related mathematical problems.	
Class 12	Clipper circuit and related problems	
Week 5	**Application of diode circuits**	
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**	
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**	CT 3
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**	
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 Junction Field Effect Transistor**	
Class 25	Introduction to FET and comparative studies between BJT and FET	
Class 26	Construction and operation of JFET	
Class 27	Drain characteristics and Transfer characteristics	
Week 10	**Basics and mathematical problems of JFET**	CT 4
Class 28	Pinch off and pinch off voltage	
Class 29	Mathematical problems related to JFET	
Class 30	Mathematical problems related to JFET (Cont..)	
Week 11	**Metal Oxide Semiconductor Field Effect Transistor**	
Class 31	Introduction to MOSFET	
Class 32	Construction of MOSFET	
Class 33	Operating principle of MOSFET	
Week 12	**Types of MOSFET**	
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**	
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**	
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	Open discussion	

Text and Ref 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. EECE202: Electronics Circuits and Simulation Lab -I

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: Electronics I (EECE 201).
Rationale:
To learn and familiarize the basics of electronic circuit components as well as the analysis of electronic circuit practically.

Course Contents:
In this course students will perform experiments to verify practically the theories and concepts learned in EECE 201. Students will also perform simulation laboratory based on EECE 201 theory courses. Students will verify the theories and concepts learned in EECE 201 using simulation software like Pspice and Matlab. Students will also perform specific design of Electronics circuits theoretically and by simulation.

Objective:
1. To learn about IC use in building up and development of any electronic devices.
2. To know about design and implementation of any electronic circuit.
3. To learn to generate desired output of any circuit
4. To compare the theoretical and practical values of electronic device.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Match** basic experimental experiences in physical operation and circuit applications of semiconductor devices with the theoretical knowledge.
2. **Explain** how to design the diode circuits and single stage BJT or MOSFET amplifier circuits from a set of specifications and interrelate the hardware knowledge with the software knowledge by using simulation software like ORCAD.
3. **Able** to design electronic projects.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Daily lab performance	**5%**
	Lab Attendance	**5%**
1-2	Lab reports	**10%**
1-3	**Lab test**	**30%**
1-3	**Lab quiz**	**40%**
1-3	Lab viva	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Match basic experimental experiences in physical operation and circuit applications of semiconductor devices with the theoretical knowledge.				√								
2. Explain how to design the diode circuits and single stage BJT or MOSFET amplifier circuits from a set of specifications and interrelate the hardware knowledge with the software knowledge by using simulation software like ORCAD.			√									
3. Able to design electronic projects.			√									

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Study of diode characteristics.	
2.	Study of diode rectifier circuits.	
3.	Study of n-p-n CB (common base) transistor characteristics.	
4.	Study of n-p-n CE (common emitter) transistor characteristics.	
5.	Study of BJT Biasing Circuit.	
6.	Lab Test-01	
7.	Study of diodes and it's application.	
8.	Study of Characteristics of Bipolar Junction transistor (BJT).	
9.	Study of Cascaded and feedback amplifier circuits using BJT.	
10.	Study of Characteristics of Field Effect Transistor (FET) and its application in CMOS inverter.	
11.	Study of JFET small signal amplifier	
12.	Quiz test	
13.	Practice Lab-01	
14.	Lab Test-02 and Viva	

Text and Ref Books:

1. Spices for Circuits and Electronic 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.**

5.1.7. EECE 203: Energy Conversion I
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: Electrical circuit I and II.
Rationale:
To gain basic knowledge on electro mechanical energy conversion of energy conversion by electrical machines, their principles, characteristics and applications and grow concepts on energy conversion by renewable energy sources.
Course Contents:
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.
Renewable energy: Introduction to wind turbine generators and solar cells.
Transformer: Principle, construction of ideal transformer, practical transformer, transformation ratio, no-load and load vector diagrams; actual transformer's equivalent circuit, regulation, short circuit and open circuit tests, parallel operation of transformers, auto transformer, instrument transformers, 3- phase transformers, different connection and their applications.

Objective:
1. To be able to apprise basic operating principle of Electrical machines like DC motor, DC generator and Transformer etc.
2. To demonstrate the performance indicating parameters of electrical machines and learn to manipulate them.
3. To learn about wind turbine generator and solar PVC systems.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Explain** the constructions, operating principles and main features of common Electrical Machines: DC generator, DC motor, transformer.
2. **Compare** between different machines and mention practical uses.
3. **Demonstrate** the concepts of renewable energy, their environmental impacts, advantages and conversion to electrical energy.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**

	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain** the constructions, operating principles and main features of common Electrical Machines: DC generator, DC motor, transformer.	√											
2. **Compare** between different machines and mention practical uses.		√										
3. **Grow** concepts of renewable energy, their environmental impacts, advantages and conversion to electrical energy.						√	√					

Lecture Schedule:

Week 1	**DC Generator**	
Class 1	Basic idea about energy conversion, conversion by electrical machines	CT 1
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..)**	CT 2
Class 10	Armature reaction of DC generator	
Class 11	Commutations	
Class 12	O.C.C and S.C.C basics and related mathematical problems.	
Week 5	**DC Generator (Cont..)**	
Class 13	Critical field resistance, load-voltage characteristic	
Class 14	effect of speed on no-load and load characteristics and voltage regulation	
Class 15	Introduction to DC motor	
Week 6	**DC Motor**	
Class 16	Construction and operating principle	
Class 17	Flemings right hand rule, left hand rule, lentz's law, conversion of energy	
Class 18	Differences between energy conversion in DC generator and DC motor	
Week 7	**DC Motor (Cont..)**	CT 3
Class 19	Back emf and related equations for DC motor	
Class 20	Torque	

Class 21	Torque –speed characteristics of DC motor	
Week 8	**DC Motor (Cont..)**	
Class 22	Different types of motor and their operating principles	
Class 23	Different types of motors' characteristics	
Class 24	Operating principles of DC motor.	
Week 9	**DC Motor (Cont..)**	
Class 25	Losses in DC motor	
Class 26	Loss related mathematical problems	
Class 27	Loss related mathematical problems (Cont..)	
Week 10	**Transformer**	CT 4
Class 28	Introduction to Transformer and its principle of operations	
Class 29	Types of transformer and ideal characteristics	
Class 30	Equivalent circuit of Transformer	
Week 11	**Transformer (Cont..)**	
Class 31	Vector diagrams of transformer under different conditions	
Class 32	Mathematical problems of Transformer	
Class 33	Losses in transformer and their explanations	
Week 12	**Transformer (Cont..)**	
Class 34	Efficiency calculation and condition for maximum efficiency	
Class 35	All day efficiency and related mathematical problems	
Class 36	Short circuit test and open circuit test of transformer	
Week 13	**Transformer (Cont..)**	
Class 37	Regulation of transformer and related problems	
Class 38	Parallel operation of transformer	
Class 39	Auto transformer	
Week 14	**Three Phase Transformer**	
Class 40	3-phase transformer principle, different connections and their applications	
Class 41	Instrument transformers, solar cell, solar PV system	
Class 42	Introduction to wind turbine generator	

Text and Ref 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
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-II
Pre-requisite: Energy Conversion-I.
Rationale:
To learn basic principles and operation of AC electrical machines such as synchronous generator, synchronous motor and three phase, single phase induction and motors.

Course Contents:
Synchronous Generator: Principle excitation systems, construction, emf equation, equivalent circuit, vector diagrams at different loads, factors affecting voltage regulation, synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations.
Parallel operation: Necessary conditions, synchronizing, circulating current and vector diagram, effect of change in excitation, mechanical input upon synchronizing.
Synchronous motor: Operation, effect of loading under different excitation condition, effect of changing excitation, V-curves and starting, hunting, application.
Three phase induction motor: Rotating magnetic field, equivalent circuit, vector diagram, torque-speed characteristics, effect of changing rotor resistance on torque-speed curves, motor torque and developed rotor power, no-load test, blocked rotor test, equivalent circuit starting and braking and speed control.
Split phase motors, squirrel cage induction motors, Single phase induction motor and other AC motors: Basic principles, types of operation, equivalent circuit, starting and torque speed characteristics, special types of motors.

Objective:
1. To learn the basic electrical machines, their operation and applications.
2. To understand the basic principle and operation of electrical machines like synchronous generator, synchronous motor and induction motor.
3. To become acquainted with the applications of these machines in the electrical power system.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Explain** the basic principle and operation of energy conversion by different AC machines such as: synchronous generator, synchronous motor and induction motors.
2. **Demonstrate** the concept for designing electrical machines including practical uses.
3. **Analyze** different applications of those considering practical situation.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, Class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment	**15**

	(Exam/Project)	
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain** the basic principle and operation of energy conversion by different AC machines such as: synchronous generator, synchronous motor and induction motors.	√											
2. Grow the concept for designing electrical machines including practical uses.		√										
3. Analyze different applications of those in practical situation.				√		√						

Lecture Schedule:

Week 1	**Synchronous Generator**	CT 1
Class 1	Operating principle, construction, winding	
Class 2	Excitation systems of Synchronous Generator	
Class 3	Equivalent circuit of synchronous Generator, emf equation of synchronous generator	
Week 2	**Synchronous Generator**	
Class 4	Vector diagram under different loads, types of load	
Class 5	Factors affecting voltage regulation	
Class 6	Synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations	
Week 3	**Synchronous Generator**	
Class 7	Losses in Alternator	
Class 8	Mathematical problems	
Class 9	Equivalent circuit of synchronous generator	
Week 4	**Parallel operation of Synchronous Generator**	CT 2
Class 10	Mathematical problems of Synchronous generator	
Class 11	Necessary conditions for Parallel operation of generators	
Class 12	Synchronizing, circulating current and effect on synchronization if excitation and mechanical inputs are changed.	
Week 5	**Synchronous motor**	
Class 13	Operation	
Class 14	Construction, Load angle	
Class 15	Starting method of synchronous motor	
Week 6	**Synchronous motor**	
Class 16	Vector diagrams of synchronous motor	
Class 17	Equivalent circuit, vector diagram and related problems	
Class 18	Effect of changing excitation with constant load	
Week 7	**Synchronous motor**	CT 3

Class 19	Power developed by a salient pole synchronous motor	
Class 20	Armature reactions	
Class 21	Variations of power factor with armature reactions	
Week 8	**Synchronous motor**	
Class 22	Maximum load angle	
Class 23	V-curves and variation of pf with respect to excitation change	
Class 24	Hunting, application, comparison with other motor, quick review	
Week 9	**Three Phase Induction Motor**	
Class 25	Rotating magnetic field, types of rotors	
Class 26	Slip, slip frequency and related problems	
Class 27	Construction, rotor types	
Week 10	**Three Phase Induction Motor**	CT 4
Class 28	Construction of squirrel cage IM	
Class 29	Construction of wound rotor IM, Starting torque , running trorque	
Class 30	Torque-speed characteristics	
Week 11	**Three Phase Induction Motor**	
Class 31	Effect of changing rotor resistance on torque-speed curves	
Class 32	Motor torque and developed rotor power, power stages	
Class 33	No-load test, blocked rotor test	
Week 12	**Three Phase Induction Motor**	
Class 34	Induction motor operation as generator	
Class 35	Starting and braking of induction motor	
Class 36	Speed control, use quick review on all topics	
Week 13	**Single Phase Induction Motor**	
Class 37	Principle of operation, construction, squirrel cage induction motors	
Class 38	Torque slip characteristics	
Class 39	Equivalent circuit and related problems	
Week 14	**Single Phase Induction Motor**	
Class 40	Split phase, starting and running winding, Starting and torque speed characteristics of capacitors	
Class 41	Induction Motor	
Class 42	Special ac motors, Q/A discussions	

Text and Ref Books:

1. Electrical Machinery Fundamentals by Chapman
2. A Textbook of Electrical Technology 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 Machines Laboratory
3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-2, Term-II
Pre-requisite: Energy Conversion I (EECE 203) & Energy Conversion II (EECE 205)
Rationale:
To learn and familiarize the basics of electrical DC machines as well as AC machines and also analyze the construction and performance of these machines.

Course Contents:
In this course students will get hands on experience about different DC and AC electrical machines. They will observe the characteristics of electrical machines practically. They will also learn to analyze different electrical machines for evaluating their operations, performances and uses.

Objective:
1. To understand the construction and basic principle of DC & AC machines.
2. To analyze the properties DC machines and AC machines practically.
3. To get required idea for designing electrical machines.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Analyze** different machines with respect to theoretical knowledge.
2. **Identify** the performance of different machines experimentally.
3. **Apply** practical knowledge for designing Electrical machines.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Daily lab performance	**5%**
	Lab Attendance	**5%**
1-2	Lab reports	**10%**
1-3	**Lab test**	**30%**
1-3	**Lab quiz**	**40%**
1-3	Lab viva	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** different machines with respect to theoretical knowledge.		√										
2. **Identify** the performance of different machines experimentally					√							
3. **Apply** practical knowledge for designing Electrical machines.				√								

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Introduction to the lab equipment's and safety measures	
2.	Expt-01: Regulation of the Transformer in Various Loads.	
3.	Expt-02: Study the properties of DC Separately Excited Shunt Generator	
4.	Expt-03: Study the properties of DC Self-Excited Shunt Generator	
5.	Expt-04: Study the properties of DC Shunt Motor	
6.	Expt-05: Study the properties of Three-Phase Alternator in various loads	
7.	Expt-06: Study the Three-Phase Alternator synchronizing process in power utility system.	
8.	Expt-07: Study the properties of Squirrel-Cage Induction Motor	
9.	Expt-08: Study the properties of Wound-Rotor Induction Motor.	
10.	Expt-09: Study the properties of Capacitor-Start Motor	
11.	Practice Lab	
12.	Lab Test + Viva	
13.	Quiz test	
14.	Project submission	

Text and Ref Books:

1. A Textbook of Electrical Technology - B.L Theraja.
2. Electrical Machinery Fundamentals- Stephen J Chapman.
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.**

5.1.10. EECE 207: Electronics II

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-II
Pre-requisite: Electrical circuit analysis (EECE-101 & 103) and Electronics-I (EECE-201)
Rationale:
To introduce the students with the advanced concepts of Electronics. The main motive is to understand and implement the advanced electronic circuits such as operational amplifiers, feedback amplifiers, frequency response etc. with the help of various problem solving.

Course Contents:
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.

Objective:
1. To learn about operational amplifiers and various applications of it.
2. To know about filters, oscillators and power amplifiers.
3. To become skilled at designing different electronic circuits like amplifiers, switches etc. using the basic concepts of the subject.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Apply** the laws and principles of amplifier circuits, oscillators, filters and their relationship in solving various engineering problems
2. **Design** control circuit using negative feedback and frequency response techniques.
3. **Classify** and **analyze** various types of power amplifiers, oscillators, filters and feedback typologies.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the laws and principles of amplifier circuits, oscillators, filters and their relationship in solving various engineering problems.	√											
2. **Design** control circuits using negative feedback and frequency response techniques.			√									

3. Classify and **analyze** various types of power amplifiers, oscillators, filters and feedback topologies.		√	√									

Lecture Schedule:

Week 1	**Operational amplifier**	
Class 1	Introduction to Electronics II	
Class 2	Basics of Operational Amplifier.	
Class 3	Inverting and Non-inverting amplifier	
Week 2	**Applications of Operational amplifier**	
Class 4	Inverting Integrators and Summer	CT 1
Class 5	Differentiator and Weighted summer	
Class 6	Other applications of Op-Amp circuits	
Week 3	**Mathematical problems on Operational amplifier**	
Class 7	Mathematical Problems based on different applications of Op-Amp.	
Class 8	Effects of finite open loop gain and bandwidth on circuit performance,	
Class 9	Logic signal operation of Op-Amp, dc imperfections	
Week 4	**Mathematical problems on Operational amplifier**	
Class 10	General purpose Op-Amp: DC analysis, of different stages, gain and frequency response of 741 Op-Amp	
Class 11	Mathematical Problem based on DC analysis	
Class 12	Small-signal analysis of different stages, gain and frequency response of 741 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 first and second order low 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	CT-2
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 and AB power amplifiers	CT-3
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	CT-4
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	

Text and Ref Books:

1. Operational Amplifiers and Linear Integrated Circuit – by Robert F. Coughlin and Frederic R. Driscoll.
2. Integrated Electronics - by Jacob Millman and Halkias.
3. Microelectronic Circuits Theory and Applications - by Adel S. Sedra and Kenneth C. Smith
4. Op amps and linear integrated circuits by Ramakant A Gayakwad
5. Electronic Circuit Analysis and Design by Donald A Neaman,
6. Electronic Devices and Circuits – by David A. Bell.

*****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

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-2, Term-II
Pre-requisite: Electronic Circuit II (EECE 207).
Rationale:
To learn and familiarize the basics of electronic components as well as the analysis of electronic circuit practically.

Course Contents:
In this course students will perform experiments to verify practically the theories and concepts learned in EECE 207. Students will also perform simulation laboratory based on EECE 207 theory courses. Students will verify the theories and concepts learned in EECE 207 using simulation software like Pspice and Orcad. Students will also perform specific design of Electronics circuits theoretically and by simulation.

Objective:
1. To learn about IC use 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 electronic circuit
4. To compare the theoretical and practical values of circuit.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Analyze** the laws and principles of amplifier circuits, understand the relationships and differences between theory and practice. The outcome of Simulation laboratory is to impart hands on experience in modeling the design using such tools as PSpice.
2. **Apply** the basic circuit components and know how to connect them to make a filters and other devices with amplifiers.
3. **Design** different electronic projects.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** the laws and principles of amplifier circuits, understand the relationships and differences between theory and practice. The outcome of Simulation laboratory is to impart hands on experience in modeling the design using such tools as PSpice.	√											
2. **Apply** the basic circuit components and know how to connect them to make filters and other devices with amplifiers.	√		√									

3. Design different electronic projects.			√									

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Mathematical operations using OPAMP.	
2.	Study of high pass and low pass filter using Op-amp.	
3.	SCR operation characteristic in dc Circuit.	
4.	Study of characteristics of field effect transistor (FET) and its application in CMOS inverter.	
5.	Determination of operational amplifier characteristics.	
6.	Lab Test-01	
7.	Linear application of operational amplifiers.	
8.	Study of JFET small signal amplifier.	
9.	Study of an R- C Phase Shift Oscillator.	
10.	Study of Wien Bridge Oscillator.	
11.	Digital Simulation of Decoders.	
12.	Practice	
13.	Quiz test	
14.	Lab Test-02 and Viva	

Text and Ref 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 Techniques Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-2, Term-II
Pre-requisite: None.
Rationale:
To learn and familiarize with the basics of MATLAB software by using it in the numerical technique problems.

Course Contents:
Laboratory on numerical techniques using computer solution of differentiation and integration problems, transcendental equations, linear and non linear differential equations and partial differential equations.

Objective:
1. To learn basic theorems and techniques of numerical analysis.
2. To be introduced with MATLAB.
3. To learn to use MATLAB in solving numerical problems.
4. To solve complex numerical problems using MATLAB.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic numerical techniques practically.
2. **Analyze** the necessity and utilize MATLAB for solving numerical problems.
3. **Design** different complex problems and solve them with MATLAB to be proficient in using MATLAB at the end of the course.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the knowledge of basic numerical techniques practically.					√							
2. Analyze the necessity and utilize MATLAB for solving numerical problems.									√			
3. Design different complex problems and solve them with MATLAB to be proficient in using MATLAB at the end of the course.											√	

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Introduction to MATLAB	
2.	Solutions to Non-linear Equations: False Position	
3.	Solutions to Non-linear Equations: Newton Raphson	
4.	Numerical Integration	
5.	Interpolation (Lagrange's Polynomial)	
6.	Interpolation (Newton's Polynomial)	
7.	Lab Test - 01	
8.	Solution of Simultaneous Linear Algebraic Equations: Gauss Jordan	

9.	Solution of Simultaneous Linear Algebraic Equations: Gauss Seidal	
10.	Curve Fitting	
11.	Quiz test	
12.	Practice Lab	
13.	Lab Test-02	
14.	Viva	

Text and Ref Books:
1. Numerical methods - Robert W. Hornbeck; Quantum Publishers.

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

5.1.13. EECE 217: Engineering Electromagnetic

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-II
Pre-requisite: None.
Rationale:
To learn and familiarize with the foundations of electromagnetism and its practice in modern communications and also acquaint students with basic laws and concepts of electrostatics and magnetostatics.

Course Contents:
Static electric field: Postulates of electrostatics, Coulomb's law for discrete and continuously distributed charges, Gauss's law and its application, electric potential due to charge distribution, conductors and dielectrics in static electric field, flux density - boundary conditions, capacitance - electrostatic energy and forces, energy in terms of field equations, capacitance calculation of different geometries, boundary value problems – Poisson's and Laplace's equations in different co-ordinate systems. Steady electric current: Ohm's law, continuity equation, Joule's law, resistance calculation.
Static Magnetic field: Postulates of magnetostatics, Biot-Savart's law, Ampere's law and applications, vector magnetic potential, magnetic dipole, magnetization, magnetic field intensity and relative permeability, boundary conditions for magnetic field, magnetic energy, magnetic forces, torque and inductance of different geometries. Time varying fields and Maxwell's equations: Faraday's law of electromagnetic induction, Maxwell's equations - differential and integral forms, boundary conditions, potential functions, time harmonic fields. Plane electromagnetic wave: Poynting theorem and EM lower flow, Plane wave in loss less media - Doppler effect, transverse electromagnetic wave, polarization of plane wave, plane wave in lossy media – low-loss dielectrics, good conductors, group velocity, instantaneous and average power densities, normal and oblique incidence of plane waves at plane boundaries for different polarization.

Objective:
1. To acquaint students with basic laws and concepts of electrostatics and magnetostatics.
2. To teach students how to implement vector analysis in solving electromagnetic field problems.
3. To provide students with competence to formulate and analyze engineering electromagnetics problems.
4. To introduce students to applications and design concepts of engineering electromagnetics.
5. To introduce students to the use of modern tools in computational analysis of engineering electromagnetics problems.

6. To prepare students for higher level courses in engineering electromagnetics.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Identify** applications of electrostatic and magnetostatic fields.
2. **Acquire** the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation
3. **Design** emission, propagation and reception of electro-magnetic wave systems.
4. **Solve** fields and electromagnetic waves propagation problems in a multidisciplinary frame.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify applications of electrostatic and magnetostatic fields.	√											
2. Acquire the knowledge of Electromagnetic field theory that allows the student to have a solid theoretical foundation to be able in the future to design emission, propagation and reception of electro- magnetic wave systems.	√											
3. Design emission, propagation and reception of electro-magnetic wave systems.			√									
4. Solve fields and electromagnetic waves propagation problems in a multidisciplinary frame.		√										

Lecture Schedule:

Week 1	**Electromagnetic Model and Vector Analysis**	CT 1
Class 1	Introduction to electromagnets	
Class 2	Basics of electrostatics	
Class 3	E-fields in different circumstances	
Week 2	**Static Electric Fields**	
Class 4	Coulomb’s law	

Class 5	Gauss's law and its application	
Class 6	Electric potential due to point charge	
Week 3	**Static Electric Fields**	
Class 7	Electric potential due to charge distribution	
Class 8	Conductors	
Class 9	Dielectrics	
Week 4	**Static Electric Fields**	CT 2
Class 10	Flux density	
Class 11	Boundary conditions of flux density	
Class 12	Capacitors	
Week 5	**Static Electric Fields**	
Class 13	Parallel plate, spherical and cylindrical capacitors	
Class 14	Capacitors with dielectrics	
Class 15	Electrostatic energy and forces	
Week 6	**Static Electric Fields**	
Class 16	Energy in term of field equations	
Class 17	Boundary value problems	
Class 18	Poisson's equation	
Week 7	**Steady Electric Currents**	CT 3
Class 19	Laplace's equation	
Class 20	Steady state electric current	
Class 21	Ohm's law and continuity equation, Joule's law	
Week 8	**Static Magnetic Fields**	
Class 22	Introduction to magnetism	
Class 23	Biot-Savart's law and applications	
Class 24	Ampere's law and application	
Week 9	**Static Magnetic Fields**	
Class 25	Vector magnetic potential	
Class 26	Magnetic Dipoles	
Class 27	Magnetic field intensity in different circumstances	
Week 10	**Static Magnetic Fields**	CT 4
Class 28	Boundary conditions of magnetic field	
Class 29	Magnetic energy and forces	
Class 30	Magnetic torque and inductance	
Week 11	**Time-Varying Fields and Maxwell's equation**	
Class 31	Maxwell's equation	
Class 32	Poynting theorem and EM lower flow	
Class 33	Plane wave in lossless medium	
Week 12	**Plane Electromagnetic Waves**	
Class 34	Plane wave in lossy medium	
Class 35	Polarization of plane wave	
Class 36	Low loss dielectrics and good conductors	
Week 13	**Plane Electromagnetic Waves**	
Class 37	Group velocity	
Class 38	Instantaneous and average power densities	
Class 39	Normal and oblique incidence of plane waves at different polarization	
Week 14	**Plane Electromagnetic Waves**	

Class 40	Doppler Effect	
Class 41	Behavior of magnetic material	
Class 42	Revision and open Discussion	

Text and Ref Books:

1. Fundamentals of engineering Electromagneticsby David K. Cheng
2. Sadiku Matthew N O, Elements of Electromagnetics, 5th Edition, Oxford University Press, 2010.
3. Hayt William Hart and Buck John A, Engineering Electromagnetics, 8th Edition, McGraw-Hill, 2012.

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

5.1.14. EECE 301: Continuous Signals and Linear System

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-3, Term-I
Pre-requisite: None
Rationale:
To learn and familiarize the basics of Continuous Signals and Linear System.

Course Contents:
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.

Objective:

1. Be able to describe signals mathematically and understand how to perform mathematical operations on signals. The operations should include operations on the dependent as well as independent variables.
2. Be familiar with commonly used signals such as unit step, ramp, impulse function, sinusoidal signal and complex exponentials.
3. Be able to classify signals as continuous-time vs. discrete-time, periodic vs. non-periodic, energy signal vs. power signal, odd vs. even, conjugate symmetric vs anti-symmetric.

4. Be able to describe system using linear constant coefficient differential equations and using their impulse response.
5. Understand system properties – linearity , time invariance, presence or absence of memory, causality, bounded-input bounded-output, stability and instability. Be able to identify whether a given system exhibits these properties and its implicit on for practical systems.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Define** and understand continuous-time signals and discrete-time signal.
2. **Apply** mathematical transforms and state-variable in order to solve electrical engineering problems.
3. **Analyze** electrical engineering signals and circuit problems.
4. **Design** various electrical systems using different transforms and also monitor the performance.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Define and understand continuous-time signals and discrete-time signal.	√											
2. Apply mathematical transforms and state-variable in order to solve electrical engineering problems.		√										
3. Analyze electrical engineering signals and circuit problems.		√										
4. Design various electrical systems using different transforms and also monitor the performance.			√									

Lecture Schedule:

Week 1		CT 1
Class 1	Introduction to Signals and Systems	
Class 2	Signals Classifications	
Class 3	Determining Various types of signals based on mathematical modeling	
Week 2		
Class 4	Basic operations on signals	
Class 5	Mathematical problems related to signal operations	
Class 6	Elementary Signals	
Week 3		
Class 7	Representation of signals using impulse functions	
Class 8	Properties of Linear Time Invariant (LTI) systems	
Class 9	Determining the Linearity, causality, time invariance of systems	
Week 4		CT 2
Class 10	Determining the memory, stability, invertiblityof systems	
Class 11	System representation by Differential equations	
Class 12	Order of the system, solution techniques	
Week 5		
Class 13	Zero state and zero input response	
Class 14	Impulse response- convolution integral	
Class 15	Determination of system properties	
Week 6		
Class 16	State-Variable Representation	
Class 17	Mathematical problems related to state equation and time domain solution	
Class 18	Fourier series- properties	
Week 7		CT 3
Class 19	Harmonic representation, system response	
Class 20	Frequency response of LTI systems	
Class 21	Mathematical problems related to Fourier series	
Week 8		
Class 22	Continuous Time Fourier Transform	
Class 23	Properties of Fourier transform: Linearity, Symmetry, Time shifting, Time scaling	
Class 24	Properties of Fourier transform: Differentiation, Energy of Aperiodic Signals, Convolution, Modulation	
Week 9		
Class 25	System Transfer Function, System Response and distortion-less systems	
Class 26	Application of time and frequency domain analysis	

Class 27	Amplitude Modulation and demodulation	
Week 10		CT 4
Class 28	Time-Division and Frequency-Division Multiplexing	
Class 29	Properties of laplace transformation	
Class 30	Inverse laplace transformation	
Week 11		
Class 31	Applicationof inverse laplace transformation	
Class 32	Solution of systems equations	
Class 33	Solution of systems equations	
Week 12		
Class 34	System transfer function using laplace	
Class 35	Problems related to system transfer function	
Class 36	System stability using laplace transform	
Week 13		
Class 37	Frequency response of the system using laplace	
Class 38	Application of laplace transform	
Class 39	Overall Mathematical problems resolve session	
Week 14		
Class 40	Interdisciplinary application of signals and systems	
Class 41	Solution to Analog Electrical and Mechanical System.	
Class 42	Solution to Analog Electrical and Mechanical System.	

Text and Ref Books:

1. Continues and Discrete Signals & Systems - S.S. Soliman& M. D. Srinath; Prentice Hall of India Private Ltd.
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. EECE303: Digital Electronics

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-3, Term-I
Pre-requisite: EECE 201 (Electronics).
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.

Course Contents:
Introduction to number systems and codes.
Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, combinational logic design, minimization of combinational logic.
Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin and power dissipation. Power optimization of basic gates and combinational logic circuits.

Modular combinational circuit design: Pass transistor, pass gates, multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements and ALU design.
Programmable logic devices: Logic arrays, field programmable logic arrays and programmable read only memory.
Sequential circuits: Different types of latches, flip-flops and their design using ASM approach, timing analysis and power optimization of sequential circuits.
Modular sequential logic circuit design: shift registers, counters and their applications

Objective:

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
2. To prepare students to perform the analysis and design of various combinational and sequential circuits using gates.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Identify** the structure of various number systems and its application in digital design.
2. **Design** various combinational and sequential circuits.
3. **Analyze** the memory elements, state table and state diagrams of the sequential circuit,

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Identify** the structure of various number systems and its application in digital design.	√											
2. **Design** various combinational and sequential circuits.			√									
3. **Analyze** the memory elements, state table and state diagrams of the sequential circuit,		√										

Lecture Schedule:

Week 1	**Various Number Systems**	CT 1
Class 1	Number base conversion	
Class 2	Complements and related problems	
Class 3	Binary codes	
Week 2	**Boolean Algebra**	
Class 4	Basic theories and properties of Boolean Algebra	
Class 5	Canonical and standard forms	
Class 6	Mathematical problems on Boolean Algebra	
Week 3	**Simplification of Boolean Function, Universal Gate Introduction**	
Class 7	Simplification of Boolean functions through Map method	
Class 8	Product of Sums simplification	
Class 9	NAND and NOR implementation	
Week 4	**Simplification of Boolean Function**	CT 2
Class 10	Simplification with Don't Care conditions	
Class 11	The Tabulation method of simplification	
Class 12	Related mathematical problem solving	
Week 5	**Combinational Circuit Design**	
Class 13	Introduction to Combinational Logic	
Class 14	Discussion on Design procedure	
Class 15	Adders and subtractors	
Week 6	**Code Conversion**	
Class 16	Code conversion	
Class 17	Boolean function implementations	
Class 18	Exclusive-OR AND equivalence functions	
Week 7	**Combinational Circuit Design**	CT 3
Class 19	Parity generation and checking	
Class 20	Combinational logic with MSI and LSI	
Class 21	Coder/decoder and multiplexer/demultiplexer design.	
Week 8	**Combinational Circuit Design**	
Class 22	Modular combinational circuit design: Pass transistor, pass gates	
Class 23	Multiplexer, demultiplexer and their implementation in CMOS	
Class 24	Decoder, encoder, comparators, binary arithmetic elements and ALU design	
Week 9	**Logic Arrays**	
Class 25	Programmable logic devices: Logic arrays	
Class 26	Field programmable logic arrays	
Class 27	Programmable read only memory	
Week 10	**Introduction to Memory Element**	CT 4
Class 28	Sequential circuits: Different types of latches	
Class 29	Flip-flops: master-slave, D, JK, T	
Class 30	Design of flip-flops using ASM approach	
Week 11	**Analyze of Sequential Circuits**	

Class 31	Timing analysis	
Class 32	Power optimization of sequential circuits	
Class 33	Modular sequential logic circuit design: shift registers	
Week 12	**Shift Registers**	
Class 34	Parallel I/O shift registers	
Class 35	Series I/O shift registers	
Class 36	Universal shift register	
Week 13	**Different types of Counters**	
Class 37	Counters: Introduction	
Class 38	Asynchronous counters: up and down	
Class 39	Synchronous counters: up and down	
Week 14	**Different types of Counters, Registers**	
Class 40	BCD counters and other modulo counters	
Class 41	Ring counter, Johnson counter	
Class 42	Applications of registers and counters	

Text and Ref 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.

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

5.1.16. EECE 304: Digital Electronics Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-3, Term-I

Pre-requisite: Digital Electronics (EECE 303).

Rationale:

To learn and familiarize with the basics of digital electronic circuits as well as utilizing digital electronic circuits for practical purposes.

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 303. In the second part, students will design simple systems using the principles learned in EECE 303.

Objective:

1. To learn about digital electronic circuits.
2. To know and use the digital ICs for theoretical and practical purposes.
3. To learn about sequential digital circuits.
4. To solve complex design problems regarding digital electronics based on realistic aspects.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic digital electronic circuits practically.

2. **Analyze** the necessity and utilization of different types of logic and sequential circuits for real problems.
3. **Design** different circuits with ICs and microprocessor to use for our day to day necessities.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods& their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the knowledge of basic digital electronic circuits practically.					√							
2. **Analyze** the necessity and utilization of different types of logic and sequential circuits for real problems.							√					
3. **Design** different circuits with ICs and microprocessor to use for our day to day necessities.									√		√	

Lectures Schedule

Weeks	**Intended topics to be covered**	**Remarks**
1.	Familiarization and use of truth table of basic logic Gates.	
2.	De Morgan’s laws using the logic gates.	
3.	Truth tables and 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 - 01	
8.	Design and implement of multiplexer & de-multiplexer circuit using logic gates.	
9.	Design and implement of various types of clocked flip-flop circuits	

	using logic gates.	
10.	Design and implement of up and down counters.	
11.	Quiz test	
12.	Project Presentation	
13.	Lab Test-02	
14.	Viva	

Text and Ref Books:

1. Digital Logic and Computer Design- M Morris Mano; Prentice Hall of India Private Ltd.
2. Digital Fundamentals - F Loyd; Prentice Hall International, Inc.
3. Pulse, Digital and Switching waveforms - Jacob Millman& Herbert Taub; Tata McGraw- Hill.

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

5.1.17. EECE305: Power System I

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-3, Term-I
Pre-requisite: EECE 101 and EECE 105.
Rationale:
To learn and familiarize with the basic power system theory along with different types of transmission and distribution model diagram.

Course Contents:
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.

Objective:
1. To understand and acquire knowledge on the fundamental of power system and their protection along with different types of transmission and distribution model diagram.
2. To apply the acquired knowledge in developing power system variables and different tools relating network constraints.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Analyze various voltage control techniques applicable to distribution feeders and model the networks in terms of symmetrical components and sequence networks. Analyze the system performance where there is an unbalanced fault and identify various power quality

issues in power systems.
2. Apply the fundamental concepts of electrical power distribution to explain static state in a power system and protection schemes for transmission and distribution networks.
3. Relate the model parameters of transmission lines from the conductor configuration and physical characteristics of the lines and the power transfer capability of transmission lines. And calculate the fault currents and voltages when faults occur in power system.
4. Estimate the ability to design and develop power system expansion plans including economic and environmental constraints.
5. Enhance knowledge in developing the power flow study with different constraints of a power system network.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** various voltage control techniques applicable to distribution feeders and model the networks in terms of symmetrical components and sequence networks. Analyze the system performance where there is an unbalanced fault and identify various power quality issues in power systems.		√										
2. Apply the fundamental concepts of electrical power distribution to explain static state in a power system and protection schemes for transmission and distribution networks.					√							
3. Relate the model parameters of transmission lines from the conductor configuration and physical characteristics of the lines and the power transfer capability of transmission lines. And calculate the fault currents and voltages when faults occur in power system.				√								
4. Estimate the ability to design and **develop** power system expansion plans including economic and					√							√

environmental constraints.												
5. Enhance **knowledge** in developing the power flow study with different constraints of a power system network.		√										

Lecture Schedule:

Week 1	**Network representation**	CT 1
Class 1	Basic of Network representation	
Class 2	Single line and reactance diagram of power system	
Class 3	Single line and reactance diagram of power system	
Week 2	**Per unit system**	
Class 4	Per unit system of calculation	
Class 5	Basic on Line representation	
Class 6	Equivalent circuit of short transmission lines	
Week 3	**Transmission Lines**	
Class 7	Equivalent circuit of medium transmission lines	
Class 8	Equivalent circuit of long transmission lines	
Class 9	Problem Analysis in transmission lines	
Week 4	**Load flow analysis**	CT 2
Class 10	Load flow analysis: Gauss- Seidel technique	
Class 11	Load flow analysis: Newton-Raphson technique	
Class 12	Problem Analysis in Load flow	
Week 5	**Power Flow Control**	
Class 13	Power flow control: Tap changing transformer	
Class 14	Power flow control: phase shifting	
Class 15	Power flow control: booster transformer	
Week 6	**Power Flow Control**	
Class 16	Power flow control: regulating transformer	
Class 17	Power flow control: shunt capacitor	
Class 18	Problem Analysis in Power flow	
Week 7	**Fault Analysis**	CT 3
Class 19	Fault analysis: Short circuit current of a synchronous machine	
Class 20	Fault analysis: Reactance of a synchronous machine	
Class 21	Problem Analysis in different Fault analysis	
Week 8	**Fault Analysis**	
Class 22	Basic on Symmetrical fault Analysis	
Class 23	Symmetrical components Analysis	
Class 24	Sequence network Analysis	
Week 9	**Fault Analysis**	
Class 25	Unsymmetrical fault Analysis	
Class 26	Problem on Symmetrical fault calculations	
Class 27	Problem on unsymmetrical fault calculations	
Week 10	**Power System Protection**	CT 4
Class 28	Power System protection concept	
Class 29	Introduction to relays	

Class 30	Introduction to differential protection	
Week 11	**Distance Protection**	
Class 31	Introduction to distance protection	
Class 32	Introduction to circuit breakers	
Class 33	Mathematical problems power system protection devices	
Week 12	**Load Curves Analysis**	
Class 34	Load curves analysis: Demand factor, diversity factor, load duration curves, Designing practical systems: using Root Locus	
Class 35	Demand factor, diversity factor, load duration curves Analysis	
Class 36	Energy load curve, load factor, capacity factor and plant factor analysis	
Week 13	**Problem Solving**	
Class 37	Different practical power system network analyze (1) : Elementary systems	
Class 38	Different practical power system network analyze (2) : Elementary systems	
Class 39	Different practical power system network analyze (3) : Elaborate systems	
Week 14	**Problem Solving**	
Class 40	Different practical power system network analyze (4) : Elaborate systems	
Class 41	Scope of research in power system network	
Class 42	Open Discussion: Power System in Bangladesh	

Text and Ref Books:

1. Elements of Power System Analysis-William D. Stevenson; McGraw-Hill International
2. Power System Analysis– J. J. Grainger and W. D. Stevenson, Jr; Mc Graw- Hill International Editions
3. Electric Power Generation, Transmission and Distribution - Singh S.N
4. Electrical Power System - Ashfaq Husain
5. Principle of Power System - V. K. Mehta
6. Electric Power Engineering Handbook - L.L. Grigsby.

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

5.1.18. EECE306: Power System I Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-3, Term-I

Pre-requisite: Power System I (EECE 305).

Rationale:

To know about the elements of power system and their impacts on the power transmission and distribution system practically.

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 305. In the second part, students will analyze and design simple systems using the principles learned in EECE 305.

Objective:

1. To learn the basic power system components and their effects on power system.
2. To know about the parameters that effect the power flow.
3. To compare the theoretical and practical concepts related to power system.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Understand and Analyze** and understand the power system parameters and their effects on the system through experiments.
2. **Formulate** and **Solve** problems related to the power system and able to design the system with better power handling capacity.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-2	Conduct of Lab Test /Class Performance	**25%**
1-2	Report Writing/ Programming	**15%**
1-2	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-2	Final Evaluation (Exam/Project/assignment)	**30%**
1-2	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** and understand the power system parameters and their effects on the system through experiments.					√							
2. **Formulate** and **Solve** problems related to the power system and able to design the system with better power handling capacity.			√									

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Safety and the power supply	
2.	Expt-01: Determination of phase sequence	
3.	Expt-02: Real and Reactive power flow	
4.	Expt-03: Power flow and voltage regulation of a simple transmission	

	line	
5.	Expt-04: Phase angle and voltage drop between sender and receiver	
6.	Expt-05: Parameters which effect real and reactive power flow	
7.	Expt-06: Parallel lines, Transformers and power handling capacity of transmission line	
8.	Expt-07: Study of the alternator	
9.	Expt-08: Study of Synchronous Motor	
10.	Expt-09: Synchronous capacitor and Long high voltage lines	
11.	Practice Lab	
12.	Lab Test + Viva	
13.	Quiz test	
14.	Project submission	

Text and Ref 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 307: Microprocessors and Interfacing

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-3, Term-II
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of how computer works, its language and interfacing between different parts of the memory of the microprocessor.

Course Contents:
Introduction to microprocessors.
Intel 8086 microprocessor: architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt.
Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard, display device and other I/O device interface. Introduction to micro-controllers. Introduction to embedded system, classification and design sample embedded systems with programmable ICs.

Objective:
1. To understand basic architecture of microprocessors and interfacing by programming languages to control the operation of microprocessors.
2. To become skilled at designing embedded systems and simplifying traditional manual process controls with programmable devices.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Identify** the basic architecture of microprocessors and relation between various internal blocks inside any microprocessor.
2. **Interrelate** Intel 8086 microprocessor and programming in assembly language to perform machine dependent programming.

3. **Solve** any mathematical operation to handle with 8086instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor.
4. **Differentiate** between classical embedded system and programmable interfacing, distinguish between the features and design, implementation and performance analysis of embedded systems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Identify** the basic architecture of microprocessors and relation between various internal blocks inside any microprocessor.	√											
2. **Interrelate** Intel 8086 microprocessor and programming in assembly language to perform machine dependent programming.				√								
3. **Solve** any mathematical operation to handle with 8086instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor.		√										
4. **Differentiate** between classical embedded system and programmable interfacing, distinguish between the features and design, implementation and performance analysis of embedded systems.				√								

Lecture Schedule:

Week 1	**Introduction to Microprocessor:**	
Class 1	Introduction to the Subject and Evaluation Process	CT 1
Class 2	Introduction to Microprocessor: Historical development of microprocessor, generation of 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	Some basic concepts: Register, Counter, Memory, ROM, RAM	
Class 5	Adder-Subtractor, Tri-state output, Bus organization etc.	
Class 6	Details of architecture of SAP- 1 and SAP-1 Instruction sets.	
Week 3	**Intel 8086 Microprocessor:**	
Class 7	Features and characteristics of 8086, PIN diagram and Detail architecture of 8086	
Class 8	Functions of Bus interface unit(BIU), instruction queue and pipelining, Execution Unit (EU) and memory segmentation, Bus timing diagram of 8086	
Class 9	Address determination of peripheral device/memory, Problems of address determination.	
Week 4	**Numbers and Characters, Registers**	CT 2
Class 10	Representation of Numbers and Characters: Review of number system, conversion of number system, Character representation.	
Class 11	Organization of Registers of 8086: General purpose register, segment register	
Class 12	Pointer and index register, Flag register	
Week 5	**Assembly Language**	
Class 13	Assembly Language: Addressing Modes of 8086	
Class 14	Data addressing Modes, Program memory addressing modes	
Class 15	Stack memory addressing modes.	
Week 6	**Assembly Language**	
Class 16	Assembly Language: Instruction Sets of 8086	
Class 17	Data movement instruction, Arithmetic and Logical instruction,	
Class 18	Program control instruction	
Week 7	**Assembly Language**	CT 3
Class 19	Arithmetic problem solving	
Class 20	Arithmetic problem solving continued	
Class 21	Program flow control	
Week 8	**Assembly language**	
Class 22	Software interrupts	
Class 23	Procedure of interrupts	
Class 24	Miscellaneous data transfer instructions	
Week 9	**Interfacing**	
Class 25	Interfacing: Introduction to 8259 Programmable Interrupt Controller, Internal Architecture of 8259	
Class 26	Initialization Command Words (ICWs) and Operational Command Words (OCWs) of 8259	
Class 27	Cascade mode 8259	
Week 10	**Interfacing**	CT 4
Class 28	Introduction to 8255A Programmable Peripheral Interface	
Class 29	Pin diagram and pin function of8255A	
Class 30	Internal architecture of 8255A	

Week 11	Interfacing	
Class 31	Initialization of control word of 8255A	
Class 32	i/o interface problems with 8255A	
Class 33	Keyboard interfacing and display interfacing with 8255A	
Week 12	**Interfacing**	
Class 34	Introduction to 8254 Programmable Timer/ Counter	
Class 35	Pin diagram, internal architecture, system connection and initialization	
Class 36	Modes of 8254	
Week 13	**Interfacing**	
Class 37	8284 clock generator architecture	
Class 38	Direct Memory Access (DMA)	
Class 39	8237 DMA controller	
Week 14	**Interfacing**	
Class 40	8237 DMA controller	
Class 41	8237 DMA controller	
Class 42	Review	

Text and Ref Books:

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Assembly Language Programming and Organization of IBMPC – Ytha Yu and Charles Marut, International Edition, McGraw Hill, Inc
3. The Intel Microprocessors – Architecture Programming and Interfacing – Barry B Brey, Pearson Education, Inc., Upper Saddle River, New Jersey 07458.
4. Digital Computer Electronics – Albert P. Malvino and JeraldA. Brown, 3rd Edition

Microprocessor and Interfacing Douglas V Hall, Third

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

5.1.20. EECE 308: Microprocessors and Interfacing Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-3, Term-II

Pre-requisite: Microprocessors and Interfacing (EECE 307)

Rationale:

To learn and familiarize the basics of how computer works, its language and interfacing between different parts of the memory of the microprocessor.

Course Contents:

Practical System orientation on basis of the course EECE-307: Intel 8086 microprocessor: architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt. Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard, display device and other I/O device interface. Introduction to microcontrollers.

Objective:

1. To observe basic architecture of microprocessors and interfacing by programming languages to control the operation of microprocessors.
2. Designing embedded systems and interfacing peripheralI/O devices and memory devices with microprocessors.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Recognize** the basic components inside Intel 8086 microprocessor and relation between various internal blocks inside any microprocessor.
2. **Interpret** intel 8086 microprocessor registers and programming in assembly language to perform machine dependent programming
3. **Apply** mathematical operations to handle with 8086instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor.
4. **Developing** communication between I/O and memory devices with microprocessor and thereby successfully accomplish error estimation, execution, signal conditioning/ conversion, automatic processing and finally transmission of data with various communication protocol.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	**25%**
1-4	Report Writing/ Programming	**15%**
1-4	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-4	Final Evaluation (Exam/Project/assignment)	**30%**
1-4	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Recognize** the basic components inside Intel 8086 microprocessor and relation between various internal blocks inside any microprocessor.	√											
2. **Interpret** intel 8086 microprocessor registers and programming in assembly language to perform machine dependent programming	√											
3. **Apply** mathematical operations to handle with 8086instruction set and ability to utilize it		√										

in programming and to interface various I/O or memory devices to the microprocessor												
4. Developing communication between I/O and memory devices with microprocessor and thereby successfully accomplish error estimation, execution, signal conditioning/conversion, automatic processing and finally transmission of data with various communication protocol			√									

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Introduction to Intel 8086 Microprocessor module and interfacing accessories	
2.	Intel 8086 programmer and simulator for assembly language programming	
3.	Solve ordinary mathematical operations with 8086microprocessor	
4.	Advanced assembly language programming	
5.	Assembly language program flow control, conditional and unconditional loops	
6.	Hardware and software interrupts and Intel 8086supportable interrupts	
7.	Interfacing digital lighting display (Dot-matrix) with microprocessor	
8.	Interfacing keyboard with microprocessor by peripheral programmable interface	
9.	Stepper motor interface and warning message generation by Intel 8086	
10.	Programmable peripheral interrupt controlling by8259 PIC	
11.	Liquid crystal device interfacing by Intel 8086 and8255 PPI	
12.	Analog to digital conversion by ADC0804 and Intel8086	
13.	Lab Test Lab Quiz	
14.	Viva-voce	

Text and Ref Books:

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Assembly Language Programming and Organization of IBMPC – Ytha Yu and Charles Marut, International Edition,McGraw Hill, Inc
3. The Intel Microprocessors – Architecture Programming and Interfacing – Barry B Brey, Pearson Education, Inc., Upper Saddle River, New Jersey 07458.
4. Digital Computer Electronics – Albert P. Malvino and JeraldA. Brown, 3rd Edition

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

5.1.21. EECE 309: Communication Theory

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-3, Term-II

Pre-requisite: Continuous signals and Linear System (EECE-301).

Rationale:

To learn and familiarize the basics and operation of various communication technology.

Course Contents:

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.

Objective:

1. To understand basic control theory along with different types of modeling of a system for the purpose of control
2. To know about various types of system design tools.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Explain** the fundamental principles of communication systems, various noises of the system and information theory.
2. **Examine** various types of modulation techniques and **evaluate** between them**.**
3. **Design** various communication systems basing on various parameters set as standard.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain** the fundamental principles of communication systems, various noises of the system and information theory.	√											
2. **Examine** various types of modulation techniques and **evaluate** between them**.**				√								
3. **Design** various communication systems basing on various parameters set as standard.			√									

Lecture Schedule:

Week 1	**Introduction to Basics**	
Class 1	Overview of communication systems: Basic principles	CT 1
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**	CT 2
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, vestigial side band details	
Class 15	Quadrature, spectral analysis of each type	
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**	CT 3
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)**	
Class 25	Demodulation of PCM. Delta modulation(DM)	
Class 26	Pulse amplitude modulation Principle	
Class 27	Digital modulation: Amplitude-shift keying– principle	
Week 10	**Phase-shift keying (PSK)**	CT 4
Class 28	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 performance simulation.	
Class 42	Open Discussion	

Text and Ref Books:

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Communication System – Somon Haykin; John Wiley & Sons, Inc.

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

5.1.22. EECE 310: Communication Theory Laboratory

3.00 Contact Hour; 1.50 Credit Hour ;

Level: Level-3, Term-II

Pre-requisite: Communication Theory (EECE-309)

Rationale:

To learn and familiarize the basics and operation of various communication technology.

Course Contents:
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 309. In the second part, students will design simple systems using the principles learned in EECE 309.

Objective:
1. To verify practically the theories and concepts learned in EECE 309.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Design** and build modulation and demodulation systems examining tradeoffs in different communication systems.
2. **Develop** prototypes of different large scale system by working in collaboration.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-2	Conduct of Lab Test /Class Performance	**25%**
1-2	Report Writing/ Programming	**15%**
1-2	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-2	Final Evaluation (Exam/Project/assignment)	**30%**
1-2	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Design** and build modulation and demodulation systems examining tradeoffs in different communication systems.			√	√								
2. **Develop** prototypes of different large scale system by working in collaboration.			√		√				√			

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Amplitude Modulation and Demodulation.	
2.	DSB-SC and SSB Modulation and Demodulation.	
3.	Frequency Modulation and Demodulation.	
4.	Sampling Signal and Reconstruction.	
5.	PCM Modulation and Demodulation.	
6.	Time Division Multiplexing and Demultiplexing	
7.	Delta Modulation and Demodulation	
8.	ASK Modulation and Demodulation	
9.	FSK Modulation and Demodulation	
10.	PSK Modulation and Demodulation	
11.	Quiz test	
12.	Practice Lab-01	
13.	Lab Test-01	
14.	Viva	

Text and Ref Books:

1. Modern Digital & Analog Communication System - B. P. Lathi; OxfordUniversity Press.
2. Communication System - SomonHaykin; John Wiley & Sons, Inc.

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

5.1.23. EECE 311: Digital Signal Processing I

3.00 Contact Hour; 3.00 Credit Hour

Level: Level-3, Term-II

Pre-requisite: None.

Rationale:

To learn and familiarize with the basics of digital signal processing as well as utilizing the knowledge in solving complex analytical practical problems related to digital signals processing.

Course Contents:

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.

Objective:

1. To learn the basic of digital signals and compare them with their analog counterparts.

2. To study the different characteristics of digital signals and learn about their processing techniques.
3. To be skilled in designing FIR and IIR filters as per practical requirement.
4. To understand the basic of Z-transformations and be able to utilize Z-transformation for practical designing purposes.
5. To be able to learn and apply the knowledge of correlation and convolution for real life scenarios of signal processing problems.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. Analyze the analog and the digital signal both in time and in frequency domain along with different types of filter techniques and the customary noise filtration.

2. Apply sampling, quantization, encoding techniques in the way of digitization of real life signals, while using the edge of digital signal with better storage and transmission facilities.

3. Compute Correlation, Convolution, Fourier series coefficients, Fourier transforms, Z-transforms, Fast Fourier transforms of digital or discrete time signals.

4. Design FIR and IIR filters with specific requirements for practical purposes using various techniques.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze the analog and the digital signal both in time and in frequency domain along with different types of filter techniques and the customary noise filtration.	√											
2. Apply sampling, quantization, encoding techniques in the way of digitization of real life signals, while using the edge of digital signal with better storage and transmission facilities.		√										

3. Compute Correlation, Convolution, Fourier series coefficients, Fourier transforms, Z-transforms, Fast Fourier transforms of digital or discrete time signals.		√										
4. Design FIR and IIR filters with specific requirements for practical purposes using various techniques.			√		√							

Lecture Schedule:

Week 1	**Introduction to Discrete Time Signals and Systems**	CT-1
Class 1	Basic elements of a digital signal processing system	
Class 2	Advantages 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	Crosscorrelation sequences	
Week 5	**Correlation and Z-transformation (Contd.)**	CT-2
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**	CT-3
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	
Week 12	**Digital Filters**	CT-4
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	Open Discussion	

Text and Ref 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. Servis; Addision Wesley Publishing Company.
3. Signal and System (Continuous & Discrete) - Rodger E. Ziemer, W. H. Tranter & D. R. Fannin; Pearson Education.

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

5.1.24. EECE 312: Digital Signal Processing I Lab
3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-3, Term-II
Pre-requisite: Digital Signal Processing I (EECE 311)
Rationale:
To learn and familiarize the basics of signal processing and analysis using MATLAB

Course Contents:
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 311. In the second part, students will design simple systems using the principles learned in EECE 311

Objective:
1. To be familiar different signal processing techniques

2. To become skilled at signals and systems analysis using MATLAB.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. Analyze the analog and the digital signal both in time and in frequency domain along with different types of filter techniques and the customary noise filtration.
2. Apply sampling, quantization, encoding techniques in the way of digitization of real life signals, while using the edge of digital signal with better storage and transmission facilities.
3. Compute Fourier series coefficients, Fourier transforms, Z-transforms, Laplace transforms of different analog, digital, continuous or discrete time signals.
4. Determine stability, region of convergence of the system.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	**25%**
1-4	Report Writing/ Programming	**15%**
1-4	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-4	Final Evaluation (Exam/Project/assignment)	**30%**
1-4	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze the analog and the digital signal in both time and frequency domain along with different types of filter techniques and the customary noise filtration.	√											
2. Apply sampling, quantization, encoding techniques in the way of digitization of real life signals, while using the edge of digital signal with better storage and transmission facilities.		√										
3. Compute Fourier series coefficients, Fourier transforms, Z-transforms, Laplace					√							

transforms of different analog, digital, continuous or discrete time signals.												
4. Determine stability, region of convergence of the system.				√								

Lecture Schedule:

Weeks	Intended topics to be covered	Remarks
1.	Study of Sampling, Quantization and Encoding: Part – I (Uniform Quantization)	
2.	Study of Sampling, Quantization and Encoding: Part – II (Non-uniform Quantization)	
3.	Time Domain Analysis of Discrete Time Signals and Systems: Part – I (Response of LTI Systems: Convolution)	
4.	Time Domain Analysis of Discrete Time Signals and Systems: Part – II (Difference Equations and Correlation)	
5.	Z – Transform and Its Application: Part – I(Z and Inverse Z – Transform, Pole-Zero Plot and ROC)	
6.	Z – Transform and Its Application: Part – II(Higher Order Stability Testing)	
7.	Lab Test – I	
8.	Frequency Domain Analysis of DT Signals and Systems: Part – I (DTFS, DTFT, DFT)	
9.	Frequency Domain Analysis of DT Signals and Systems: Part – II (DFT)	
10.	Frequency Domain Analysis of DT Signals and Systems: Part – II (Circular Convolution, Correlation, Modulation)	
11.	FIR Filter Design	
12.	Lab Test – II	
13.	Project Submission	
14.	Quiz test	

Text and Ref Books:

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

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

5.1.25. EECE313: Electrical Measurement, Instrumentation and Sensors

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-3, Term-I

Pre-requisite: EECE101, EECE 105, EECE 201 and EECE 207.

Rationale:

To learn and familiarize with the basic electrical and electronic measurement system components along with different types of methods of measurement.

Course Contents:

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.

Objective:

1. To understand basic electrical and electronic measurement system components along with different types of methods of measurement.

2. To enhance knowledge in developing precise measurement with measuring variables and different tools relating network.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. Define the basic electrical and electronic equipment's and their characteristics along with different types of methods of measurement.

2. Analyze synthesis of data and information with the help of modern technologies: Study, design, implementation and performance analysis of measurement systems.

3. Apply evaluation, debugging and improvement of the operation of a measurement system to adapt new, unexpected situations.

4.Compute error estimation, measurement execution, measurement conditioning/conversion, measurement processing and finally measurements acquisition via various platforms, either analog or digital, with or without computer systems.

5. Estimate to develop an awareness and understanding of the crucial part that measurement plays in industrial and scientific activities and to be familiar with criteria for sensors and transducers selection and choose appropriate measurement methods for engineering tasks and scientific researches.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**

	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Define the basic electrical and electronic equipment's and their characteristics along with different types of methods of measurement.		√										
2. Analyze synthesis of data and information with the help of modern technologies: Study, design, implementation and performance analysis of measurement systems.					√							
3. Apply evaluation, debugging and improvement of the operation of a measurement system to adapt new, unexpected situations.				√								
4. Compute error estimation, measurement execution, measurement conditioning/ conversion, measurement processing and finally measurements acquisition via various platforms, either analog or digital, with or without computer systems.				√								
5. Estimate to develop an awareness and understanding of the crucial part that measurement plays in industrial and scientific activities and to be familiar with criteria for sensors and transducers selection and choose appropriate measurement methods for engineering tasks and scientific researches.					√							

Lecture Schedule:

Week 1	**Measurement System**	CT 1
Class 1	Introduction on Measurement System	
Class 2	Basic requirements, Significance and Methods of measurement	
Class 3	Classification of Instruments	
Week 2	**Measurement System**	
Class 4	Types of Instrumentation system	
Class 5	Elements of generalized measurement system	
Class 6	Functional elements of an instrument	
Week 3	**Error Analysis**	
Class 7	Applications	
Class 8	Measurement system performance	

Class 9	Errors in measurement	
Week 4	**Noise Analysis**	
Class 10	Noise: SNR, Noise source, Johonson Noise,	
Class 11	PSD, F, nf, Scale Range and Span	
Class 12	Accuracy and precision, Sensitivity, linearity	
Week 5	**Instruments**	
Class 13	Hysteresis, threshold, dead time, dead zone,	
Class 14	Resolution, sensors, loading effect	
Class 15	Classifications of Instruments	
Week 6	**Instrument Principles**	
Class 16	Operation Principle of instruments	
Class 17	D'Arsonval Galvanometer torque equation	CT 2
Class 18	Damping mechanism	
Week 7	**Instrument Principles**	
Class 19	Critical damping	
Class 20	Rectifier type AC Meters	
Class 21	Electrodynamics Meter principle	
Week 8	**Energy Meters**	
Class 22	Single-Phase Induction Type Energy Meters	
Class 23	Measurement of non-electrical quantities: Temperature	CT 3
Class 24	Measurement of non-electrical quantities: pressure	
Week 9	**Measurement of non-electrical quantities**	
Class 25	Measurement of non-electrical quantities: flow, level	
Class 26	Measurement of non-electrical quantities: strain, force and torque.	
Class 27	Basic elements of dc and ac signal conditioning elements.	
Week 10	**Instrumentation amplifier**	
Class 28	Instrumentation amplifier	
Class 29	Noise and source of noise, noise elimination compensation	
Class 30	function generation and linearization, A/D and D/A converters, sample and hold circuits	
Week 11	**data transmission**	
Class 31	Methods of data transmission	
Class 32	dc/ac telemetry system	CT 4
Class 33	Recording and display devices.	
Week 12	**Data Acquisition**	
Class 34	Data acquisition system in instrumentation	
Class 35	Microprocessor applications in instrumentation	
Class 36	Digital data transmission	
Week 13	**Problem Solving**	
Class 37	Different practical measurement system analyze (1) : Elementary systems	
Class 38	Different practical measurement system network analyze (2) : Elementary systems	
Class 39	Different practical measurement system network analyze (3) : Elaborate systems	

Week 14	Problem Solving	
Class 40	Different practical measurement system network analyze (4) : Elaborate systems	
Class 41	Scope of research in measurement system and devices	
Class 42	Open Discussion	

Text and Ref 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.**

5.1.26. EECE 314: Electrical Measurement, Instrumentation and Sensors Laboratory
3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-3, Term-I
Pre-requisite: EECE 313
Rationale:
To learn and familiarize the basics of electrical and electronic measurement system components along with different types of methods of measurement practically.

Course Contents:
In this course students will get a hands on experience about electrical and electronic measurement system components. They will observe the uses of electrical and electronic measurement system components practically.

Objective:

1. To understand practically basic electrical and electronic measurement system components along with different types of methods of measurement.
2. To enhance practical knowledge in developing precise measurement with measuring variables and different tools relating network.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic electrical and electronic measurement system components practically.
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different electrical and electronic measurement system related projects using circuit tools.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	

1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the knowledge of basic electrical and electronic measurement system components practically.						√						
2. Analyze the differences between theoretical knowledge with the practical observations.										√		
3. Design different electrical and electronic measurement system related projects using circuit tools.											√	

Lectures Schedule

Weeks	**Intended topics to be covered**	**Remarks**
1.	Errors in Measurement and Basic Statistical Sampling	
2.	Measurement of medium resistance using Wheatstone bridge	
3.	Range Extension of Ammeter and Voltmeter	
4.	Measurement of Power by 3 Voltmeter Method, Ammeter Method	
5.	Design of an Active Low-pass Butterworth Filter	
6.	Lab Test-01	
7.	Measurement of Capacitance Using 555 Timer IC.	
8.	Measurement of self-inductance by Maxwell's Capacitance Bridge	
9.	Measurement of Low resistance using Kelvin Double Bridge method	
10.	Measurement of High Resistance by loss of charge method	
11.	Study of an 8-bit Analog to Digital (A/D) converter	
12.	Practice Lab	
13.	Lab Test-2	
14.	Lab Quiz &Viva-voce	

Text and Ref 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.**

5.1.27. EECE 315: Electrical Properties of Material

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-3, Term-I
Pre-requisite: None
Rationale:
To learn and familiarize the basics of Properties of Material as well as the modern and classical theories of material.

Course Contents:
Crystal structures: Types of crystals, lattice and basis, Bravais lattice and Miller indices.
Classical theory of electrical and thermal conduction: Scattering, mobility and resistivity, temperature dependence of metal resistivity, Mathiessen's rule, Hall effect and thermal conductivity.
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.
Band theory of solids: Band theory from molecular orbital, Bloch theorem, Kronig-Penny model, effective mass, density-of-states.
Carrier statistics: Maxwell-Boltzmann and Fermi-Dirac distributions, Fermi energy.
Modern theory of metals: Determination of Fermi energy and average energy of electrons, classical and quantum mechanical calculation of specific heat.
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.
Magnetic properties of materials: Magnetic moment, magnetization and relative permitivity, different types of magnetic materials, origin of ferromagnetism and magnetic domains.
Introduction to superconductivity: Zero resistance and Meissner effect, Type I and Type II superconductors and critical current density.

Objective:
1. To understand some important electrical and magnetic phenomena in materials.
2. To become skilled at considering different electric and magnetic properties of solids required for a specific electrical application.
3. To understand the basic working principle of various energy storage devices like capacitors, inductors and resistors.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Analyze** Crystal structures, Classical and quantum theory of semiconductor, Modern theory of metals and Magnetic properties of materials.
2. **Apply** Bravais lattice and Miller indices, Mathiessen's rule, Schrodinger's equation for solving different aspect.

3. **Compute** lattice and basis, Fermi energy and average energy of electrons, classical and quantum mechanical calculation of specific heat, density of states.
4. **Estimate** wave nature of electrons, temperature dependency of metal resistivity and behavior of Type I and Type II superconductors.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze Crystal structures, Classical and quantum theory of semiconductor, Modern theory of metals and Magnetic properties of materials.	√											
2. Apply Bravais lattice and Miller indices, Mathiessen's rule, Schrodinger's equation for solving different aspect.		√										
3. Compute lattice and basis, Fermi energy and average energy of electrons, classical and quantum mechanical calculation of specific heat, density of states.			√									
4. Estimate wave nature of electrons, temperature dependency of metal resistivity and behavior of Type I and Type II superconductors.				√								

Lecture Schedule:

Week 1	**Crystal structures**	CT 1
Class 1	Types of crystals, lattice and basis	
Class 2	Types of crystals, lattice and basis	
Class 3	Types of crystals, lattice and basis,	
Week 2	**Crystal structures**	
Class 4	Bravais lattice and Miller indices	

Class 5	Bravais lattice and Miller indices	
Class 6	Bravais lattice and Miller indices	
Week 3	**Classical theory of electrical and thermal conduction**	
Class 7	Scattering	
Class 8	Mobility and resistivity	
Class 9	Mobility and resistivity	
Week 4	**Classical theory of electrical and thermal conduction**	CT 2
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	Schrodinger's equation	
Week 6	**Introduction to quantum mechanics**	
Class 16	Schrodinger's equation	
Class 17	Schrodinger's equation	
Class 18	One-dimensional quantum problems - infinite quantum well	
Week 7	**Introduction to quantum mechanics**	
Class 19	One-dimensional quantum problems - infinite quantum well	
Class 20	potential step and potential barrier; Heisenbergs's uncertainty principle and quantum box	
Class 21	potential step and potential barrier; Heisenbergs's uncertainty principle and quantum box	
Week 8	**Band theory of solids**	CT 3
Class 22	Band theory from molecular orbital	
Class 23	Band theory from molecular orbital	
Class 24	Bloch theorem	
Week 9	**Band theory of solids**	
Class 25	Density-of-states	
Class 26	Density-of-states	
Class 27	Kronig-Penny model, effective mass	
Week 10	**Carrier statistics**	
Class 28	Maxwell-Boltzmann and Fermi-Dirac distributions, Fermi energy	
Class 29	Determination of Fermi energy and average energy of electrons	
Class 30	Classical and quantum mechanical calculation of specific heat	
Week 11	**Dielectric properties of materials**	CT 4
Class 31	Dielectric constant, polarization - Electronics	
Class 32	Ionic and orientational, internal field	
Class 33	Clausius-Mosotti equation	
Week 12	**Dielectric properties of materials**	
Class 34	Spontaneous polarization	

Class 35	Frequency dependence of dielectric constant	
Class 36	Dielectric loss and piezoelectricity	
Week 13	**Magnetic properties of materials**	
Class 37	Magnetic moment, magnetization and relative permitivity	
Class 38	Magnetic moment, magnetization and relative permitivity	
Class 39	Different types of magnetic materials, origin of ferromagnetism and magnetic domains.	
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	Type I and Type II superconductors and critical current density.	

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

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

5.1.28. EECE317: VLSI I
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-3, Term-II
Pre-requisite: 1. EECE-207- Electronics II.
2. EECE-303-Digital Electronics
Rationale: To achieve a proper knowledge on VLSI IC design and to build a good CMOS chip.

Course Contents:
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.

Objectives:
1. To learn the basic VLSI design approach, technology trends and design styles.
2. To learn basic CMOS circuits.
3. To understand the basic layout design for CMOS circuits.
4. To learn the concepts of designing VLSI subsystems.
5. To be able to estimate the response and delay for CMOS circuits.
6. To be able to calculate the power dissipation for CMOS circuits.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:
1. **Identify** the various IC fabrication methods.
2. **Express** the Layout of simple MOS circuit using Lambda based design rules.
3. **Apply** the Lambda based design rules for subsystem design.
4. **Differentiate** various CMOS architectures.
5. **Design** an application using latest technology tools.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify the various IC fabrication methods.	√											
2. Express the Layout of simple MOS circuit using Lambda based design rules.	√											
3. Apply the Lambda based design rules for subsystem design.	√		√									
4. Differentiate various CMOS architectures.		√		√								
5. Design an application using latest technology tools.		√		√	√							

Lecture Schedule:

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

Class 7	MOS Capacitor	
Class 8	MOS Device Design Equations	
Class 9	MOS Transconductance	
Week 4	**MOS Transistor Theory**	CT 2
Class 10	Nonlinear Behavior of MOS Device, Mobility Degradation & Velocity Saturation	
Class 11	Channel Length Modulation, Threshold Voltage Effect	
Class 12	Leakage, Pass Transistor and Pass Gate	
Week 5	**Circuit Design Process**	
Class 13	MOS Layers	
Class 14	Stick Diagrams	
Class 15	Design Rules and Layout, Examples & Summary	
Week 6	**Circuit Design Process**	
Class 16	Lambda-Based Design and Other Rules	
Class 17	Layout Diagrams	
Class 18	Basic Physical Design of Simple Logic Gates	
Week 7	**CMOS Amplifiers**	CT 3
Class 19	MOS Biasing	
Class 20	CS Stage with Diode Connected Load	
Class 21	MOS Device as Current Source	
Week 8	**CMOS Amplifiers**	
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	**CMOS Subsystem Design**	
Class 25	Architectural Issues	
Class 26	Switch Logic, Pull up and Pull down Network	
Class 27	Gate Logic, Compound Logic	
Week 10	**CMOS Subsystem Design**	CT 4
Class 28	Clocked Circuits	
Class 29	ALU Subsystem, Adders, Multipliers, Memory Arrays	
Class 30	Examples & Summary	
Week 11	**Response and Delay**	
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	**Response and Delay**	
Class 34	Transient Response and Delay Estimation	
Class 35	Elmore Delay and Delay Estimation Using Elmore Delay	
Class 36	Examples & Summary	
Week 13	**Power**	
Class 37	Power in Circuit Elements	
Class 38	Switching Power	
Class 39	Power Dissipation Sources	
Week 14	**Power**	

Class 40	Dynamic Power and Dynamic Power Reduction	
Class 41	Activity Factor Estimation	
Class 42	Stack Effect and Power Gating, Examples & Summary	

TEXT 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 Edition, 2001.

REFERENCE BOOKS

1. Introduction to VLSI – D. Bricius; McGraw-Hill international.
2. CMOS Circuit Design, Layout and Simulation by R. Jacob Baker, Harry H. Li, David E Boyce, Wiley–IEEE Press 3rd Edition, 2010.
3. CMOS digital Integrated circuits: Analysis and design: Sung-Mo Kang and Yusuf Leblebici.
4. Analysis and design of digital integrated circuits:D.A.Hodges, Jackson and Saleh.
5. Microelectronics-Circuit Analysis and Design by Donald A. Neamen

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

5.1.29. EECE318: VLSI I Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-3, Term-II
Pre-requisite: VLSI I (EECE 317).
Rationale:
To learn and familiarize with the basics of VLSI circuit design as well as the analysis and simulation of VLSI circuits.

Course Contents:
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 317. In the second part, students will design simple systems using the principles learned in EECE 317.

Objective:
1. To Understand the use of Microwind, DSCH2, Quartus II and FPGA board.
2. To develop schematic and layout using Microwind and DSCH2.
3. To develop Verilog HDL code and test digital circuits on FPGA.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Analyze** the CMOS layout levels, how the design layers are used in the process sequence, and resulting device structures (i.e. cross-sectional views).
2. **Implement** digital logic designs of various types (i.e. combinational logic, multiplexers).
3. **Develop** professional IC layout using Microwind.
4. **Design** prototypes of different practical systems by working in collaboration.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	**25%**
1-4	Report Writing/ Programming	**15%**
1-4	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-4	Final Evaluation (Exam/Project/assignment)	**30%**
1-4	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze the CMOS layout levels, how the design layers are used in the process sequence, and resulting device structures (i.e. cross-sectional views).		√										
2. Implement digital logic designs of various types (i.e. combinational logic, multiplexers).			√									
3. Develop professional IC layout using Microwind.					√							
4. Design prototypes of different practical systems by working in collaboration.									√		√	

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Spice simulation of logic gates.	
2.	Layout design of a CMOS inverter.	
3.	Layout design of Boolean algebra using Euler's Formula.	
4.	Layout design using pass transistor logic.	
5.	Design of a 4-bit full adder by using one bit full adder in DSCH2 .	
6.	Design of a 3-bit comparator by using one bit comparator in DSCH2 .	
7.	Schematic Design of a 4-bit A.L.U. (Arithmetic Logic Unit)	
8.	Introduction to Verilog HDL, Quartus II and FPGA board.	
9.	Design of a Full-adder, 8:1 Multiplexer and 1:8 Demultiplexer using Verilog.	
10.	Design of a Finite State machine using Verilog in Quartus II.	

11.	Practice Lab	
12.	Lab Test	
13.	Viva	
14.	Lab Quiz	

Text and Ref Books:

1. Analysis and Design of Analog Integrated Circuits Gray and Meyer, Wiley Publication.
2. CMOS: Circuit Design, Layout, and Simulation Boyce, Baker, Li, Prentice Hall Publication

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

5.1.30. EECE 319: Solid State Devices

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-3, Term-II

Pre-requisite: Electronics-I(EECE-201), Electronics-II(EECE-207), Math-211 (Ordinary & Partial Differential Equation)

Rationale:

To learn and familiarize the physics of Semiconductor.

Course Contents:

Semiconductors in equilibrium: Energy bands, intrinsic and extrinsic semiconductors, Fermi levels, electron and hole concentrations, and temperature dependence of carrier concentrations and invariance of Fermi level.

Carrier transport processes and excess carriers: Drift and diffusion, generation and recombination of excess carriers, built-in-field, Einstein relations, continuity and diffusion equations for holes and electrons and quasi-Fermi level.

PN junction: Basic structure, equilibrium conditions, contact potential, equilibrium Fermi level, space charge, non-equilibrium condition, forward and reverse bias, carrier injection, minority and majority carrier currents, transient and ac conditions, time variation of stored charge, reverse recovery transient and capacitance.

Bipolar junction transistor: Basic principle of pnp and npn transistors, emitter efficiency, base transport factor and current gain, diffusion equation in the base, terminal currents, coupled-diode model and charge control analysis, Ebers-Moll equations and circuit synthesis.

Metal-semiconductor junction: Energy band diagram of metal semiconductor junctions, rectifying and ohmic contacts.

MOS structure: MOS capacitor, energy band diagrams and flat band voltage, threshold voltage and control of threshold voltage, static C-V characteristics, qualitative theory of MOSFET operation, body effect and current-voltage relationship of a MOSFET.

Objective:

1. To understand the characteristics, operation and limitation of semiconductor devices.
2. To understand the physical concepts underlying the operation of semiconductordevices.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Analyze** carrier flow and associated fields due to drift, diffusion, generation, and recombination. Be able to draw and interpret energy band diagrams.

2. **Analyze** the behavior of a pn junction (diode) field effect transistor (FET), including device physics, device operation, and device characteristics and summarize how device design affects performance.
3. **Apply** mathematical methods for the analysis of solid state electronics processes and theirs application to the solution of energy problems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class ,tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze carrier flow and associated fields due to drift, diffusion, generation, and recombination. Be able to draw and interpret energy band diagrams.	√											
2. **Analyze** the behavior of a pn junction (diode) field effect transistor (FET), including device physics, device operation, and device characteristics and summarize how device design affects performance.		√										
3. Apply mathematical methods for the analysis of solid state electronics processes and theirs application to the solution of energy problems.		√	√									

Lecture Schedule:

Week 1	**Semiconductors in equilibrium**	CT 1
Class 1	Energy bands	
Class 2	Energy bands	
Class 3	Intrinsic and extrinsic semiconductors	
Week 2	**Semiconductors in equilibrium**	
Class 4	Fermi levels	
Class 5	Electron and hole Concentrations	
Class 6	Electron and hole Concentrations	

Week 3	**Semiconductors in equilibrium**	
Class 7	Electron and hole Concentrations	
Class 8	Temperature dependence of carrier concentrations and	
Class 9	Invariance of Fermi level	
Week 4	**Carrier transport processes and excess carriers**	CT 2
Class 10	Drift and diffusion	
Class 11	Drift and diffusion, Generation and recombination of excess carriers	
Class 12	Generation and recombination of excess carriers, built-in-field	
Week 5	**Carrier transport processes and excess carriers**	
Class 13	Einstein relations,	
Class 14	Continuity and diffusion equations for holes and electrons and quasi-Fermi level.	
Class 15	Continuity and diffusion equations for holes and electrons and quasi-Fermi level.	
Week 6	**PN junction**	
Class 16	Basic structure, equilibrium conditions, contact potential	
Class 17	Equilibrium Fermi level, space charge	
Class 18	Non-equilibrium condition	
Week 7	**PN junction**	
Class 19	Forward and reverse bias	
Class 20	Carrier injection	
Class 21	Potential step and potential barrier; Heisenbergs's uncertainty principle and quantum box	
Week 8	**PN junction**	CT 3
Class 22	Minority and majority carrier currents,	
Class 23	Minority and majority carrier currents,	
Class 24	Transient and ac conditions	
Week 9	**PN junction**	
Class 25	Transient and ac conditions	
Class 26	Time variation of stored charge, reverse recovery transient	
Class 27	Capacitance	
Week 10	**Bipolar junction transistor**	
Class 28	Basic principle of pnp and npn transistors,	
Class 29	Emitter efficiency, base transport factor and current gain,	
Class 30	Emitter efficiency, base transport factor and current gain,	
Week 11	**Bipolar junction transistor**	CT 4
Class 31	Diffusion equation in the base,	
Class 32	Terminal currents, coupled-diode model and charge control analysis	
Class 33	Ebers-Moll equations and circuit synthesis.	
Week 12	**Metal-semiconductor junction**	
Class 34	Energy band diagram of metal semiconductor junctions	
Class 35	Energy band diagram of metal semiconductor junctions	
Class 36	Rectifying and ohmic contacts.	
Week 13	**MOS structure**	
Class 37	MOS capacitor,	
Class 38	Energy band diagrams and flat band voltage,	
Class 39	Threshold voltage and control of threshold voltage,	
Week 14	**MOS structure**	

Class 40	Static C-V characteristics,	
Class 41	Qualitative theory of MOSFET operation,	
Class 42	Body effect and current-voltage relationship of a MOSFET.	

Text and Ref Books:

1. Fundamentals of Electric Circuit- Alexander &sadiku.
2. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
3. Introductory Circuits for Electrical & Computer Engineering - James. W. Nilson; Prentice Hall of India Private Ltd.
4. Alternating Current Circuits – Russell & George F. Corcoran; John Wiley and Sons.

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

5.1.31. EECE322: Electrical Service Design Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-3, Term-II
Pre-requisite: Nil.
Rationale:
To learn and familiarize the basics of electric and magnetic circuit as well as the analysis of DC and AC circuit.

Course Contents:
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.

Objective:

1. To learn professional wiring rules and electrical protection system for industry, residential building, substation etc.
2. To become skilled at designing modern security systems, fire and electrical protection system, illumination etc. along with traditional wiring.

Course Outcomes (CO):
Upon completion of all sessional, the students will be able to:

1. **Measure** electrical safety, earthing requirements, process of earthing for surge and lightning protection.
2. **Apply** different electrical wiring techniques in practical building design.
3. **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.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods& their Weights:

COs	Assessment Method	(100%)
	Class Assessment	

1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Measure electrical safety, earthing requirements, process of earthing for surge and lightning protection					√		√					
2. Apply different electrical wiring techniques in practical building design.									√	√		
3. Design an electrical layout of a residential / commercial building with protective measures as a group project.									√		√	

Lectures Schedule:

Weeks	**Intended topics to be covered**	**Remarks**
1.	Introduction to Basic Electrical Appliances. Illumination & Lighting.	
2.	Protective Devices: Relays, Fuse, Circuit Breakers. Grounding & Hazards: Earthing.	
3.	Design of Home Security and Safety: Fire Alarm, CCTV, Burglar Alarm, Smoke Detector and Sprinklers.	
4.	Layout of a multi-storied building (Residential, Commercial, Industrial etc) using AutoCAD.	
5.	Design and Layout of a Substation, Single Line Diagram	
6.	Fittings and Fixture Layout using AutoCAD	
7.	Electrical Wiring Design: Conduit Layout-1	
8.	Electrical Wiring Design: Conduit Layout-2	
9.	Distribution board and Switch Board connection diagram using AutoCAD. Load Calculation of a building.	
10.	Detailed calculation of each type of circuit breakers including their normal current rating, short circuit current rating and type. Detailed estimation of overall design cost.	
11.	Sample design of the electrical services for a residential / commercial building with proper lighting, ventilation, cooling facility and electrical safety.	
12.	Presentation on Project	

13.	Viva	
14.	Quiz	

Text and Ref 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.**

5.1.32. EECE 330 Industrial Training/attachment
6 Weeks
Credit Hour 1.00
Intensive training in a particular industry as arranged by the student. It will be conducted at any convenient time after the term end exam of Level-3 Term-2 for a duration of 6 weeks as applicable or decided by the department. Completion of industrial attachment is mandatory for issuing of B.Sc degree.

5.1.33. EECE 401: Control System I
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I
Pre-requisite: Electronics I (EECe-201), Electronics II (EECE-207), Continuous Signals and Linear system (EECE- 301)
Rationale:
To learn and familiarize the basics of control system as well as the application of this area of electrical engineering.

Course Contents:
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.

Objectives:
1. To understand basic control theory along with different types of modeling of a system for the purpose of control.
2. To become skilled at various types of system design tools.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Analyze** different systems with respect to ideal control system models.
2. Grow the ability to **evaluate** practical systems in realistic conditions.
3. **Design** actual system fulfilling various constraints.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze different systems with respect to ideal control system models.				√								
2. Grow the ability to **evaluate** practical systems in realistic conditions					√							
3. Design actual system fulfilling various constraints.			√									

Lectures Schedule

Week 1		CT 1
Class 1	Basic idea about Control System	
Class 2	Examples of practical controls systems	
Class 3	How to model a control system	
Week 2		
Class 4	Introduction to linear system models	
Class 5	State variables	
Class 6	Effects of state variables over control system	
Week 3		
Class 7	Signal flow graphs	
Class 8	Relations between signal flow graphs and state variables	
Class 9	Transfer function to state variables	
Week 4		CT 2
Class 10	Introduction to Feedback control system	
Class 11	Practical examples of feedback control system	

Class 12	Mathematical modeling of feedback control system	
Week 5		
Class 13	Transient characteristic of control systems	
Class 14	Ideas of poles and zeros.	
Class 15	Relation between system response and poles and zeros.	
Week 6		
Class 16	Stability of a control system	
Class 17	Routh stability criterion	
Class 18	Mathematical problems regarding to Routh stability criterion	
Week 7		CT 3
Class 19	Effects of poles on system's stability	
Class 20	Second order system response	
Class 21	System stability in a second order system	
Week 8		
Class 22	Control parameters for a second order system	
Class 23	Introduction to PID controller	
Class 24	Mathematical problems regarding to PID controller	
Week 9		
Class 25	Practical applications of PID controller	
Class 26	Industrial automation through PID controller	
Class 27	Other controlling tools to control second order systems	
Week 10		CT 4
Class 28	Analysis techniques for feedback control system	
Class 29	Introduction to Root Locus system	
Class 30	Mathematical problems regarding Root Locus system	
Week 11		
Class 31	Introduction to frequency response method	
Class 32	Mathematical problems regarding frequency response method	
Class 33	Designing practical systems	
Week 12		
Class 34	Designing practical systems: using Root Locus	
Class 35	Designing practical systems: using frequency response	
Class 36	Different practical control system design(1) : Elementary systems	
Week 13		
Class 37	Different practical control system design(2) : Elementary systems	
Class 38	Different practical control system design(3) : Elementary systems	
Class 39	Different practical control system design(4) : Elementary systems	
Week 14		
Class 40	Different practical control system design(5) : Elementary systems	
Class 41	Scope of research in control system	
Class 42	Open Discussion	

Text and Ref Books:

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

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

5.1.34. EECE 402: Control System I Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-4, Term-I
Prerequisite: Control System I (EECE 401)
Rationale:
To learn and familiarize the basics of high voltage engineering as well as the application of this area of electrical engineering practically.

Course Contents:
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 401. In the second part, students will design simple systems using the principles learned in EECE 401.

Objectives:
1. To understand basic ideas of control system using small prototyped modules
2. To learn about practical control system design.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Evaluate** the concepts learned in the theoretical classes in practical small systems.
2. **Design** actual large scale system fulfilling all control system constraints.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-2	Conduct of Lab Test /Class Performance	**25%**
1-2	Report Writing/ Programming	**15%**
1-2	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-2	Final Evaluation (Exam/Project/assignment)	**30%**
1-2	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Evaluate the concepts learned in the theoretical classes in practical small systems.	√											

2. Design actual large scale system fulfilling all control system constraints.			√									

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Water level control by feedback transducer.	
2.	Water flow control by feedback transducer.	
3.	Speed control of DC Motor	
4.	Project idea discussion	
5.	Position control of DC Motor	
6.	Final Project Ideas	
7.	Speed control of induction motor	
8.	Gas pressure control by feedback transducer	
9.	Temperature control by STT	
10.	Temperature control by NTT	
11.	Lab Test	
12.	Viva	
13.	Quiz	
14.	Project Submission	

Text and Ref Books:

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

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

5.2.3.12. EECE 400: Thesis

6.00 Contact Hour; 6.00 Credit Hour;

Level: Level-4, Term-I and II

Pre-requisite: None.

Rationale:

To learn and familiarize with the basic principle and operation of machines like synchronous generator, synchronous motor and induction motor.

Course Contents:

Students may choose to write alone or in groups of up to 4 students.

Types of thesis:

Students can choose topics containing theoretical, empirical and/or practical aspects. But irrespective of the topic chosen, the use of relevant theory and literature is fundamental to the thesis.

An empirical paper: The idea is to gather knowledge on a specific topic and to relate theory to empirical observations, e.g. by using existing data, by using questionnaires or experiments.

A case study: A case study approach involves an analysis of a specific occurrence or process in an actual company or another type of organization. The purpose of a case study is to provide descriptions, analyses and suggested solutions to problems in relation to the case in hand. Case studies will involve the use of quantitative and/or qualitative methods for data collection.

A theoretical paper: This type of thesis builds on a theoretical model or a generic problem. Often a theoretical thesis is based on existing literature studies in which a theoretical problem is analyzed. This type of thesis is the least common.

No type of thesis is superior to others and no topics guarantee a high grade. The grade is based solely on whether the topic is thoroughly analyzed, the results clearly presented and whether you are able to demonstrate your knowledge of current theories and analyses, competent application of methods as well as independent critical judgment.

Objective:

1. To learn more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.
2. To contribute to research and development work.
3. To use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.
4. To plan and use adequate methods to conduct qualified tasks in given frameworks and to evaluate this work.
5. To create, analyse and critically evaluate different technical/architectural solutions.
6. To critically and systematically integrate knowledge.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. Further **develop** the ability to give an independent, systematic and clear treatment of a certain topic.
2. **Develop** the ability to independently identify and analyze relevant problems.
3. **Solve** a practical problem by a systematic use of an appropriate choice of theory and methodologies.
4. **Analyze** and handle academic knowledge through independent studies of relevant literature, and to cultivate the ability to evaluate and briefly account for the central elements in a large literature base.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	**25%**
1-4	Report Writing/ Programming	**15%**
1-4	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-4	Final Evaluation (Exam/Project/assignment)	**30%**
1-4	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Further **develop** the ability to give an independent, systematic and clear treatment of a certain topic.			√									
2. **Develop** the ability to independently identify and analyze relevant problems.				√								
3. **Solve** a practical problem by a systematic use of an appropriate choice of theory and methodologies.					√							
4. **Analyze** and handle academic knowledge through independent studies of relevant literature, and to cultivate the ability to evaluate and briefly account for the central elements in a large literature base.					√	√						

5.2.3.12. EECE 350 & 450: Capstone Project I
9.00 Contact Hour; 4.50 Credit Hour;
Level: Level-3, Term-II and Level-4, Term-I
Project topic and supervisor selection should be done by Level-3, Term-II
Pre-requisite: If any.
Rationale:
To design a project using the knowledge of basic subjects.

Course Contents:
This course is the first part to Capstone Project. The course aims to synergies all the basic engineering knowledge gained previously to solve real electrical engineering problems in an integrated and comprehensive manner. Students will be first exposed to the importance of good design concepts that considers important characteristics considering public health and safety, society and culture, environment and sustainability, authorities' requirements, as well as project cost effectiveness. Students will work in groups to observe existing project to evaluate the pros and cons of project characteristics. Electrical engineering is an engineering stream that comprises study and understanding about electricity and electronics. The main work of electrical engineers is to distribute energy for different devices. They have to use their knowledge and skills of electrical engineering for solving various technical problems. Students will be capable of doing on some specified electrical devices or products like developing GPS systems, airline navigation systems; designing power generating and transmitting system like a power plant of a wind farmhouse, and so on. Preparation and presentation of report will be done at the end of the course by the students.

Objective:
1. To provide design experience to the students through teamwork and familiarize them with the project management methodology
2. To provide the ability to understand and redefine a given engineering problem, and the

ability to develop a conceptual design
3. To provide students the ability to communicate effectively

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Identify** a problem requiring an electrical, electronic and communication engineering based solution.
2. **Function** effectively as a team.
3. **Analyze** a problem, and identify, formulate techniques and use the project management skill, appropriate computing and engineering tools for obtaining its solution.
4. **Assess** professional, ethical, environmental, social impacts and responsibilities of the design project
5. **Present** the design project results through written technical documents and oral presentations.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods& their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-6	Conduct of Lab Test /Class Performance	**25%**
1-6	Report Writing/ Programming	**15%**
1-6	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-6	Final Evaluation (Exam/Project/assignment)	**30%**
1-6	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Identify** a problem requiring an electrical, electronic and communication engineering based solution.	√	√	√	√								
2. **Function** effectively as a team.								√				
3. **Analyze** a problem, and identify, formulate techniques and use the project management skill, appropriate computing and engineering tools for obtaining its solution.				√	√						√	√

4. Assess professional, ethical, environmental, social impacts and responsibilities of the design project						√	√	√				
5. Present the design project results through written technical documents and oral presentations.									√	√		

Text and Ref Books:

1. Power System Analysis– J. J. Grainger and W. D. Stevenson, Jr
2. Modern Power System Planning – X. Wang and J. R. Mc Donald
3. Electric Power Engineering Handbook - L.L. Grigsby.
4. Reliability Evaluation of Engineering System – R. Billinton and R. N. Allan; Pitman Advanced
Publishing Program, New York
5. The Algebra of Modern Variable – M. D. Springer
6. High Voltage engineering – M. Khalifa; Dekker.
7. Op Amps & Linear Integrated Circuits - James M. Fiore; Delmar Thomson Learing.
8. Physics of Semiconductor Devices – S M Sze..
9. Design of Analog CMOS Integrated Circuits by Behzad Razavi, MacGraw Hill International Edition, 2001.
10. Optical Electronics in Modern Communications – Amnon Yariv; Oxford University Press.
11. Optical Fiber Communications: Principles & Practice - John M. Senior; Prentice Hall.
12. Microwave Devices and Circuits - Samuel Y. Liao; Prentice Hall of India.
13. Fiber Optic Communication System - Gerd Keiser; McGraw-Hill International
14. Digital Communications - Simon Haykin; McGraw Hill International.
15. Mobile Cellular Telecommunication (Analog Digital Systems) - William C.Y Lee; McGraw-Hill.
16. Probability, Random Variables, and Random Processes: Theory and Signal Processing Applications - John J. Shynk; Wiley-Interscience.
17. 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 Elective Course

5.2.1 Power

5.2.1.1. EECE 471: Power System II

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: EECE305
Rationale:
To learn and familiarize with the basic on stability problems of a power system and its mitigation techniques.

Course Contents:
Transmission lines cables: Overhead and underground.

Stability: Swing equation, power angle equation, equal area criterion, multi-machine system, step by step solution of swing equation.
Factors affecting stability: Reactive power compensation.Flexible AC transmission system (FACTS). High voltage DC transmission system. Power quality: harmonics, sag and swell.

Objective:
1. To understand the roles of transmission cables lines with their mathematical representations in a power system.
2. To realize the stability problems of a power system and its mitigation techniques.
3. To be acquainted with FACTS and power quality of a power system and the improvement measures.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Recognize** the necessity of different transmission lines according to their characteristics.
2. **Summarize** the stability factors and problems considering practical power plants.
3. **Generalize** the necessity of reactive power compensation.
4. **Analyze** and **employ** the compensation techniques regarding FACTS.
5. **Develop** model ideas to improve power quality of a system.
6. **Recommend** solutions regarding improvement of power quality and transmission of power through transmission line.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**
3-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
5-6	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Recognize the necessity of different transmission lines according to their characteristics.						√						
2. Summarize the stability factors and problems considering practical power plants.					√							
3. Generalize the necessity of reactive power compensation.						√						

4. **Analyze** and **employ** the compensation techniques regarding FACTS.							√					
5. **Develop** model ideas to improve power quality of a system.					√							
6. **Recommend** solutions regarding improvement of power quality and transmission of power through transmission line.							√					

Lecture Schedule:

Week 1	**Transmission Lines Cables**	
Class 1	Representation of lines	
Class 2	Short transmission lines	
Class 3	Medium-length line	
Week 2	**Transmission Lines Cables**	
Class 4	The long transmission line	
Class 5	Solution of differential equation of long transmission line	CT 1
Class 6	Equivalent circuit of long line	
Week 3	**Transmission Lines Cables**	
Class 7	Overhead and underground transmission line	
Class 8	Power flow through a transmission line	
Class 9	Power flow through a transmission line (contd.)	
Week 4	**Transmission Lines**	
Class 10	Reactive compensation of transmission lines	
Class 11	Reactive compensation of transmission lines (contd.)	
Class 12	Transmission line transients	
Week 5	**Transient Analysis**	
Class 13	Transient analysis: travelling waves	
Class 14	Transient analysis: travelling waves (contd.)	CT 2
Class 15	Transient analysis: reflections	
Week 6	**Transient Analysis**	
Class 16	Transient analysis: reflections (contd.)	
Class 17	The stability problem	
Class 18	Rotor dynamics	
Week 7	**Swing Equation**	
Class 19	Swing equation	
Class 20	Step-by step solution to swing equation (contd.)	
Class 21	Further considerations of the swing equation	
Week 8	**Swing Equation**	
Class 22	Further considerations of the swing equation (contd.)	CT 3
Class 23	The power angle equation	
Class 24	Power angle equation (contd.)	
Week 9	**Stability**	
Class 25	Equal area criterion of stability	
Class 26	Equal area criterion of stability (contd.)	
Class 27	Applications of equal area criterion	

Week 10	Flexible AC Transmission Systems	
Class 28	Multi-machine stability classical representation	CT 4
Class 29	Factors affecting transient stability	
Class 30	Flexible AC transmission systems (FACTS)	
Week 11	**Shunt Compensation**	
Class 31	Shunt compensation : SVC	
Class 32	Shunt compensation : STATCOM	
Class 33	Series Compensation : SSSC, TCSC	
Week 12	**Series Compensation**	
Class 34	Series Compensation : TCSR, TCPST	
Class 35	Series shunt compensation : UPFC	
Class 36	Direct current transmission	
Week 13	**Power Quality**	
Class 37	Power quality : voltage sag and swell	
Class 38	Surges, harmonics, flicker	
Class 39	Solving practical transmission line problems	
Week 14	**Problem Solving**	
Class 40	Solving practical problems related to stability	
Class 41	Scope of research	
Class 42	Open discussion	

Text and Ref Books:

1. Elements of Power System Analysis-William D. Stevenson
2. Electric Power Engineering Handbook – L.L. Grigsby.
3. Electric Power Generation, Transmission and Distribution - Singh S.N
4. Electrical Power System – Wadhwas
5. Modern Power System Analysis – IJ Nagrath and DP Kothan
6. Power System Analysis– J. J. Grainger and W. D. Stevenson, Jr
7. Power System– Behic R. Gungor
8. Electrical Power System – Ashfaq Husain
9. Principle of Power System – V. K. Mehta
10. Modern Power System Planning – X. Wang and J. R. Mc Donald

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

5.2.1.2. EECE 473: Power Electronics

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-4, Term-I/II

Pre-requisite: None.

Rationale:

To understand the operating characteristics of various power electronic devices in order to convert electrical power from the available form to the required form.

Course Contents:

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.

Objective:
1. To understand the operating characteristics of various power electronic devices.
2. To describe the operation of single and poly-phase rectifiers, converters and inverters.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Apply** power circuit analysis techniques to interpret and solve balanced and unbalanced three phase power circuits and power networks with linear and non-linear loads.
2. **Analyze** and **Evaluate** different power conversion applications combining circuit mathematics with characteristics of linear and non-linear devices.
3. **Apply** advanced knowledge and analysis techniques to design and critically assess key aspects of power conversion.
4. **Research, design,** and **simulate** a complete power system and/or power electronics application based on a complex set of user requirements.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods& their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply power circuit analysis techniques to interpret and solve balanced and unbalanced three phase power circuits and power networks with linear and non-linear loads.	√	√										
2. Analyze and **Evaluate** different power conversion applications combining circuit mathematics with characteristics of linear and non-linear devices.				√								

3. Apply advanced knowledge and analysis techniques to design and critically assess key aspects of power conversion.	√											
4. Research, design, and **simulate** a complete power system and/or power electronics application based on a complex set of user requirements.			√									

Lecture Schedule:

Week 1	**Switching Devices**	
Class 1	Introduction to power semiconductor switches.	
Class 2	Introduction to triggering devices.	
Class 3	Introduction to BJT and MOSFET.	
Week 2	**Switching Devices**	
Class 4	Introduction to SCR and IGBT	CT 1
Class 5	Introduction to GTO and UJT	
Class 6	Introduction to DIAC and TRIAC	
Week 3	**Rectifiers**	
Class 7	Introduction to Rectifiers.	
Class 8	Uncontrolled single phase and three phase Rectifiers.	
Class 9	Controlled single phase and three phase Rectifiers.	
Week 4	**Rectifiers Continued and Regulated power supplies**	
Class 10	Working principle of different types of rectifiers	
Class 11	Practical application of different types of rectifiers	
Class 12	Introduction to Regulated power supplies	
Week 5	**Regulators**	
Class 13	Different types of regulators	CT 2
Class 14	Linear-series and shunt regulators	
Class 15	Switching buck and buck-boost regulators	
Week 6	**Regulators continued**	
Class 16	Boost and Cûk regulators	
Class 17	Working principle of different types of regulators	
Class 18	Practical application of different types of regulators	
Week 7	**Chopper**	
Class 19	Introduction to AC voltage controllers	
Class 20	Introduction to Single and three phase Choppers	
Class 21	Working principle of Single and three phase Choppers	
Week 8	**Chopper and Cyclo-converter**	
Class 22	Practical application of Single and three phase Choppers	CT 3
Class 23	DC motor control.	
Class 24	Introduction to Single phase cyclo-converter	
Week 9	**Cyclo-converter and Inverters**	
Class 25	Working principle of cyclo-converter	
Class 26	Practical application of cyclo-converter	
Class 27	Introduction to Inverters	

Week 10	Inverters	CT 4
Class 28	Introduction to Single phase and three phase inverters	
Class 29	Working principle of Single phase and three phase inverters	
Class 30	Practical application of Single phase and three phase inverters	
Week 11	**AC motor**	
Class 31	Introduction to AC motor	
Class 32	Working principle of AC motor	
Class 33	AC motor control	
Week 12	**Stepper motor**	
Class 34	Introduction to stepper motor	
Class 35	Working principle of stepper motor	
Class 36	Stepper motor control	
Week 13	**Resonance inverters and Pulse width modulation**	
Class 37	Resonance inverters	
Class 38	Introduction to Pulse width modulation	
Class 39	Pulse width modulation techniques	
Week 14	**Static converters and Review**	
Class 40	Control of static converters(1)	
Class 41	Control of static converters(2)	
Class 42	Review on the topics	

Text and Ref Books:

1. Power Electronics: Device, Principles and Application –Muhammad H Rashid

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

5.2.1.3. EECE 474: Power Electronics Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: Power Electronics (EECE 473).
Rationale:
To understand the operating characteristics of various power electronic devices in order to convert electrical power from the available form to the required form.

Course Contents:
Power semiconductor switches, SCR operation in AC circuit, Switching losses, Switching regulator circuits for controlling DC-DC converters, Switching regulator circuits for controlling single phase square wave inverter, DC-DC converter circuits: Buck, Boost, Buck-Boost, Cuk. Single phase inverter circuits: Square wave push pull and half bridge voltage source inverters. Operation of single and three phase uncontrolled rectifiers.

Objective:

1. To verify practically the theories and concepts learned in EECE 474.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Apply** theoretical idea of power electronic devices to small practical systems to understand the operation of that system.
2. **Develop** prototypes of different large scale systems by working in collaboration.
3. **Apply** the theory and operating principles of electric machines to explain and evaluate their properties and characteristics when integrated into power systems.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply theoretical idea of power electronic devices to small practical systems to understand the operation of that system.			√	√								
2. Develop prototypes of different large scale systems by working in collaboration.					√				√	√		
3. Apply the theory and operating principles of electric machines to explain and evaluate their properties and characteristics when integrated into power systems.	√											

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Introduction to Power semiconductor switches	
2.	Switching losses for various power electronic switches.	
3.	SCR operation in AC circuit.	
4.	Switching regulator circuits for controlling DC-DC converters.	
5.	Switching regulator circuits for controlling single phase square wave	

	inverter.	
6.	DC-DC converter circuits: Buck, Boost	
7.	DC-DC converter circuits: Buck-Boost, Cuk	
8.	Single phase inverter circuits: Square wave push pull	
9.	Single phase inverter circuits: half bridge voltage source inverters.	
10.	Operation of single and three phase uncontrolled rectifiers.	
11.	Quiz test	
12.	Practice Lab-01	
13.	Lab Test-01 and Viva	
14.	Project	

Text and Ref Books:

1. Power Electronics: Device, Principles and Application –Muhammad H Rashid

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

5.2.1.4. EECE475: Power Plant Engineering

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-4, Term-I/II

Pre-requisite: Power System (EECE-305)

Rationale:

To learn and familiarize with the layout and operations of various types of power plants.

Course Contents:

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.

Objective:

1. To understand the layout and principles in operation of various types of power plants.

2. To be proficient in designing the necessary steps to set up new power plants with proper layout and load forecasting.

3. To be capable of evaluating the electricity tariff system for bill calculations.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Understand** basics of different types of power plants.
2. **Express** the necessity of respective types of power plants to meet the power demand of a certain area.
3. **Prepare** the plan to set up power plants with all necessary auxiliaries and instrumentations.
4. **Analyze** the performances of different types of power plants.
5. **Recommend** the electricity tariff for various power demand scenario.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
	Class Performance	**05**
1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Understand basics of different types of power plants.					√							
2. Express the necessity of respective types of power plants to meet the power demand of a certain area.					√							
3. Prepare the plan to set up power plants with all necessary auxiliaries and instrumentations.						√						
4. Analyze the performances of different types of power plants.						√						
5. Recommend the electricity tariff for various power demand scenario.											√	

Lecture 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	CT 1
Class 5	Basic type of steam generators	
Class 6	Fire-tube boilers and Water-tube boilers	
Week 3	**Steam Power Plant**	
Class 7	Economizers and Super-heaters	

Class 8	Steam generator control	
Class 9	Steam generator control (contd.)	
Week 4	**Steam Power Plant**	CT 2
Class 10	Supercritical boiler: PC vs CFB technology	
Class 11	Introduction to steam turbines	
Class 12	Steam turbines (contd.)	
Week 5	**Hydroelectric Power Plants**	
Class 13	Turbine blading	
Class 14	Turbine blading (contd.)	
Class 15	Introduction to hydroelectric power plants	
Week 6	**Hydroelectric Power Plants**	
Class 16	Advantages and disadvantages of water power	
Class 17	Selection of site for hydroelectric plants	
Class 18	Hydrological cycle	
Week 7	**Hydroelectric Power Plants**	CT 3
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**	CT 4
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	

Text and Ref Books:

1. Power Plant Engineering- G R and G. R. Nagpal
2. Power Station Engineering & Economy - William A. Vopat
3. Electric Power Generation, Transmission and Distribution - Singh S.N
4. Principle of Power System - V. K. Mehta
5. Electric Power Engineering Handbook - L.L. Grigsby.
6. Power Plant Engineering- P. K Nag

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

5.2.1.5. EECE477: Power System Protection

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-4, Term-I/II

Pre-requisite: Power System (EECE-305)

Rationale:

To learn and familiarize with the basic power system protective components like relay, circuit breaker etc. and their applications for the protection of costly electrical equipments.

Course Contents:

Purpose of power system protection.

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 digitalRelays: 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.

Objective:

1. To realize the purpose of protection for power system and understand the criteria of various faults like over and under current, voltage frequency etc.
2. To learn about various protection devices and their proper usages like instrument transformers, relays, circuit breakers and fuses etc.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Decide** required protection scheme and equipment for power system protection.
2. **Compare** different types of faults and can take necessary actions.
3. **Analyze** and select the appropriate circuit breakers, relays and fuses.
4. **Design** plans for unit protection like generator, transformer, motor and transmission lines etc

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Decide required protection scheme and equipment for power system protection.					√							
2. Compare different types of faults and can take necessary actions.		√										
3. Analyze and select the appropriate circuit breakers, relays and fuses.					√							
4. Design plans for unit protection like generator, transformer, motor and transmission lines etc				√								

Lecture Schedule:

Week 1	**Power System Protection**	
Class 1	Purpose of power system protection	CT 1
Class 2	Criteria for detecting faults and the 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 voltages	
Week 4	**Generator Protection (Cont..)**	CT 2
Class 10	Over and under frequency protection	
Class 11	Current transformers	
Class 12	Potential 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..)**	CT 3
Class 19	Directional relay	
Class 20	Trip circuits	
Class 21	Unit protection schemes: Generator	
Week 8	**Unit Protection**	
Class 22	Unit protection schemes: Transformer	
Class 23	Unit protection schemes: Motor	
Class 24	Unit protection schemes: Bus bar	
Week 9	**Unit Protection (Cont..)**	
Class 25	Unit protection schemes: Transmission lines	
Class 26	Unit protection schemes: Distribution lines	
Class 27	Miniature circuit breakers	
Week 10	**Fuses and Circuit breaker**	CT 4
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: SF6 and vaccum	
Week 12	**Design Problem**	
Class 34	Ratings of circuit breakers	
Class 35	Designing practical power system protection unit for generation side-1	
Class 36	Designing practical power system protection unit for distribution side-1	
Week 13	**Design Problem (Cont..)**	
Class 37	Designing practical power system protection unit for transmission side-1	
Class 38	Designing practical power system protection unit for generation side-2	
Class 39	Designing practical power system protection unit for distribution side-2	
Week 14	**Research and Open discussion**	
Class 40	Designing practical power system protection unit for transmission side-2	
Class 41	Research opportunities on protection	
Class 42	Open discussion	

Text and Ref Books:

1. Switchgear protection and Power Systems–Sunil S. Rao
2. Power System Protection and Switchgear–Badri Ram
3. Fundamentals of power system protection – Y. G. Paithankar

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

5.2.1.6. EECE 478: Power System Protection Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: Power System Protection (EECE 477).
Rationale:
To learn and familiarize the basics of protection system as well as the use of protective equipments like CT, PT, relay and circuit breaker.

Course Contents:
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 477. In the second part, students will design simple systems using the principles learned in EECE 477.

Objective:
1. To understand the working principles and usages of different protection system and the protection instruments.
2. To be skilled in using the protection devices and designing protection circuit system with the gained knowledge.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Propose required fault protection techniques.
2. Design power system protection system by own with the course knowledge for a given scenario.
3. Choose appropriate protection schemes and recommend proper solution for practical protection related problems of power system.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12

1. **Propose** required fault protection techniques.							√					
2. **Design** power system protection system by own with the course knowledge for a given scenario.				√								
3. **Choose** appropriate protection schemes and recommend proper solution for practical protection related problems of power system.			√									

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Familiarization with the protection equipments.	
2.	Generator synchronization	
3.	Differential protection of a synchronous generator	
4.	Over speed protection of a synchronous generator	
5.	Reverse power protection of a synchronous generator	
6.	Lab Test-01	
7.	Overvoltage protection of a synchronous generator	
8.	Over current protection of a synchronous generator	
9.	Mechanical overload/under load protection of a three phase induction motor	
10.	Mechanical overload/under load protection of a three phase induction motor	
11.	Differential protection of a three phase power transformer	
12.	Quiz	
13.	Practice Lab	
14.	Lab Test-02 + Viva	

Text and Ref Books:

1. Switchgear protection and Power Systems–Sunil S. Rao
2. Power System Protection and Switchgear–Badri Ram
3. 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

3.00 Contact Hour; 3.00 Credit Hour

Level: Level-4, Term-I/II

Pre-requisite: None.

Rationale:

To gain basic knowledge on probability and reliability concepts of power system and to become expert on modeling of power system network for reliability analysis.

Course Contents:

Review of probability concepts. Probability distribution: Binomial, Poisson, and Normal. Reliability concepts: Failure rate, outage, mean time to failure, series and parallel systems and redundancy. Markov process, Probabilistic generation and load models. Reliability indices: Loss of load probability and loss of energy probability. Frequency and duration, Reliability evaluation techniques of single area system, Introduction to the evaluation of interconnected system, jointly owned unit.

Objective:

1. To be acknowledged about reliability concepts and probability distributions.
2. To understand and apply the reliability evaluation techniques considering different reliability indices.
3. To evaluate the redundancy of power plants
4. Analyze the loss of load probability and loss of energy probability.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Compare** different probability distribution functions.
2. **Construct** the load models for assessment of reliability of various types of interconnected power systems.
3. **Choose** the evaluation techniques from the gained knowledge to interpret practical reliability problems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Compare** different probability distribution functions.		√										
2. **Construct** the load models for assessment of reliability of various types of interconnected power systems.						√						

3. Choose the evaluation techniques from the gained knowledge to interpret practical reliability problems.					√							

Lecture Schedule:

Week 1	**Probability concepts**	
Class 1	Probabilistic reliability criteria	
Class 2	Review of probability concepts	
Class 3	Binomial probability distribution	
Week 2	**Probability distribution**	
Class 4	Poission probability distribution	CT 1
Class 5	Normal probability distribution	
Class 6	Reliability concepts: Failure rate and outage	
Week 3	**Reliability parameters**	
Class 7	Reliability cost and reliability worth	
Class 8	Concepts of adequacy and security	
Class 9	Methods of assessment	
Week 4	**Reliability Indices**	
Class 10	Reliability indices: Loss of load probability	
Class 11	Concepts and evaluation techniques	
Class 12	Numerical examples	
Week 5	**Reliability Indices (Cont..)**	
Class 13	Loss of energy indices	CT 2
Class 14	Evaluation of energy indices	
Class 15	Energy limited systems	
Week 6	**Transformer (Cont..)**	
Class 16	Generator capacity: frequency and duration methods	
Class 17	System risk indices: Individual state load model	
Class 18	System risk indices: Cumulative state load model	
Week 7	**Reliability Indices (Cont..)**	
Class 19	Factors affecting the emergency assistance through interconnection	
Class 20	Effect of tie capacity	
Class 21	Effect of tie line reliability	
Week 8	**Interconnected system**	
Class 22	Effect of number of tie lines	CT 3
Class 23	Effect of load forecast uncertainty	
Class 24	Reliability evaluation technique of interconnected system	
Week 9	**Forecasting and evaluation**	
Class 25	Reliability evaluation technique of single area system	
Class 26	Reliability evaluation technique of joined unit	
Class 27	Mean time to failure redundancy	
Week 10	**Failures**	CT 4

Class 28	Series and parallel systems and redundancy	
Class 29	Temporary and transient failures	
Class 30	Common mode failures	
Week 11	**Markov process**	
Class 31	Inclusion of weather effects	
Class 32	Inclusion of breaker failures	
Class 33	Markov process	
Week 12	**Markov process (Cont..)**	
Class 34	Markov process (contd.)	
Class 35	Probabilistic generation and load models -1	
Class 36	Probabilistic generation and load models - 2	
Week 13	**Problem formulation**	
Class 37	Probabilistic generation and load models - 3	
Class 38	Solution of actual problems regarding reliability of an existing power system model-1	
Class 39	Solution of actual problems regarding reliability of an existing power system model-2	
Week 14	**Research**	
Class 40	Solution of actual problems regarding reliability of an existing power system model-3	
Class 41	Scope of research in power system reliability	
Class 42	Open discussion	

Text and Ref Books:

1. Reliability Evaluation of Power System – Billinton and Allan; Pitman Advanced Publishing Program.
2. Reliability Evaluation of Engineering System – R. Billinton and R. N. Allan; Pitman Advanced
Publishing Program, New York

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

5.2.1.8. EECE 481: Power System Operation and Control

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-4, Term-I/II

Pre-requisite: Power System (EECE305)

Rationale:

To learn and familiarize with the basic on integrated and deregulated power system with real time operation and various data acquisition devices.

Course Contents:

Principles of power system operation: SCADA, conventional and competitive environment.

Unit commitment, static security analysis, state estimation, optimal power flow, automatic generation control and dynamic security analysis.

Objective:

1. To learn about integrated and deregulated power system with real time operation and various data acquisition devices.

2. To be skilled about power system security, demand side control and electricity market operation etc. with their application in present power system scenario.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. Recognize the necessity of vertically integrated power system and deregulated power system.

2. Explain SCADA and EMS.

3. Choose from various data acquisition devices necessary for practical purpose.

4. Compare and **utilize** static and dynamic power security.

5. Compose the application functions like UC, OPF, ACE and AGC etc.

6. Compare and evaluate electricity market operations with the knowledge of GenCos, ISO, DisCos etc.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
	Class Performance	**05**
1-6	Class Tests/Assignments	**20**
1-6	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-6	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Recognize the necessity of vertically integrated power system and deregulated power system.						√						
2. **Explain** SCADA and EMS.					√							
3. Choose from various data acquisition devices necessary for practical purpose.						√						
4. Compare and **utilize** static and dynamic power security.							√					
5. Compose the application functions like UC, OPF, ACE and AGC etc.					√							
6. Compare and evaluate electricity market operations with the knowledge of GenCos, ISO, DisCos etc.							√					

Lecture Schedule:

Week 1	**Transmission Lines Cables**	CT 1
Class 1	Principles of power system operation	
Class 2	Vertically integrated power system	
Class 3	Deregulated power system	
Week 2	**Transmission Lines Cables**	
Class 4	Real time operation: SCADA	
Class 5	Energy management system (EMS)	
Class 6	Various data acquisition devices	
Week 3	**Transmission Lines Cables**	
Class 7	RTU (Remote thermal unit)	
Class 8	IED (Intelligent Electronic Devices)	
Class 9	PMU (Phasor management unit)	
Week 4	**Transmission Lines**	CT 2
Class 10	DFDR	
Class 11	WAMPC (Wide area monitoring, protection and control)	
Class 12	State estimation	
Week 5	**Transient Analysis**	
Class 13	Short term load forecasting	
Class 14	Unit commitment (UC)	
Class 15	Economic Dispatch (ED)	
Week 6	**Transient Analysis**	
Class 16	Optimal power flow (OPF)	
Class 17	Generations and turbine governors	
Class 18	Generations and turbine governors (contd.)	
Week 7	**Swing Equation**	CT 3
Class 19	Droop	
Class 20	Frequency sensitivity of loads	
Class 21	ACE (area control error)	
Week 8	**Swing Equation**	
Class 22	AGC (Automatic Generation Control)	
Class 23	Coordination with UC and ED	
Class 24	Frequency collapse	
Week 9	**Stability**	
Class 25	Emergency load shed	
Class 26	Static power system security	
Class 27	Dynamic power system security	
Week 10	**Flexible AC Transmission Systems**	CT 4
Class 28	Security constrained OPF	
Class 29	Electricity market operation: GenCos	
Class 30	Electricity market operation: ISO	
Week 11	**Shunt Compensation**	
Class 31	Electricity market operation: DisCos	
Class 32	Bidding	
Class 33	Spot market and Social welfare	
Week 12	**Series Compensation**	

Class 34	Market clearing price (MCP)	
Class 35	Locational marginal price (LMP)	
Class 36	Bilateral contact and forward market	
Week 13	**Power Quality**	
Class 37	Demand side control: Distribution management system	
Class 38	Demand side management	
Class 39	Smart grid concept	
Week 14	**Problem Solving**	
Class 40	Practical operation and control problems and solution	
Class 41	Scope of research on power system operation and control	
Class 42	Open discussion	

Text and Ref Books:

1. Power System Optimization – Kthori and Dhillon
2. Reliability Evaluation of Power System – Billinton and Allan
3. Modern Power System Analysis – IJ Nagrath and DP Kothan
4. Element of Power System Analysis –J. J. Grainger and W. D. Stevenson,
5. The Algebra of Modern Variable – M. D. Springer

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

5.2.1.9. EECE 483: High Voltage Engineering

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of high voltage engineering as well as the application of this area of electrical engineering.

Course Contents:
High voltage DC: Rectifier circuits, voltage multipliers, Van-de-Graaf and electrostatic generators.
High voltage AC: Cascaded transformers and Tesla coils.
Impulse voltage: Shapes, mathematical analysis, codes and standards, single and multi-stage impulse generators, tripping and control of impulse generators. Breakdown in gas, liquid and solid dielectric materials. Corona. High voltage measurements and testing.Over-voltage phenomenon and insulation coordination. Lightning and switching surges, basic insulation level, surge diverters and arresters.

Objectives:

1. To possess knowledge of high voltage techniques including concepts on insulating materials and breakdown phenomena.
2. To be proficient in designing and developing high voltage laboratories for high voltage testing with appropriate testing apparatus and equipment.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Identify** the insulating materials and usage of them at proper purpose.
2. **Summarize** the breakdown phenomena and take necessary actions accordingly for safety purpose.

3. **Solve** practical problems regarding high voltage issues.
4. **Analyze** the generation and measurement techniques of high voltage AC , DC and impulse voltages and currents.
5. **Develop** high voltage laboratory for testing of instruments.
6. **Recommend** best insulation, isolation apparatus and circuit breakers for practical uses.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-6	Class Tests/Assignments	**20**
1-6	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-6	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Identify** the insulating materials and usage of them at proper purpose.	√											
2. **Summarize** the breakdown phenomena and take necessary actions accordingly for safety purpose.		√										
3. **Solve** practical problems regarding high voltage issues.			√									
4. **Analyze** the generation and measurement techniques of high voltage AC , DC and impulse voltages and currents.	√											
5. **Develop** high voltage laboratory for testing of instruments.			√									
6. **Recommend** best insulation, isolation apparatus and circuit breakers for practical uses.				√								

Lectures Schedule

Week 1		
Class 1	Introduction to high voltage engineering.	
Class 2	High voltage DC generation	
Class 3	Rectifier circuits	
Week 2		

Class 4	Ripple minimization	CT 1
Class 5	Voltage multipliers	
Class 6	Van-de-Graaf and electrostatic generators	
Week 3		
Class 7	High voltage AC generation	
Class 8	Tesla coils	
Class 9	Cascaded transformers	
Week 4		CT 2
Class 10	Resonance transformers	
Class 11	Impulse voltage generation: Shape	
Class 12	Mathematical analysis	
Week 5		
Class 13	Codes and standards	
Class 14	Single and multistage impulse generators	
Class 15	Tripping and control of impulse generators	
Week 6		
Class 16	Breakdown in gas	
Class 17	Liquid and solid dielectric materials	
Class 18	Applications of gas and solid dielectrics in transformers	
Week 7		CT 3
Class 19	Corona	
Class 20	High voltage measurement and testing: IEC and IEEE standards	
Class 21	Sphere gap	
Week 8		
Class 22	Electrostatic voltmeter	
Class 23	Potential divider	
Class 24	Schering bridge	
Week 9		
Class 25	Mega ohm Meter	
Class 26	HV current and voltage transducers Contact and non contact	
Class 27	Over voltage phenomena	
Week 10		CT 4
Class 28	Insulation Coordination	
Class 29	Lightning Surges	
Class 30	Switching Surges	
Week 11		
Class 31	Basic Insulation Level: EV	
Class 32	Basic Insulation Level: HV	
Class 33	Basic Insulation Level: EHV	
Week 12		
Class 34	Surge Diverters	
Class 35	Arresters	
Class 36	Testing of insulators and bushings	
Week 13		

Class 37	Testing of isolators and circuit breakers	
Class 38	Testing of cables	
Class 39	Testing of transformers	
Week 14		
Class 40	Testing of Surge arresters	
Class 41	Scope of research Engineering	
Class 42	Open discussion	

Text and Ref Books:

1. High Voltage engineering – Naidu; Tata McGraw-Hill.
2. High Voltage engineering – Wadhwa; New Age India.
3. High Voltage engineering – M. Khalifa; Dekker.
*****Details of program outcome and grading policy are attached as Annex A and Annex B.**

5.2.1.10. EECE 484: High Voltage Engineering Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: High Voltage Engineering (EECE 483)
Rationale:
To learn and familiarize the basics of high voltage engineering as well as the application of this area of electrical engineering practically.

Course Contents:
High voltage DC: Rectifier circuits, voltage multipliers, Van-de-Graaf and electrostatic generators.
High voltage AC: Cascaded transformers and Tesla coils.
Impulse voltage: Shapes, mathematical analysis, codes and standards, single and multi-stage impulse generators, tripping and control of impulse generators. Breakdown in gas, liquid and solid dielectric materials. Corona. High voltage measurements and testing. Over-voltage phenomenon and insulation coordination. Lightning and switching surges, basic insulation level, surge diverters and arresters.

Objectives:

1. To be skilled in performing experiments regarding testing of high voltage instruments.
2. To be proficient in designing and developing simple high voltage power system=m model.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Recognize** the insulating materials, isolators and circuit breakers and usage of them at appropriate places.
2. **Solve** practical problems with the knowledge regarding high voltage issues.
3. **Design** high voltage power transmission system.
4. **Recommend** about the various high voltage apparatus and instruments after their testing.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	**25%**
1-4	Report Writing/ Programming	**15%**
1-4	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-4	Final Evaluation (Exam/Project/assignment)	**30%**
1-4	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Recognize** the insulating materials, isolators and circuit breakers and usage of them at appropriate places.		√										
2. **Solve** practical problems with the knowledge regarding high voltage issues.		√										
3. **Design** high voltage power transmission system.				√								
4. **Recommend** about the various high voltage apparatus and instruments after their testing.					√							

<u>Lectures Schedule</u>

Weeks	Intended topics to be covered	Remarks
1.	Construction and operation of High Voltage Rectifier circuits	
2.	Study of voltage multipliers	
3.	Study of Van-de-Graaf and electrostatic generators	
4.	Generation of Impulse voltage	
5.	Study of Cascaded transformers and Tesla coils	
6.	Lab Test-01	
7.	Study of single and multi-stage impulse generators	
8.	Tripping and control of impulse generators	
9.	High voltage measurements and testing	
10.	Study of Lightning and switching surges	
11.	Quiz	
12.	Practice Lab-02	

13.	Lab Test-02	
14.	Viva	

Text and Ref Books:
1. High Voltage engineering – Naidu; Tata McGraw-Hill.
2. High Voltage engineering – Wadhwa; New Age India.
3. High Voltage engineering – M. Khalifa; Dekker.

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

5.2.2 Electronics

5.2.2.1. EECE 451: Processing and Fabrication Technology

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: VLSI I (EECE-317)

Rationale:
To learn and familiarize the basics of processing and fabrication technology of VLSI as well as the application of this area of electrical engineering.

Course Contents:
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 devices. Testing, bonding and packaging.

Objectives:
1. To become familiarize with statistical modeling and the control of semiconductor fabrication processes and plants.
2. To understand the physical concepts underlying the operation of semiconductor devices.
3. To introduce semiconductor process flow from wafer fabrication to package assembly and final test, and what the semiconductor device failure analysis is and how it is conducted.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Design** systems using the knowledge of semiconductor fabrication processes.
2. **Analyze** failed products and clarify the failure causes and mechanism, and provide feedback to the manufacturing and design process not only to prevent reoccurrence in the future and but also to improve manufacturing and product quality.
3. **Select** appropriate fab technique for given specification and fabrication limitation.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Design** systems using the knowledge of semiconductor fabrication processes.		√										
2. **Analyze** failed products and clarify the failure causes and mechanism, and provide feedback to the manufacturing and design process not only to prevent reoccurrence in the future and but also to improve manufacturing and product quality.			√									
3. **Select** appropriate fab technique for given specification and fabrication limitation.					√							

<u>Lectures Schedule</u>

Week 1		
Class 1	Introduction to Processing and Fabrication Technology	
Class 2	Substrate materials: Crystal growth and wafer preparation	
Class 3	Substrate materials: Crystal growth and wafer preparation	
Week 2		
Class 4	Epitaxial growth technique	
Class 5	Molecular beam epitaxy	
Class 6	Molecular beam epitaxy	
Week 3		
Class 7	Chemical vapor phase epitaxy and chemical vapor deposition (CVD)	CT 1

Class 8	Chemical vapor phase epitaxy and chemical vapor deposition (CVD)	
Class 9	Doping techniques: Diffusion and ion implantation	
Week 4		CT 2
Class 10	Doping techniques: Diffusion and ion implantation	
Class 11	Growth and deposition of dielectric layers: Thermal oxidation	
Class 12	Growth and deposition of dielectric layers: Thermal oxidation	
Week 5		
Class 13	CVD	
Class 14	Plasma CVD	
Class 15	Sputtering and silicon -nitride growth. Etching: wet chemical etching	
Week 6		
Class 16	Sputtering and silicon -nitride growth. Etching: wet chemical etching	
Class 17	Silicon and GaAs etching, anisotropic etching, selective etching, dry physical etching	
Class 18	Silicon and GaAs etching, anisotropic etching, selective etching, dry physical etching	
Week 7		CT 3
Class 19	Ion beam etching, sputtering etching and reactive ion etching	
Class 20	Ion beam etching, sputtering etching and reactive ion etching	
Class 21	Ion beam etching, sputtering etching and reactive ion etching	
Week 8		
Class 22	Cleaning: Surface cleaning	
Class 23	Organic cleaning and RCA cleaning	
Class 24	Lithography: Photo -reactive materials	
Week 9		
Class 25	Pattern generation	
Class 26	Pattern generation	
Class 27	Pattern transfer and metalization	
Week 10		CT 4
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		
Class 31	Discrete device fabrication: Diode, transistor, resistor and capacitor	
Class 32	Integrated circuit fabrication: Isolation - pn junction isolation	
Class 33	Integrated circuit fabrication: Isolation - pn junction isolation	
Week 12		
Class 34	Integrated circuit fabrication: Isolation - pn junction isolation	
Class 35	Mesa isolation and oxide isolation	
Class 36	Mesa isolation and oxide isolation	
Week 13		
Class 37	BJT based microcircuits	

Class 38	P -channel and n -channel mosfets	
Class 39	Complimentary mosfets and silicon on insulator devices	
Week 14		
Class 40	Complimentary mosfets and silicon on insulator devices	
Class 41	Testing, bonding and packaging	
Class 42	Testing, bonding and packaging	

Text and Ref Books:

1. Introduction to VLSI – D. Bricius; McGraw-Hill international.
2. An Introduction to VLSI Physical Design – C. K. Wong; McGraw-Hill Higher Education.
3. Basic VLSI Design - Douglas A. Pucknell; Prentice Hall of India private Ltd.

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

5.2.2.2. EECE 453: Analog Integrated Circuit

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of analog integrated circuit as well as the application of this area of electrical engineering.

Course Contents:
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.

Objectives:
To learn the advanced techniques to address design issues and challenges including offset, noise, gain, voltage, power, bandwidth etc. and have fundamental knowledge in data converters and RF building block

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Design** analog integrated circuits in a more comprehensive manner with consideration of tradeoffs.
2. **Design** basic analog integrated circuits in a standard flow with consideration of performance and powers.

3. **Develop** a basic understanding and knowledge of the driving and limiting factors in circuit performance, of circuit design techniques, and of technology issues important to integrated amplifier circuits

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Design analog integrated circuits in a more comprehensive manner with consideration of tradeoffs.			√									
2. Design basic analog integrated circuits in a standard flow with consideration of performance and powers.				√								
3.Develop a basic understanding and knowledge of the driving and limiting factors in circuit performance, of circuit design techniques, and of technology issues important to integrated amplifier circuits	√											

<u>Lectures Schedule</u>

Week 1		CT 1
Class 1	Introduction to Analog Integrated Circuits	
Class 2	Review of FET amplifiers: Passive and active loads and frequency limitation	
Class 3	Review of FET amplifiers: Passive and active loads and frequency limitation	
Week 2		
Class 4	Current mirror: Basic	
Class 5	Cascade and active current mirror	
Class 6	Cascade and active current mirror	
Week 3		
Class 7	Differential Amplifier: Introduction, large and small signal analysis	
Class 8	Differential Amplifier: Introduction, large and small signal analysis	
Class 9	Differential Amplifier: Introduction, large and small signal analysis	

Week 4		CT 2
Class 10	Common mode analysis and differential amplifier with active load	
Class 11	Common mode analysis and differential amplifier with active load	
Class 12	Common mode analysis and differential amplifier with active load	
Week 5		
Class 13	Introduction to noise	
Class 14	Noise: types	
Class 15	Noise: types	
Week 6		
Class 16	Noise representation in circuits	
Class 17	Noise representation in circuits	
Class 18	Noise representation in circuits	
Week 7		CT 3
Class 19	Noise in single stage and differential amplifiers and bandwidth	
Class 20	Noise in single stage and differential amplifiers and bandwidth	
Class 21	Noise in single stage and differential amplifiers and bandwidth	
Week 8		
Class 22	Band -gap References: Supply voltage independent biasing	
Class 23	Band -gap References: Supply voltage independent biasing	
Class 24	Temperature independent biasing	
Week 9		
Class 25	Temperature independent biasing	
Class 26	Proportional to absolute temperature current generation and constant transconductance biasing.	
Class 27	Proportional to absolute temperature current generation and constant transconductance biasing.	
Week 10		CT 4
Class 28	Proportional to absolute temperature current generation and constant transconductance biasing.	
Class 29	Switch capacitor circuits: Sampling switches,	
Class 30	Switch capacitor circuits: Sampling switches,	
Week 11		
Class 31	Switched capacitor circuits including unity gain buffer,	
Class 32	Switched capacitor circuits including unity gain buffer,	
Class 33	Switched capacitor circuits including unity gain buffer,	
Week 12		
Class 34	Amplifier and integrator	
Class 35	Amplifier and integrator	
Class 36	Phase locked loop (PLL): introduction	
Week 13		
Class 37	Basic PLL and charge pumped PLL	
Class 38	Basic PLL and charge pumped PLL	
Class 39	Different Practical Problems and Solution (1)	
Week 14		
Class 40	Different Practical Problems and Solution (2)	

Class 41	Different Practical Problems and Solution (3)	
Class 42	Open Discussion	

Text and Ref Books:

1. Integrated Electronics – Jacob Millman; Tata McGraw-Hill.
2. Op Amps & Linear Integrated Circuits - James M. Fiore; Delmar Thomson Learing.
3. Micro Electronic Circuits – Adel S. Sedra&Keneth C. Smith; OxfordUniversity Press.
4. Pulse, Digital and Switching waveforms - Jacob Millman& Herbert Taub; Tata McGraw- Hill

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

5.2.2.3. EECE 455: Compound Semiconductor and Heterojunction Devices

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-4, Term-I/II

Pre-requisite: None.

Rationale: Electronics I (EECE-201), Electronics II (EECE-207)

To learn and familiarize with the characteristics of compound semiconductors as well as with different heterojunction devices along with different device models.

Course Contents:

Compound Semiconductor: Zinc-blend crystal structures, growth techniques, alloys, band gap, 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, latticemismatch and strain and common hetero-structure material systems.

Hetero-junction diode: Band banding, carrier transport and I-V characteristics. Hetero-junction field effect transistor: Structure and principle, band structure, carrier transport and I-V characteristics.

Hetero-structure Bipolar Transistor (HBT): Structure and operating principle, quasi-static analysis, extended Gummel-Poon model, Ebers-Moll model, secondary effects and band diagram of a graded alloy base HBT.

Objective:

1. To learn the existing silicon technology, its advantages and drawbacks.
2. To study the different characteristics of compound semiconductors and heterojunctions along with their comparative superiorities with silicon.
3. To use different compound semiconductors and heterojunctions in various practical fields.
4. To understand the basic working principle of various heterojunction devices.
5. To be able to apply different device model techniques for different device analysis.
6. To understand the advantages of compound semiconductors and their practical applications in day to day life uses.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Analyze** relevant material, optical and transport properties of compound semiconductors and their facility to form hetero-structures in a flexible manner for fabricating photonic devices.

2. **Relate** the trends in heterogeneous integration of compound semiconductors on lattice mismatched substrates or non-polar substrates.
3. **Design** a particular photonic device from judicious choice of compound semiconductor and heterostructures.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** relevant material, optical and transport properties of compound semiconductors and their facility to form hetero-structures in a flexible manner for fabricating photonic devices.				√								
2. **Relate** the trends in heterogeneous integration of compound semiconductors on lattice mismatched substrates or non-polar substrates.			√									
3. **Design** a particular photonic device from judicious choice of compound semiconductor and heterostructures.			√									

Lecture Schedule:

Week 1	**Compound Semiconductor**	CT 1
Class 1	Introduction	
Class 2	Compound semiconductor: Zinc-blend crystal structures	
Class 3	Compound semiconductor: Zinc-blend crystal structures	
Week 2	**Compound Semiconductor**	
Class 4	Growth techniques	
Class 5	Growth techniques	
Class 6	Alloys, band gap	
Week 3	**Compound Semiconductor**	

Class 7	Alloys, band gap	
Class 8	Alloys, band gap	
Class 9	Density of carriers in intrinsic and doped compound semiconductors	
Week 4	**Compound Semiconductor**	CT 2
Class 10	Density of carriers in intrinsic and doped compound semiconductors	
Class 11	Density of carriers in intrinsic and doped compound semiconductors	
Class 12	Density of carriers in intrinsic and doped compound semiconductors	
Week 5	**Hetero-Junctions**	
Class 13	Hetero-Junctions: Band alignment	
Class 14	Hetero-Junctions: Band alignment	
Class 15	Band offset	
Week 6	**Hetero-Junctions**	
Class 16	Anderson's rule	
Class 17	Single and double sided hetero- junctions	
Class 18	Quantum wells and quantization effects	
Week 7	**Hetero-Junctions**	CT 3
Class 19	Quantum wells and quantization effects	
Class 20	Lattice mismatch and strain and common hetero-structure material systems	
Class 21	Lattice mismatch and strain and common hetero-structure material systems	
Week 8	**Hetero-junction diode**	
Class 22	Hetero-junction diode: Band banding	
Class 23	Hetero-junction diode: Band banding	
Class 24	Carrier transport and I-V characteristics	
Week 9	**Hetero-junction field effect transistor**	
Class 25	Carrier transport and I-V characteristics	
Class 26	Hetero-junction field effect transistor: Structure and principle	
Class 27	Hetero-junction field effect transistor: Structure and principle	
Week 10	**Hetero-junction field effect transistor**	CT 4
Class 28	Band structure, carrier transport and I-V characteristics	
Class 29	Band structure, carrier transport and I-V characteristics	
Class 30	Band structure, carrier transport and I-V characteristics	
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	Hetero-structure bipolar transistor (HBT): Structure and operating principle	
Week 12	**Hetero-structure bipolar transistor**	
Class 34	Quasi-static analysis	
Class 35	Quasi-static analysis	
Class 36	Extended Gummel-Poon model	
Week 13	**Hetero-structure bipolar transistor**	
Class 37	Extended Gummel-Poon model	
Class 38	Ebers-Moll model	
Class 39	Ebers-Moll model	
Week 14	**Hetero-structure bipolar transistor**	

Class 40	Secondary effects and band diagram of a graded alloy base HBT	
Class 41	Secondary effects and band diagram of a graded alloy base HBT	
Class 42	Secondary effects and band diagram of a graded alloy base HBT	

Text and Ref Books:
1. Physics of Semiconductor Devices – S M Sze..

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

5.2.2.4. EECE457: VLSI II

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: EECE-317- VLSI I.
Rationale:
To achieve advanced knowledge on VLSI IC design and to build a chip with optimum Performance.

Course Contents:
VLSI MOS system design: Layout extraction and verification, full and semi-full custom design styles and logical and physical positioning.
Design entry tools: Schematic capture and HDL. Logic and switch level simulation. Static timing. Concepts and tools of analysis, solution techniques for floor planning, placement, global routing and detailed routing.
Application specific integrated circuit design including FPGA.

Objectives:
1. To learn the advanced VLSI design approach.
2. To learn different circuit techniques for VLSI design.
3. To learn the manufacturing process and testing process for designed IC.
4. To learn the effect of wire resistance and capacitance on system delay.
5. To be able to design the application specific IC design.
6. To be able to use the modern tools for VLSI IC design.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Understand** advanced VLSI Design.
2. **Express** the Layout of different circuit topologies using advanced knowledge.
3. **Apply** the advanced knowledge for application specific IC design.
4. **Differentiate** various FPGA architectures.
5. **Design** an application specific using latest technology tools.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**

1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Understand** advanced VLSI Design.	√											
2. Express the Layout of different circuit topologies using advanced knowledge.	√											
3. Apply the advanced knowledge for application specific IC design.	√		√									
4. **Differentiate** various FPGA architectures.		√		√								
5. **Design** an application using latest technology tools.		√		√	√							

Lecture Schedule:

Week 1	**Logical Effort**	CT 1
Class 1 Class 2 Class 3	Delay in a Logic Gate, Multistage Logic Networks	
Week 2	**Logical Effort**	
Class 4 Class 5 Class 6	Choosing the Best Number of Stages, example, summary	
Week 3	**Cascode and Current Mirror**	
Class 7	Cascode Basics	
Class 8	Cascode Amplifier	
Class 9	Practical Cascode	
Week 4	**Cascode and Current Mirror**	CT 2
Class 10 Class 11 Class 12	Current Mirror Basics, CMOS Current Mirror, Example	
Week 5	**CMOS Manufacturing Process**	
Class 13	Layout Design Rules, Process Enhancements	

Class 14		
Class 15		
Week 6	**CMOS Manufacturing Process**	
Class 16	Manufacturing Issues, example, summary	
Class 17		
Class 18		
Week 7	**Testing**	CT 3
Class 19	Logic Verification, Silicon Debug	
Class 20	Manufacturing Test, Fault Models	
Class 21	Observability and Controllability, Design for Test, Scan	
Week 8	**Wire**	
Class 22	Introduction, Interconnect Modeling, Wire Resistance	
Class 23	Wire Capacitance, Wire RC Delay, Crosstalk,	
Class 24	Wire Engineering, Repeaters	
Week 9	**Scaling & Packaging**	
Class 25	Scaling, Transistors, Interconnect, Future Challenges, Economics, Packaging	
Class 26		
Class 27		
Week 10	**Application Specific IC**	CT 4
Class 28	VCO Design, PLL Design, Filter Design	
Class 29		
Class 30		
Week 11	**Application Specific IC**	
Class 31	I/O Pad Design, Low Power IC Design	
Class 32		
Class 33		
Week 12	**Implementations Strategies**	
Class 34	Full Custom IC Design, Semi-Custom IC Design, Standard Cell Design and Cell Libraries	
Class 35		
Class 36		
Week 13	**Implementations Strategies**	
Class 37	FPGA Building Block Architectures, Global, Detailed, Special Routing	
Class 38		
Class 39		
Week 14	**CAD Tools**	
Class 40	SPICE, Cadence, Schematic Entry, Verification	
Class 41	Layout Extraction	
Class 42	Application Specific Circuit Design, Summary	

Text Books and References

1. Introduction to VLSI – D. Bricius; McGraw-Hill international.
2. Basic VLSI Design - Douglas A. Pucknell; Prentice Hall of India private Ltd.
3. CMOS VLSI Design - A Circuits and System Perspective by N. H. E. Weste and D. Harris.
4. CMOS Circuit Design, Layout and Simulation by R. Jacob Baker, Harry H. Li, David E Boyce, Wiley–IEEE Press 3rd Edition, 2010.
5. An Introduction to VLSI Physical Design by M. Sarrafzadeh, C.K. Wong, McGraw-Hill, 1996.
6. Design of Analog CMOS Integrated Circuits by Behzad Razavi, MacGraw Hill International Edition, 2001.

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

5.2.2.5. EECE458: VLSI II Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: VLSI II (EECE 457).
Rationale:
To achieve advanced knowledge on VLSI IC design and to design a application specific chip with optimum Performance.

Course Contents:
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 457. In the second part, students will design simple systems using the principles learned in EECE 457.

Objective:
1. To Understand the use of CAD tools.
2. To develop schematic and layout using Cadence.
3. To develop code and test digital circuits on FPGA.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:
1. **Analyze** the CMOS layout levels, how the design layers are used in the process sequence, and resulting device structures (i.e. cross-sectional views) in Cadence.
2. **Model** a digital circuit using Verilog HDL and validate its functionality.
3. **Develop** professional IC layout using Microwind in Cadence.
4. **Design** prototypes of different practical systems by working in collaboration.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-4	Conduct of Lab Test /Class	**25%**

	Performance	
1-4	Report Writing/ Programming	**15%**
1-4	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-4	Final Evaluation (Exam/Project/assignment)	**30%**
1-4	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze the CMOS layout levels, how the design layers are used in the process sequence, and resulting device structures (i.e. cross-sectional views) in Cadence.		√										
2. Construct a digital circuit using Verilog HDL and validate its functionality.				√								
3. Develop professional IC layout using Microwind in Cadence.					√							
4. Design prototypes of different practical systems by working in collaboration.									√		√	

Lectures Schedule

Weeks	**Intended topics to be covered**	**Remarks**
1.	Drawing the schematic of a 2-input NAND Gate, creating a Symbol and Performing Simulation.	
2.	Layout design of a 2 input NAND Gate, apply DRC and LVS	
3.	Drawing the schematic of nMOS CS amplifier with pMOS current source, creating a Symbol and Performing Simulation.	
4.	Layout design of CS amplifier, apply DRC/LVS and do post layout simulation	
5.	Practice Lab-01	
6.	Lab Test-01	
7.	ASIC Front End Design: RTL design, Simulation and Synthesis of an 8-bit Up/Down Counter using Cadence.	
8.	ASIC Front End Design: Physical Design of an 8-bit Up/Down Counter using Cadence.	
9.	Design of a Finite State Machine in Cadence.	
10.	Design of a sequence Detector in Cadence.	
11.	Practice Lab-02	
12.	Lab Test-02	
13.	Viva	
14.	Quiz	

Text and Ref Books:

1. CMOS VLSI Design - A Circuits and System Perspective by N. H. E. Weste and D. Harris.
2. CMOS Circuit Design, Layout and Simulation by R. Jacob Baker, Harry H. Li, David E Boyce, Wiley–IEEE Press 3rd Edition, 2010.

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

5.2.2.6. EECE459: Optoelectronics

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of electrical circuit components as well as the analysis of DC circuits.

Course Contents:
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.
Properties of Light: Particle and wave nature of light, polarization, interference, diffraction and blackbody radiation.
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.
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.
Photo-detectors: Photoconductors, junction photodetectors, PIN detectors, avalanche photodiodes and phototransistors.
Solar cells: Solar energy and spectrum, silicon and Schottkey solar cells.
Modulation of light: Phase and amplitude modulation, electrooptic effect, acousto-optic effect and magentooptic devices. Introduction to integrated optics.

Objective:

1. To learn the optical properties of semiconductor.
2. To study the different properties of light.
3. To understand the basic working principle of various optoelectronic devices like LED, Lasers and Photo-detectors.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Report** different optical properties of semiconductors and different properties of light.
2. **Analyze** optoelectronic device characteristics in detail using concepts from quantum mechanics and solid state physics for the implementation of these devices to solve engineering problems.

3. **Develop** techniques to improve the operation of optoelectronic devices and device characteristics that have to be optimized for new applications by employing their understanding of optoelectronic device physics.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Report** different optical properties of semiconductors and different properties of light.	√											
2. **Analyze** optoelectronic device characteristics in detail using concepts from quantum mechanics and solid state physics for the implementation of these devices to solve engineering problems.		√										
3. **Develop** techniques to improve the operation of optoelectronic devices and device characteristics that have to be optimized for new applications by employing their understanding of optoelectronic device physics.					√							

Lecture Schedule:

Week 1	**Optical Properties in Semiconductor**	CT 1
Class 1	Optical properties in semiconductor: Direct and indirect band-gap materials	
Class 2	Optical properties in semiconductor: Direct and indirect band-gap materials	
Class 3	Radiative and non-radiative recombination	
Week 2	**Optical Properties in Semiconductor**	
Class 4	Optical absorption	
Class 5	Photo-generated excess carriers	
Class 6	Minority carrier life time	

Week 3	**Optical Properties in Semiconductor**	
Class 7	Luminescence and quantum efficiency in radiation	
Class 8	Luminescence and quantum efficiency in radiation	
Class 9	Properties of light: Particle and wave nature of light	
Week 4	**Properties of Light**	CT 2
Class 10	Properties of light: Particle and wave nature of light	
Class 11	Polarization	
Class 12	Interference	
Week 5	**Properties of Light**	
Class 13	Polarization, interference	
Class 14	Diffraction and blackbody radiation	
Class 15	Light emitting diode (LED): Principles, materials for visible and infrared LED	
Week 6	**Light Emitting Diode**	
Class 16	Internal and external efficiency	
Class 17	Loss mechanism, structure and coupling to optical fibers	
Class 18	Stimulated emission and light amplification: Spontaneous and stimulated emission	
Week 7	**Stimulated emission and light amplification**	CT 3
Class 19	Stimulated emission and light amplification: Spontaneous and stimulated emission	
Class 20	Einstein relations, population inversion	
Class 21	Einstein relations, population inversion	
Week 8	**Stimulated emission and light amplification**	
Class 22	Einstein relations, population inversion	
Class 23	Absorption of radiation	
Class 24	Optical feedback and threshold conditions	
Week 9	**Semiconductor Lasers**	
Class 25	Semiconductor Lasers: Population inversion in degenerate semiconductors	
Class 26	Semiconductor Lasers: Population inversion in degenerate semiconductors	
Class 27	Laser cavity	
Week 10	**Semiconductor Lasers**	CT 4
Class 28	Operating wavelength	
Class 29	Threshold current density, power output	
Class 30	Threshold current density, power output	
Week 11	**Hetero-junction lasers**	
Class 31	Hetero-junction lasers	
Class 32	Optical and electrical confinement	
Class 33	Introduction to quantum well lasers	
Week 12	**Photo-detectors**	
Class 34	Photo-detectors	
Class 35	Photoconductors	
Class 36	junction photodetectors	
Week 13	**PIN detectors**	
Class 37	PIN detectors,	
Class 38	Avalanche photodiodes and phototransistors	
Class 39	Solar cells: Solar energy and spectrum, silicon and Schottkey solar cells	
Week 14	**Modulation of light**	

Class 40	Modulation of light: Phase and amplitude modulation, electro-optic effect	
Class 41	Acousto-optic effect and magento-optic devices	
Class 42	Introduction to integrated optics	

Text and Ref Books:

1. Opto-Electronics – an Introduction - J. Wilson, J.F.B. Hawkes; Prentice Hall of India Private Ltd.
2. Optical Electronics in Modern Communications – Amnon Yariv; Oxford University Press.
3. Optical Fiber Communications: Principles & Practice - John M. Senior; Prentice Hall.
4. Introduction to optical Electronics – A. Jones; Harper & Row.
5. Electro-optical System Design for Information Process – L. Wyatt; McGraw-Hill.

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

5.2.3 <u>Communication</u>

5.2.3.1. EECE 403: Telecommunication Engineering

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: Communication Theory (EECE-309).
Rationale:
To understand and develop the basics of microwave devices as well as their radiation patterns, beam width, losses etc.

Course Contents:
Introduction: Principle, evolution, networks, exchange and international regulatory bodies. Telephone apparatus: Microphone, speakers, ringer, pulse and tone dialing 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.

Objective:
1. To introduce students to various switching system of telephone network.
2. To analyze different parameters of analog and digital communication techniques.
3. To understand mobile technologies like GSM and CDMA.
4. To know the mobile communication evolution of 2G, 3G and 4G in detail.
5. Understanding of optical network system components, variety of networking aspects, SONET/SDH.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Use** different modulation and demodulation techniques used in analog and digital

communication.
2. **Identify** and solve basic communication problems.
3. **Analyze** transmitter and receiver circuits.
4. **Compare** between different design issues, advantages, disadvantages and limitations of analog and digital communication systems.
5. **Apply** the fundamental principles of optics and light wave to design optical fiber communication systems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
	Class Performance	**05**
1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Use** different modulation and demodulation techniques used in analog and digital communication.	√											
2. **Identify** and solve basic communication problems.		√										
3. **Analyze** transmitter and receiver circuits.		√										
4. **Compare** between different design issues, advantages, disadvantages and limitations of analog and digital communication systems.	√											
5. **Apply** the fundamental principles of optics and light wave to design optical fiber communication systems.			√									

Lecture Schedule:

Week 1	**Introduction**	
Class 1	Basic telephony	CT 1
Class 2	Simple Telephone Communication	
Class 3	Half-duplex telephone communication	

Week 2	**Switching Techniques**	
Class 4	Introduction to step by step switching	
Class 5	Function of telephone control circuit	
Class 6	Introduction to digital switching system	
Week 3	**Different stages of Switching**	
Class 7	Three stage switching	
Class 8	Blocking probability	
Class 9	Mathematical problem on Lee's blocking probability	
Week 4	**Different types of Switching**	CT 2
Class 10	Time division switching	
Class 11	STS switching	
Class 12	TST switching	
Week 5	**Traffic**	
Class 13	Traffic analysis	
Class 14	Arrival distribution	
Class 15	Mathematical modeling on traffic analysis	
Week 6	**Optical Fiber Communication Basic**	
Class 16	Fiber optic transmission system	
Class 17	Single mode fiber	
Class 18	Chromatic dispersion	
Week 7	**Transmission Basics**	CT 3
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**	CT 4
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	

Text and Ref 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 – ThiagarajanViswanathan; 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

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: None.
Rationale:
To understand and develop the basics of microwave devices as well as their radiation patterns, beam width, losses etc.

Course Contents:
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, rhombic and parabolic reflector, array, and Yagi-Uda antenna.

Objective:

1. To gain knowledge and understanding of microwave analysis methods in a lossy transmission medium.
2. To use Smith Chart by examining the load where the impedance must be matched.
3. To be able to apply analysis methods to determine circuit properties of passive/active microwave devices.
4. To understand the antenna characteristics, losses, radiation patterns and their applications.
5. To determine the performance characteristics of a microwave circuit or system using computer aided design methods.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Apply** microwave analysis methods to find out different values like Transmission Co-efficient, Reflection Co-efficient, Voltage, Current in the sending or receiving end, VSWR etc.
2. **Analyze** the circuit properties in case of impedance matching with the help of Smith Chart.
3. **Analyze** standard type transmission line and waveguide physical structures and associated interconnect components.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** microwave analysis methods to find out different values like Transmission Co-efficient, Reflection Co-efficient, Voltage, Current in the sending or receiving end, VSWR etc.		√										
2. **Analyze** the circuit properties in case of impedance matching with the help of Smith Chart.				√								
3. **Analyze** standard type transmission line and waveguide physical structures and associated interconnect components.	√											

Lecture Schedule:

Week 1	**Introduction to Microwave**	
Class 1	Introduction to microwaves	CT 1
Class 2	Advantages of microwaves	
Class 3	General and Industrial applications of microwaves	
Week 2	**Transmission Lines**	

Class 4	Transmission line equations & solutions	
Class 5	Reflection and transmission coefficient	
Class 6	Standing wave and standing wave ratio	
Week 3	**Transmission Lines**	
Class 7	Line impedance and admittance	
Class 8	Impedance matching using stub line	
Class 9	Application of smith chart in solving transmission line problems	
Week 4	**Waveguides**	CT 2
Class 10	.Rectangular waveguides-theory and analysis.	
Class 11	Principle of circular waveguide	
Class 12	Wave-guide tees	
Week 5	**Waveguides**	
Class 13	Magic tees	
Class 14	Wave-guide corners, bends, twists,	
Class 15	Directional couples, circulators and isolators. S Matrix and its applications	
Week 6		
Class 16	Microwave components	
Class 17	Limitations of conventional tubes at UHF & Microwave	
Class 18	Klystrons, velocity modulation, multicavity klystron, reflex klystron	
Week 7	**Microwaves and Microstrips**	CT 3
Class 19	Traveling wave tube	
Class 20	Magnetron. (Without derivations)	
Class 21	Introduction to strip lines, Microstrip lines, parallel strip lines, Coplanar strip lines, shielded strip lines	
Week 8	**Microstrips**	
Class 22	Microstrips: Structures and characteristics	
Class 23	Rectangular resonant cavities	
Class 24	Energy storage, losses and Q	
Week 9	**Radiation Pattern**	
Class 25	Mathematical problems	
Class 26	Introduction to Radiation	
Class 27	Small current element	
Week 10	**BeamWidth**	CT 4
Class 28	Radiation resistance	
Class 29	Radiation pattern and properties	
Class 30	Beam width and Null point calculation.	
Week 11	**Antenna Basics**	
Class 31	Hertzian and halfwave dipoles(1)	
Class 32	Hertzian and halfwave dipoles(2)	
Class 33	Mathematical problems	
Week 12	**Antenna**	
Class 34	Antennas	
Class 35	Mono pole Antennas	
Class 36	Horn Antennas	
Week 13	**Antenna**	

Class 37	Rhombic Antennas	
Class 38	Parabolic reflector Antennas	
Class 39	Array Antennas	
Week 14	**Antenna**	
Class 40	Yagi-UdaAntennas	
Class 41	Scope of research in Microwave Engineering	
Class 42	Open Discussion	

Text and Ref Books:

1. D. M. Pozar, Microwave Engineering, Second Edition, John Wiley & Sons, 1998.
2. Microwave Devices and Circuits - Samuel Y. Liao; Prentice Hall of India.
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

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: Microwave Engineering (EECE 433).
Rationale:
To understand and develop the basics of microwave devices as well as their radiation patterns, beam width, losses etc.

Course Contents:
In this course students will perform experiments to verify practically the theories and concepts learned in Microwave Engineering course.
Objective:

1. To get practical ideas about microwave theories.
2. To develop skills about different tools regarding microwaves.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. Apply the knowledge of microwave transmission practically.
2. Analyze the differences between theoretical knowledge with the practical observations.
3. Design small scale microwave based systems in a collaborative manner.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**

1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the knowledge of microwave transmission practically.						√						
2. **Analyze** the differences between theoretical knowledge with the practical observations.										√		
3. **Design** small scale microwave based systems in a collaborative manner.											√	

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Familiarization of Microwave cables, connectors, adaptors, wave guides, components & passive devices.	
2.	Study of Microwave Signal, Radiation pattern Beam width and Directionality.	
3.	Study of polarization of micro wave signal	
4.	Study of Penetration Properties of Materials	
5.	Study of Antenna Training System	
6.	Lab Test-1	
7.	Study of reflection of microwaves& application of reflection of microwave	
8.	Familiarization with RADAR(Radio Detection and Ranging)Module.	
9.	Study of Microwave Tee	
10.	Measurement of Microwave Power.	
11.	Measurement of wave length by slotted wave guide and wave impedance	
12.	Lab Test-2	
13.	Viva	
14.	Quiz test	

Text and Ref Books:

1. Microwave Devices and Circuits - Samuel Y. Liao; Prentice Hall of India.
2. Foundations for Microwave Engineering– E. Colliong; McGraw-Hill International.
3. Microwave Engineering - M.Pozar; Addision Wesley Publishing Company.

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

5.2.3.4. EECE 435: Optical Fiber Communication

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: Electrical Properties of Material(EECE-316), Communication Theory (EECE-309)
Rationale:
To learn and familiarize with the basics of optical fiber communication.

Course Contents:
Introduction: Light propagation through optical fiber: Ray optics theory and mode theory.
Optical fiber: Types and characteristics, transmission characteristics, fiber joints and fiber couplers.
Light sources: Light emitting diodes and laser diodes. Detectors: PIN photo-detector and avalanche photo-detectors.
Receiver analysis: Direct detection and coherent detection, noise and limitations.
Transmission limitations: Chromatic dispersion, nonlinear refraction, four wave mixing and laser phase noises.
Optical amplifier: Laser and fiber amplifiers, applications and limitations.
Multi-channel optical system: Frequency division multiplexing, wavelength division multiplexing and optical CDMA. Radio on fiber technology, Fiber optic access network.

Objective:
1. To understand basic idea about optical fiber, optical devices and optical communication system
2. To get acquainted with large scale optical communication system.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Combine** different concepts of optical fiber communication with different optical devices and systems.
2. **Judge** practical communication systems in realistic conditions.
3. **Design** optical fiber system in a controlled environment and co-relate it with the real system in an uncontrolled environment.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Combine** different concepts of optical fiber communication with different optical devices and systems.	√											
2. **Judge** practical communication systems in realistic conditions.		√										
3. **Design** optical fiber system in a controlled environment and co-relate it with the real system in an uncontrolled environment.				√								

Lecture Schedule:

Week 1		CT 1
Class 1	Introduction	
Class 2	Background and different theories behind light propagation	
Class 3	Ray optics theory	
Week 2		
Class 4	Mode Theory	
Class 5	What is optical fiber?	
Class 6	Ideal characteristics of optical fiber	
Week 3		
Class 7	Qualities of real optical fibers(1)	
Class 8	Qualities of real optical fibers(2)	
Class 9	Mathematical modelling of optical fibers	
Week 4		CT 2
Class 10	Introduction to optical communication system	
Class 11	Light sources: LEDs	
Class 12	Light sources: Lasers	
Week 5		
Class 13	Detectors: PIN photo-detector	
Class 14	Detectors: Avalanche photo-detector	
Class 15	Transmission Limitations	
Week 6		
Class 16	Chromatic dispersion	
Class 17	Nonlinear refraction	
Class 18	Four wave mixing	
Week 7		CT 3
Class 19	Laser phase noises	
Class 20	Different detection methods (1)	
Class 21	Different detection methods (2)	
Week 8		

Class 22	How noise effects transmission and detection in optical fibers	
Class 23	Limitations in practical transmission and detection systems	
Class 24	Introduction to optical amplifiers	
Week 9		
Class 25	How amplifiers used to improve real systems	
Class 26	Different types of optical amplifiers	
Class 27	Laser amplifiers	
Week 10		CT 4
Class 28	Fiber amplifiers	
Class 29	Different approaches to improve amplifiers	
Class 30	Mathematical problems regarding transmission and detection systems	
Week 11		
Class 31	Optical fiber based communication	
Class 32	Multi-channel using optical fibers: FDMA	
Class 33	Multichannel using optical fibers: WDMA	
Week 12		
Class 34	Multichannel using optical fibers: CDMA	
Class 35	Design problems regarding multi-channel using optical fiber(1)	
Class 36	Design problems regarding multi-channel using optical fiber(2)	
Week 13		
Class 37	Radio on fiber technology	
Class 38	Fiber optic access networks: Ideas	
Class 39	Fiber optic access networks: Implementations	
Week 14		
Class 40	Fiber optic access networks: Limitations	
Class 41	Scope of research in optical communication system	
Class 42	Open Discussion	

Text and Ref Books:

1. Optical Fiber Communications: Principles & Practice - John M. Senior; Prentice Hall of India.
2. Fiber Optic Communications - D C Agrawal; Wheeler Publishing.
3. Fiber Optic Communication System - Gerd Keiser; McGraw-Hill International

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

5.2.3.5. EECE 437: Digital Communication

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-4, Term-I/II

Pre-requisite: Communication Theory (EECE-309)

Rationale:

To learn and familiarize the basics of digital communication systems and their operation.

Course Contents:

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.

Objective:
1. To learn the building blocks of digital communication system.
2. To learn and use different modulation techniques and different sorts of source coding, channel coding coefficients for the purpose of the computation of channel coefficients.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Apply** theoretical idea of probability and random processes to understand different concepts of information theory.
2. **Evaluate** performance of various coding techniques, the model for different modulation and demodulations schemes, tradeoff between the existing channel coding methods.

Teaching-learning and Assessment Strategy: Lectures, class performance, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**
1-2	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-2	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply theoretical idea of probability and random processes to understand different concepts of information theory.	√											

2. Evaluate accuracy of various coding techniques, the model for different modulation and demodulations schemes, tradeoff between the existing channel coding methods.		√										

Lecture 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	CT 1
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	CT 2
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)	CT 3
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	CT 4
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	Tradeoff between the existing coding methods	
Class 41	Spread spectrum signals and system	
Class 42	Review of the topics	

Text and Ref 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

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-4, Term-I/II

Pre-requisite: Digital Communication (EECE 438)

Rationale:

To apply the knowledge from EECE 437 in designing and analyzing the performance of a digital communication system.

Course Contents:

In this course students will get a hands on experience about electrical circuits. They will observe the uses of electrical circuits practically. They will also simulate and analyze different electrical circuits and find out different values of elements inside the circuits using PSpice**.**

Objective:

1. To verify practically the theories and concepts learned in EECE 437.

Course Outcomes (CO):

Upon completion of all sessional, the students will be able to:

1. **Apply** theoretical idea of probability and random processes to small practical systems.
2. **Develop** prototypes of different large scale systems by working in collaboration.
3. **Design** a communication system with different coding techniques and channel assumptions to analyze its performance.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply theoretical idea of probability and random processes to small practical systems.	√											
2. Develop prototypes of different large scale systems by working in collaboration.			√									
3. Design a communication system with different coding techniques and channel assumptions to analyze its performance.					√							

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Study of Source Coding	
2.	Study of Line Coding I	
3.	Study of Line Coding II	
4.	Study of Modulation Techniques I: ASK and FSK	
5.	Study of Modulation Techniques I: PSK, QPSK	
6.	Study of Modulation Techniques II	
7.	Lab Test	
8.	Channel Coding I	
9.	Channel Coding II	
10.	Spread Spectrum Techniques	
11.	Practice Lab	
12.	Lab Test	
13.	Quiz test	
14.	Project Submission	

Text and Ref Books:

1. Digital Communications - Simon Haykin; McGraw Hill International.
2. Digital Communication - G.J Proakis; Prentice Hall of India.

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

5.2.3.7. EECE 439: Mobile Cellular Communication

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: Telecommunication Engineering (EECE-403), Digital Communication (EECE-437)
Rationale:
To understand and develop the basics of mobile cellular communication system and various access method, modulation, path loss and propagation method.

Course Contents:
Introduction: Concept, evolution and fundamentals. Analog and digital cellular systems.
Cellular Radio System: Frequency reuse, co-channel interference, cell splitting and components.
Mobile radio propagation: Propagation characteristics, models for radio propagation, antenna at cell site and mobile antenna.
Frequency Management and Channel Assignment: Fundamentals, spectrum utilization, fundamentals of channel assignment, fixed channel assignment, non-fixed channel assignment, traffic and channel assignment.
Handoffs and Dropped Calls: Reasons and types, forced handoffs, mobile assisted handoffs and dropped call rate.
Diversity Techniques: Concept of diversity branch and signal paths, carrier to noise and carrier to interference ratio performance. Multi-carrier modulation, Orthogonal FDM (OFDM). Multiple Access Techniques: FDMA, TDMA, CDMA, MC-CDMA and receiver.
Digital cellular systems: Global system for mobile, time division multiple access and code division multiple access. 3G and 4G wireless system, future wireless communication system, Wi-Fi, Wi-max and other IEEE standards of wireless communication system.

Objective:
1. To get acquainted with mobile cellular systems with a depth knowledge in the related theories along with different modern protocols.
2. To become skilled at using different sorts of advanced techniques for mobile communication.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Explain** different background theories related to mobile communication systems
2. **Apply** analytical techniques to portray the abstractions in the real life cellular systems.
3. **Analyze** modern cellular systems with respect to different underlying protocols.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain** different background theories related to mobile communication systems	√											
2. **Apply** analytical techniques to portray the abstractions in the real life cellular systems.		√										
3. **Analyze** modern cellular systems with respect to different underlying protocols.		√										

Lecture Schedule:

Week 1	**Introduction**	CT 1
Class 1	Introduction: Topics to be covered	
Class 2	Early wireless	
Class 3	The Cellular Revolution: 1 to 5G	
Week 2	**Frequency Reuse**	
Class 4	Wireless LANs	
Class 5	Why some technologies succeed, and some don't	
Class 6	Basic concepts about cellular systems: Frequency reuse	
Week 3	**Cellular System Block Diagram**	
Class 7	Basic concepts about cellular systems: Cell splitting and components	
Class 8	Practical applications in perspective to the city of Dhaka	
Class 9	Practical applications in perspective to an isolated land St. Martin	
Week 4	**Propagation Models**	CT 2
Class 10	Theoretical discussions regarding cellular propagation	
Class 11	Propagation characteristics	
Class 12	Different propagation models	
Week 5	**Antenna Concepts**	
Class 13	Different propagation models	
Class 14	Ideas about antennas, MIMO Antenna, Antenna array	
Class 15	Antennas used for mobile communication	

Week 6	**Frequency Management**	
Class 16	Frequency Management: Fundamentals, Duplexing Techniques	
Class 17	Frequency Management: Spectrum utilization	
Class 18	Channel assignment: Ideas	
Week 7	**Traffic**	CT 3
Class 19	Fixed channel assignment	
Class 20	Non-fixed channel assignment	
Class 21	How traffic in the system effects channel assignment	
Week 8	**Handoffs and Dropped Calls**	
Class 22	Handoffs and Dropped Calls	
Class 23	Forced handoffs	
Class 24	Mobile assisted handoffs	
Week 9	**Dropped Calls and Diversity**	
Class 25	Dropped call rate.	
Class 26	What is diversity?	
Class 27	Different types of diversity techniques	
Week 10	**Diversity**	CT 4
Class 28	How to measure performance of a system?	
Class 29	Evaluation of practical cellular systems	
Class 30	Mathematical problems regarding diversity techniques	
Week 11	**Multi-Carrier Modulation**	
Class 31	Ideas about Multi-carrier modulation	
Class 32	Mathematical problems regarding frequency response method	
Class 33	OFDM: Mathematical modeling	
Week 12	**Different Multiple Access Techniques**	
Class 34	Multiple Access Techniques: TDMA,FDMA	
Class 35	Multiple Access Techniques: TDMA,FDMA	
Class 36	Multiple Access Techniques: CDMA	
Week 13	**Different Multiple Access Techniques**	
Class 37	Multiple Access Techniques: MC-CDMA	
Class 38	GSM Technology	
Class 39	Ideas about 3G and 4G Technology	
Week 14	**5G and Satellite Basics**	
Class 40	The future: 5G Technology, IOT	
Class 41	Scope of research in Cellular communication systems	
Class 42	Open Discussion	

Text and Ref Books:

1. Mobile Cellular Telecommunication (Analog Digital Systems) - William C.Y Lee; McGraw-Hill.

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

5.2.3.8. EECE441: Random Signals and Processes
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: EECE 301 (Continuous Signal and Systems).
Rationale:
To familiarize with the real life signals, express them in numerical equations and to learn the theorems to process the real life signals.

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

Objective:
1. To learn the fundamentals of probability theory, random variables and random processes.
2. To solve the engineering problems involving random processes.
3. To analyze the given probabilistic model of the problem.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1. **Develop** the ability to find correlation, CDF, PDF and probability of random signals.
2. **Analyze** continuous and discrete-time random processes.
3. **Explain** the concepts of stationary and wide-sense stationarity, and appreciate their significance.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**

1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Develop the ability to find correlation, CDF, PDF and probability of random signals.		√			√							
2. Analyze continuous and discrete-time random processes.			√		√							
3. Explain the concepts of stationary and wide-sense stationarity, and appreciate their significance.		√			√							

Lecture Schedule:

Week 1	**Probability and Random Variables**	CT 1
Class 1	Probability and random variables	
Class 2	Distribution functions	
Class 3	Density functions	
Week 2	**Expectation Value**	
Class 4	Conditional probability	
Class 5	Expectation	
Class 6	Moments	
Week 3	**Random Variables**	
Class 7	Characteristic functions	
Class 8	Types of random variable	
Class 9	Transformation of a random variable	
Week 4	**Joint Distribution**	CT 2
Class 10	Vector random variables	
Class 11	Joint distribution and density	
Class 12	Independence	
Week 5	**Random Processes**	
Class 13	Sum of random variables	
Class 14	Introduction to Random Processes	
Class 15	Different Random Processes	
Week 6	**Random Processes**	
Class 16	Correlation functions.	
Class 17	Process measurements	
Class 18	Gaussian random processes	

Week 7	**Different Types of Random Processes**	CT 3
Class 19	Poisson random processes.	
Class 20	Measurement of Gaussian random processes.	
Class 21	Measurement of Poisson random processes.	
Week 8	**Noise Models**	
Class 22	Introduction to Noise models	
Class 23	Different types of noise models	
Class 24	Stationarity	
Week 9	**Ergodic Process**	
Class 25	Ergodicity	
Class 26	Introduction to Spectral Estimation	
Class 27	Spectral Estimation methods	
Week 10	**Power Spectral Density**	CT 4
Class 28	Correlation	
Class 29	Power spectrum	
Class 30	Cross spectral densities	
Week 11	**Random Input**	
Class 31	Introduction to random inputs	
Class 32	Different types of random inputs	
Class 33	Response of linear systems to random inputs	
Week 12	**Mean-Square Error**	
Class 34	Introduction to discrete time processes	
Class 35	Mean-square error estimation	
Class 36	Methods of Mean-square error estimation	
Week 13	**Error Detection**	
Class 37	Error Detection	
Class 38	Error Detection methods	
Class 39	Comparison between detection methods	
Week 14	**Linear Filtering**	
Class 40	Introduction to Linear filtering.	
Class 41	Linear filtering methods	
Class 42	Review of the topics	

Text and Ref Books:

1. Probability, Random Variables, and Random Signal Principles - Peyton Peebles.
2. Probability, Random Variables, and Random Processes: Theory and Signal Processing Applications - John J. Shynk; Wiley-Interscience.

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

5.2.3.9. EECE 443: Satellite Communication

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II

Pre-requisite: Communication Theory (EECE-309), Digital Communication (EECE-437).

Rationale:

To learn and familiarize with the basics of satellite communication system and operation.

Course Contents:

Elements of Satellite Communication

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, Up-converter, Down-converter.

Satellite Link: Basic link analysis, interference analysis, rain-induced attenuation, system availability, satellite link design.

Random Access Techniques in Satellite Communication: P-ALOHA, S-ALOHA, R-ALOHA, C-ALOHA.

Multiple Access Techniques in Satellite Communication FDMA: FDM-FM-FDMA, SCPC, FM-FDMA television, Companded FDM-FM-FDMA, TDMA: TDMA frame structure, TDMA burst structure, TDMA frame efficiency, TDMA super frame structure. Efficient Techniques: Demand Assigned Multiple Access (DAMA), Erlang B formula, Digital speech interpolation.

Satellite Spread Spectrum Communication Direct Sequence Spread Spectrum (DS-SS): PN Sequence, Error rate performance of DS System in uniform and pulsed jamming. DS-CDMA: Sequence-synchronous DS-CDMA, Sequence-asynchronous DS-CDMA. Frequency Hop Spread Spectrum (FH-SS) Satellite Communication Systems, FH-CDMA, Error rate performance of FH System in uniform and pulsed jamming.

VSAT Networks: Technology and recent advancements, Mobile Satellite Networks.

Objective:

1. To learn the basics of satellite communication systems
2. To analyze the performances of different techniques used in satellite communication systems.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. Critically **analyze** the design requirements and the performance of satellite communication system.
2. **Apply** communication theory, modulation techniques, multiple access technologies, error correction codes, telephone traffic analysis related to satellite communication.
3. **Compute** link power budget for satellites in the presence of rain-induced attenuation, ionospheric scintillation, fading, interference and other kinds of propagation impairments.
4. **Estimate** bit error probability of spread spectrum satellite systems in the presence of tone and pulsed jamming.
5. **Explain** the principles, concepts and operation of satellite communication systems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Critically **analyze** the design requirements and the performance of satellite communication system.			√									
2. Apply communication theory, modulation techniques, multiple access technologies, error correction codes, telephone traffic analysis related to satellite communication.		√										
3. Compute link power budget for satellites in the presence of rain-induced attenuation, ionospheric scintillation, fading, interference and other kinds of propagation impairments.			√									
4. Estimate bit error probability of spread spectrum satellite systems in the presence of tone and pulsed jamming.					√							
5. Explain the principles, concepts and operation of satellite communication systems.	√											

Lecture Schedule:

Week 1	**Introduction**	CT 1
Class 1	Definition, history, need of satellite communication, how satellite communication works	
Class 2	Advantage and disadvantage, application,orbital elements, semi major axis, semi minor axis, mean anamoly, argument of perige	
Class 3	Satellite orbits, posigrade, retrograde, ascending node, descending node, Geo stationary satellite, Geo synchronous satellite	
Week 2	**Orbital Mechanics**	
Class 4	Orbital mechanics, equation of orbit, Kepler's three law of planetary motion	

Class 5	Describing the orbit of a satellite, locating the satellite in the orbit	
Class 6	Look angle determination, subsatellite point, elevation angle, azimuth angle	
Week 3	**Orbital Mechanics**	
Class 7	Solar eclipse	
Class 8	Sidereal period	
Class 9	Slant range, synodal period	
Week 4	**Satellite Link Design**	CT 2
Class 10	Introduction, Basic Transmission Theory	
Class 11	Rain Attenution, System noise temperature and G/T ratio	
Class 12	Calculation of system noise temperature, Noise figure	
Week 5	**Satellite Link Design**	
Class 13	Noise temperature, G/T ratio for earth station and its measurement and characteristics	
Class 14	Link budget calculation	
Class 15	System availability, mean unavailability, radio-star method	
Week 6	**Multiple Access Technique**	
Class 16	FDMA, FDM-FM-FDMA, Single Channel per carrier	
Class 17	TDMA, TDMA frame structure, reference burst, traffic burst, guard time	
Class 18	TDMA burst structure, carrier and clock recovery sequence, unique word, TDMA frame efficiency	
Week 7	**Demand Assignment**	CT 3
Class 19	Earlang B formulae	
Class 20	Types of Demand Assignment	
Class 21	DAMA characteristics(demand assignment), Blocking probability	
Week 8	**ALOHA**	
Class 22	Types of ALOHA	
Class 23	Throughput calculation	
Class 24	Average packet delay vs satellite channel throughput	
Week 9	**CDMA**	
Class 25	Code generator, pn sequence	
Class 26	Property of pn sequence	
Class 27	Satellite spread spectrum communication	
Week 10	**CDMA**	CT 4
Class 28	Interference(unintentional and intentional interference)	
Class 29	Classification of spread spectrum(Direct sequence spread spectrum and frequency hoping)	
Class 30	Direct sequence spread spectrum system	
Week 11	**CDMA**	
Class 31	Error rate performace in uniform jamming	
Class 32	Error rate performace in pulsed jamming	
Class 33	Direct Sequence CDMA	

Week 12	CDMA	
Class 34	Frequency hopping spread spectrum	
Class 35	Jamming Waveform, steps for finding jamming waveform	
Class 36	Interference analysis, different types of unintentional interference	
Week 13	**VSAT Communication Network**	
Class 37	Characteristics, VSAT network system concept	
Class 38	Service of VSAT	
Class 39	Nature of traffic	
Week 14	**VSAT Communication Network**	
Class 40	Satellite channels(P-ALOHA,S-ALOHA,C-ALOHA,R-ALOHA)	
Class 41	Mobile satellite network	
Class 42	Application	

Text and Ref Books:
1. Digital Satellite Communications by Tri T. Ha, Second Ed. McGrawHill.
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 445: Communication Networks

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-4, Term-I/II
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of communication networks.

Course Contents:

Switching and multiplexing: ISO, TCP-IP and ATM reference models.
Different data communication services: Physical layer wired and wireless transmission media. **Cellular radio:** Communication satellites;
Data Link Layer: Elementary protocols. Sliding window protocols, error detection and corrections of HDLC.DLLL of Internet. DLLL of ATM: 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. ARP; NI in ATM transport layer, transmission control protocol, UDP, ATM adaptation layer, application layer, network security, email, domain name system. Simple network management protocol, HTTP and World Wide Web

Objective:
1. To understand fundamental concepts of communications systems.
2. To become acquainted with different types of communication system protocols.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Develop** a solid background on the fundamental concepts of communication networks.
2. **Pursue** independent research in wireless networking with the help of various tools learned in this course.
3. **Evaluate** a practical, complex communication system.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Develop a solid background on the fundamental concepts of communication networks.	√											
2. Pursue independent research in wireless networking with the help of various tools learned in this course.		√										
3. Evaluate a practical, complex communication system.			√	√								

Lecture Schedule:

Week 1		CT 1
Class 1	Introduction to Communication Networks	

Class 2	Protocol stack in communication networks	
Class 3	OSI, TCP-IP and ATM reference models	
Week 2		
Class 4	Physical Layer	
Class 5	Wired and wireless transmission media, power-line and optical fiber medium	
Class 6	Overview on digital modulations	
Week 3		
Class 7	Multiplexing: FDM	
Class 8	Multiplexing: TDM	
Class 9	Multiplexing: WDM	
Week 4		CT 2
Class 10	Switching: Circuit vs Packet	
Class 11	Data Link Layer	
Class 12	Functions	
Week 5		
Class 13	Error and flow control	
Class 14	Error detection and correction	
Class 15	Error detection and correction	
Week 6		
Class 16	MAC Sub-layer	
Class 17	HDLC, DLLL of Internet and ATM	
Class 18	Multiple Access protocols	
Week 7		CT 3
Class 19	IEEE 802 Protocols for LANs and MANs	
Class 20	Switches. Hubs and bridges	
Class 21	Network Layer	
Week 8		
Class 22	Routing algorithms	
Class 23	Congestion control algorithms	
Class 24	Admission control	
Week 9		
Class 25	Internetworking	
Class 26	Internet network layer: IP protocol, IP addresses	
Class 27	Transport Layer	
Week 10		CT 4
Class 28	TCP, UDP for Internet	
Class 29	TCP, UDP for Internet	
Class 30	Application Layer	
Week 11		
Class 31	Application Layer	

Class 32	ATM application layer	
Class 33	Network security	
Week 12		
Class 34	Email	
Class 35	Domain name system	
Class 36	Simple network management protocol	
Week 13		
Class 37	Complex network management protocol	
Class 38	HTTP. world wide web	
Class 39	World wide web	
Week 14		
Class 40	Ideas about cyber security	
Class 41	Scope of research in communication network	
Class 42	Open Discussion	

Text and Ref 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.**

5.2.3.11. EECE 446: Communication Networks Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-4, Term-I
Pre-requisite: Communication Networks (EECE 445)
Rationale:
To apply the knowledge obtained from Communication Networks in order to simulate different aspects of a communication system.

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 EECE 445. In the second part, students will design simple systems using the principles learned in EECE 445.
Objective:

1. To get practical ideas about different routing protocols using simulator software.
2. To develop skills about actual channel coding schemes.

Course Outcomes (CO):
Upon completion of all sessional, the students will be able to:
1. **Evaluate** different routing protocols.
2. **Design** channel coding systems to keep data communication robust.

3. **Monitor** a network's traffic and control the bandwidth distribution.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Evaluate** different routing protocols.			√									
2. **Design** channel coding systems to keep data communication robust.		√										
3. **Monitor** a network's traffic and control the bandwidth distribution.					√							

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1.	Physical Network Interface Connection	
2.	IP Addressing	
3.	Basic Network Configuration (Static)	
4.	VLSM (Variable-Length Subnet Mask)	
5.	Dynamic Routing (RIP), Dynamic Host Control Protocol (DHCP)	
6.	Introduction to Wireshark and Packet Sniffing	
7.	Lab Test-1	
8.	ALOHA MAC Protocols	
9.	Introduction to Channel Coding and Linear Block Codes	
10.	Linear Block Coding using Modules	

11.	Introduction to Linear Block Codes: Cyclic Coding	
12.	Lab Test-2	
13.	Viva	
14.	Quiz test	

Text and Ref 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.**

CHAPTER 6

Course Offered by EECE To Students of Other Departments

6.1. Dept of Computer Science and Engineering

L-1, T-1

6.1.1. EECE 163: Electrical Circuit Analysis

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-1, Term-I

Pre-requisite: None.

Rationale:

To learn and familiarize the basics of electrical circuit components as well as the analysis of DC and AC circuits.

Course Contents:

Fundamental electrical concepts and measuring units.

Direct current: Voltage, current, resistance and power. Laws of electrical circuits and methods of Network analysis.

Introduction to magnetic circuits.

Alternating Current: Instantaneous and RMS values of current, voltage and power, average power for various combination of R, L and C circuits, phasor representation of sinusoidal quantities.

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 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 (CO):

Upon completion of the course, the students will be able to:

1. **Apply** different laws of circuit theorems to solve various engineering problems.
2. **Analyze** different circuit related complex engineering problems efficiently.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply different laws of circuit theorems to solve various engineering problems.	√											
2. Analyze different circuit related complex engineering problems efficiently.		√										
3. Design different elementary circuit related projects using circuit theorems and components.			√									

Lecture Schedule:

Week 1	**Fundamental Electric Concepts**	
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC)	CT 1
Class 2	Voltage , 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	**Y-Δ conversion and Measuring Units**	
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	**Nodal Analysis**	CT 2
Class 10	Method of Obtaining Node voltages	
Class 11	Super node analysis	
Class 12	Various mathematical problems solving nodal analysis	
Week 5	**Mesh Analysis**	
Class 13	Method of obtaining mesh currents using mesh analysis	
Class 14	Mesh analysis with current source	
Class 15	Mathematical problems related to Mesh Analysis	
Week 6	**Network Theorem**	
Class 16	Superposition Theorem and applications	
Class 17	Thevenin's Theorem Procedure	
Class 18	Application of Thevenin Theorem	
Week 7	**Network Theorem**	CT 3
Class 19	Norton's Theorem	
Class 20	Application of Norton's Theorem	
Class 21	Introduction to Magnetic circuits	
Week 8	**AC Current**	
Class 22	Introduction to AC current	
Class 23	Electrical Reactive components: Resistor, Capacitor, Inductor	
Class 24	Network theorems for AC circuit analysis	
Week 9	**Average and RMS values**	
Class 25	Network theorems for AC circuit analysis (continued)	
Class 26	Average values of current, voltage and power	
Class 27	RMS values of current, voltage and power	
Week 10	**R, L and C circuits**	CT 4
Class 28	Current, Voltage and Power for R circuits	
Class 29	Current, Voltage and Power for L circuits	
Class 30	Current, Voltage and Power for C circuits	
Week 11	**RL circuits**	
Class 31	Instantaneous Current and voltage for RL circuits	
Class 32	Instantaneous and average values of real and reactive power for RL circuits	
Class 33	Mathematical problems for RL circuits	
Week 12	**RC Circuits**	

Class 34	Instantaneous Current and voltage for RC circuits	
Class 35	Instantaneous and average values of real and reactive power for RC circuits	
Class 36	Mathematical problems for RC circuits	
Week 13	**RLC Circuits**	
Class 37	Instantaneous Current and voltage for RLC circuits	
Class 38	Instantaneous and average values of real and reactive power for RLC circuits	
Class 39	Mathematical problems for RLC circuits	
Week 14	**Phasor Representation**	
Class 40	Basics of Phasor Algebra	
Class 41	Phasor representation of AC quantities	
Class 42	Leading Lagging Power factor	

Text and Ref 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.

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

6.1.2. EECE 164: Electrical Circuit Analysis Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-1, Term-I

Pre-requisite: Fundamentals of Electrical Engineering (EECE 163).

Rationale:

To learn and familiarize the basics of electrical circuit as well as the analysis of DC and AC circuit.

Course Contents:

In this course students will get a hands on experience about AC and DC electrical circuits that are taught in EECE 163. 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.

Objective:

1. To learn about electrical elements and use them practically.
2. To compare the theoretical and practical values of circuit.

Course Outcomes (CO):

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic electrical components and networks practically.
2. **Analyze** the differences between theoretical knowledge with the practical observations.

3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the knowledge of basic electrical components and networks practically.						√						
2. **Analyze** the differences between theoretical knowledge with the practical observations.										√		
3. **Design** different elementary circuit related projects using circuit theorems and components.											√	

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Construction and operation of simple electrical circuits	
2	Verification of KVL	

3	Verification of KCL	
4	Verification of Thevenin's theorem	
5	Verification of Norton's theorem	
6	Practice Lab-01	
7	Lab Test-01	
8	Familiarization with alternating current (ac) waves	
9	Study of R-L-C series circuit	
10	Different types of filters and its characteristics with different input frequency	
11	Practice Lab-02	
12	Lab Test-02	
13	Quiz test	
14	Viva	

Text and Ref 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.
3. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
4. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
5. Introduction to Electrical Engineering – Robert P. Ward; Prentice Hall of India Private Ltd.
6. Introduction to Electric Circuits – Richard C. Dorf& James A. Svoboda; John Wiley & Sons Inc.

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

<u>L-1, T-2</u>

6.1.3. EECE 169: Electronic Devices and Circuits

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-1, Term-II

Pre-requisite: EECE 163

Rationale:

This subject is classified under the applied technology group and intended to teach the students the concepts, principles and working of basic electronic 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.

Course Contents:

Introduction to semiconductors: P type and n type semiconductors, p-n junction diode characteristics;

Diode applications: Half wave 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 feedback, oscillators, silicon controlled rectifier (SCR), TRIAC, DIAC and UJT: Characteristics and applications. Introduction to IC fabrication processes.

Objective:

1. To understand the basics of electronic devices like diode, Transistor, MOSFET etc and its applications.
2. To become skilled at designing different electronic circuits like rectifier, amplifiers etc. using electronic devices.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Explain** the basic operation of diodes, BJT, MOSFET, JFET, Op-Amp, oscillators, TRIAC, DIAC and their characteristics to solve engineering problems.
2. **Compare** the characteristics of different types of diodes, transistors, OP-Amp and oscillators.
3. **Apply** the knowledge of semiconductor diodes, BJT, MOSFET, JFET, Op-Amp etc to solve real life engineering problems such as rectification, switching and amplification.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain** the basic operation of diodes, BJT, MOSFET, JFET, OP-Amp, oscillators, TRIAC, DIAC and their characteristics to solve engineering problems	√											
2. **Compare** the characteristics of different types of diodes, transistors, OP-Amp and oscillators.		√										
3. **Apply** the knowledge of semiconductor diodes, BJT, MOSFET, JFET, Op-Amp etc to solve real life engineering problems such as rectification, switching and amplification			√									

Lecture Schedule:

Week 1	**Introduction to Electronics**	CT 1
Class 1	Basic idea about Electronics	
Class 2	Examples of electronic devices and comparison with electrical equipment.	
Class 3	Introduction to semiconductor devices and its classifications	
Week 2	**Semiconductor diodes**	
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**	
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 maths of zener diode	
Class 9	Applications of diode	
Week 4	**Diode Rectifier**	CT 2
Class 10	Diode rectifiers	
Class 11	Ripple factor and related mathematical problems.	
Class 12	Clipper circuit and related problems	
Week 5	**Application of diode circuits**	

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**	
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	**BJT Biasing and BJT as amplifier and switch**	
Class 19	BJT Biasing circuits	
Class 20	BJT as an amplifier, biasing the BJT for discrete circuits	
Class 21	Small signal equivalent circuit models, BJT as a switch	
Week 8	**Introduction to Junction Field Effect Transistor**	
Class 22	Introduction to FET and comparative studies between BJT and FET	CT 3
Class 23	Construction and operation of JFET	
Class 24	Mathematical problems related to JFET	
Week 9	**Metal Oxide Semiconductor Field Effect Transistor**	
Class 25	Introduction to MOSFET	
Class 26	Construction and operating principle of MOSFET	
Class 27	Types of MOSFET	
Week 10	**Biasing of MOSFET**	
Class 28	Characteristics curve of MOSFET	
Class 29	Biasing of MOSFET and related problems	
Class 30	Biasing of MOSFET and related problems (Cont.)	
Week 11	**MOSFET as amplifier, switch and CMOS inverter**	
Class 31	Threshold voltage, Body effect, current- voltage characteristics of an enhancement MOSFET	CT 4
Class 32	Single-stage MOS amplifiers, MOSFET as a switch	
Class 33	CMOS circuits	
Week 12	**Operational amplifier**	
Class 34	Basics of Operational Amplifier.	
Class 35	Different types of operational amplifier.	
Class 36	Mathematical problems related to operational amplifier.	
Week 13	**Oscillators**	
Class 37	Basic Principle of oscillation	
Class 38	Different type of oscillators	
Class 39	Mathematical problems related to oscillator	
Week 14	**Feedback, SCR, TRIAC, DIAC and UJT**	

Class 40	Concepts of negative feedback	
Class 41	Characteristics and applications silicon controlled rectifier (SCR), TRIAC DIAC and UJT	
Class 42	Review class	

Text and Ref 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
4. Op amps and linear integrated circuits by Ramakant A Gayakwad
5. Electronic Circuit Analysis and Design by Donald A Neaman

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

6.1.4. EECE 170: Electronic Devices and Circuits Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-1, Term-II

Pre-requisite: Electronic Devices and Circuits (EECE 169).

Rationale:

To learn and familiarize with the basics of electronic circuits as well as utilizing electronic devices for practical purposes.

Course Contents:

In this course, students will perform experiments to verify practically the theories and concepts learned in EECE 169. Students will also design simple systems using the principles learned in EECE 169.

Objective:

1. To learn about electronic circuits.
2. To know and use the electronic circuits and devices for theoretical and practical purposes.
3. To learn about operational amplifier circuits.
4. To solve complex design problems regarding electronics based on realistic aspects.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic electronic circuits practically.
2. **Analyze** the necessity and utilization of different types of transistor circuits for real problems.
3. **Design** different circuits with op-amps to use for our day to day necessities.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the knowledge of basic electronic circuits practically.					√							
2. Analyze the necessity and utilization of different types of transistor circuits for real problems.							√					
3. Design different circuits with op-amps to use for our day to day necessities.									√		√	

Lectures Schedule

Weeks	**Intended topics to be covered**	**Remarks**
1	Introduction to electronic devices	
2	Diode Characteristics	
3	Applications of diodes: Rectifier circuits	
4	Common base configuration of BJT	
5	Common emitter configuration of BJT	
6	BJT Biasing	

7	Lab Test - 01	
8	Characteristics of JFET	
9	Applications of Op-amp: Adder, Differentiator and Integrator	
10	Practice lab	
11	Quiz test	
12	Project Presentation	
13	Lab Test-02	
14	Viva	

Text and Ref Books:

1. Electronics Devices and Circuit Theory - R.L Boylsted; Prentice Hall of India Private Ltd. Hall India International Inc.

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

<u>L-2, T-1 (Dept of Computer Science and Engineering)</u>

6.1.5. EECE 269: Electrical Drives and Instrumentation
3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: EECE 163.

Rationale:

To learn and familiarize with the basic electrical machines and electronic measurement system components along with different types of methods of measurement.

Course Contents:

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.

Objective:

1. To understand basic operating principle of different types of electrical machines like motor, generator and transformer etc.

2. To understand basic electrical and electronic measurement system components along with different types of methods of measurement.
3. To enhance knowledge in developing precise measurement with measuring variables and different tools relating network.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Define** the basic electrical machines operation and their characteristics along with different types of practical applications.
2. **Analyze** synthesis of data and information with the help of modern technologies: Study, design, implementation and performance analysis of electrical machines as well as measurement systems.
3. **Apply** evaluation, debugging and improvement of the operation of electrical machines and measurement system to adapt new, unexpected situations.
4. **Compute** error estimation, measurement execution, measurement conditioning/conversion, measurement processing and finally measurements acquisition via various platforms, either analog or digital, with or without computer systems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Define the basic electrical machines operation and their characteristics along with different types of practical applications.		√										

2. Analyze synthesis of data and information with the help of modern technologies: Study, design, implementation and performance analysis of electrical machines as well as measurement systems.					√							
3. Apply evaluation, debugging and improvement of the operation of electrical machines and measurement system to adapt new, unexpected situations.				√								
4. Compute error estimation, measurement execution, measurement conditioning/conversion, measurement processing and finally measurements acquisition via various platforms, either analog or digital, with or without computer systems.				√								

Lecture Schedule:

Week 1	**DC Generator**	
Class 1	Basic idea about Electrical Machines	
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 maths	
Week 3	**DC Motor**	
Class 7	Construction and operating principle of DC motor	CT 1
Class 8	Flemings right hand rule and left hand rule	
Class 9	Differences between DC generator and DC motor	
Week 4	**DC Motor**	
Class 10	Back emf and related equations for DC motor	
Class 11	Speed control of DC generator	
Class 12	Torque –speed characteristics of different types DC motors.	
Week 5	**Transformer**	CT 2
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**	CT 3
Class 19	Synchronous Generator: Operating principle	
Class 20	Excitation systems of Synchronous Generator	
Class 21	equivalent circuit of synchronous Generator	
Week 8	**Instruments**	
Class 22	Hysteresis, threshold, dead time, dead zone	
Class 23	Resolution, sensors, loading effect	
Class 24	Classifications of Instruments	
Week 9	**Transducer**	
Class 25	Operation Principle of instruments	
Class 26	Measurement of non-electrical quantities: Temperature	
Class 27	Measurement of non-electrical quantities: Pressure	
Week 10	**Measurement of non-electrical quantities**	CT 4
Class 28	Measurement of non-electrical quantities: flow, level	
Class 29	Measurement of non-electrical quantities: strain, force and torque.	
Class 30	Basic elements of dc and ac signal conditioning elements.	
Week 11	**Instrumentation amplifier**	
Class 31	Instrumentation amplifier	
Class 32	Noise and source of noise, noise elimination compensation	
Class 33	function generation and linearization, A/D and D/A converters, sample and hold circuits	
Week 12	**Data Transmission**	
Class 34	Methods of data transmission	
Class 35	dc/ac telemetry system	
Class 36	Recording and display devices.	
Week 13	**Data Acquisition**	
Class 37	Data acquisition system in instrumentation	
Class 38	Microprocessor applications in instrumentation	
Class 39	Digital data transmission	
Week 14	**Problem Solving**	
Class 40	Different practical measurement system network analyze	
Class 41	Scope of research in course	
Class 42	Open Discussion	

Text and Ref Books:

1. A Textbook of Electrical Technology by B.L Theraja
2. Electrical Machinery Fundamentals by Chapman

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

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

6.1.6. EECE 270: Electrical Drives and Instrumentation Laboratory

1.5 Contact Hour; 0.75 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: EECE 269
Rationale:
To learn and familiarize the basics of electrical machines and electronic measurement system components along with different types of methods of measurement practically.
Course Contents:

In this course students will get a hands on experience about electrical machineries and electronic measurement system components. They will observe the uses of electrical machines and electronic measurement system components practically.

Objective:

1. To understand practically basic operation of electrical machineries and electronic measurement system components along with different types of methods of measurement.
2. To enhance practical knowledge in developing precise measurement and analysis with measuring variables and different tools relating network.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic electrical machineries and electronic measurement system components practically.
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different electrical machineries and electronic measurement system related projects using laboratory tools.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	

1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the knowledge of basic electrical machineries and electronic measurement system components practically.						√						
2. Analyze the differences between theoretical knowledge with the practical observations.										√		
3. Design different electrical machineries and electronic measurement system related projects using laboratory tools.											√	

Lectures Schedule

Weeks	**Intended topics to be covered**	**Remarks**
1	Study the properties of DC Separately and Self Excited Shunt Generator	
2	Regulation of the Transformer in Various Loads.	
3	Study the properties of DC Shunt Motor	
4	Study the properties of Squirrel-Cage Induction Motor	
5	Study the properties of Three-Phase Alternator in various loads	
6	Lab Test-01	
7	Measurement of medium resistance using Wheatstone bridge	
8	Range Extension of Ammeter and Voltmeter	
9	Measurement of Power by 3 Voltmeter Method, Ammeter Method	
10	Measurement of Capacitance Using 555 Timer IC.	
11	Study of an 8-bit Analog to Digital (A/D) converter	
12	Practice Lab	

13	Lab Test-2	
14	Lab Quiz & Viva-voce	

Text and Ref Books:

1. A Textbook of Electrical Technology by B.L Theraja
2. Electrical Machinery Fundamentals by Chapman
3. A Course in Electrical and Electronic Measurements and Instrumentation - A. K. Sawhney
4. Measurement and Instrumentation Principle – Alan Morris (3rd Ed.)

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

6.2 Dept of Civil Engineering

L-1, T-2

6.2.1. EECE 165: Basic Electrical Technology

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-1, Term-II

Pre-requisite: None.

Rationale:

To learn and familiarize the basics of electrical circuit components as well as the analysis of DC and AC circuits and Electrical machines.

Course Contents:

Electrical units and standards.
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.
Phasor algebra: Single phase RLC circuits, balanced three phase circuits.
Introduction to electrical wiring for residential and commercial loads.
Familiarization with different types of electrical machines: DC generators and motors, alternators, AC motors, transformers. Working principles of transformers and induction motors.
Introduction to Electronics devices with simple application: Diodes, Rectifiers.

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 basic working principle of various electrical machines like transformers, generators and motors.
5. To understand the DC circuit, AC circuit, Electrical machines and their practical applications in day to day life uses.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Apply** different laws of circuit theorems to solve various engineering problems.
2. **Analyze** different circuit related complex engineering problems efficiently.
3. **Explain** the operations and applications of different electrical machines.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** different laws of circuit theorems to solve various engineering problems.		√										
2. **Analyze** different circuit related complex engineering problems efficiently.		√										
3. **Explain** the operations and applications of different electrical machines.			√									

Lecture Schedule:

Week 1	**Fundamental Electric Concepts**	CT 1
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage	
Class 2	Power and energy, Active elements, Passive elements, Independent and Dependent source	
Class 3	Ohm's law, Resistor, Conductor, Insulator, Semi-conductor, Branch, Node, Loop, Mesh	
Week 2	**Series and Parallel DC Circuits**	
Class 4	Series-parallel connection	
Class 5	KCL, KVL, Analysis of equivalent resistance of electrical circuit	
Class 6	Analysis of voltage, current and power	
Week 3	**Y-Δ conversion and Measuring Units**	
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	**Nodal Analysis**	CT 2
Class 10	Method of Obtaining Node voltages	
Class 11	Super node analysis	
Class 12	Various mathematical problems solving nodal analysis	
Week 5	**Mesh Analysis**	
Class 13	Method of obtaining mesh currents using mesh analysis	
Class 14	Mesh analysis with current source	
Class 15	Mathematical problems related to Mesh Analysis	
Week 6	**Network Theorem**	
Class 16	Superposition Theorem and applications	
Class 17	Thevenin's Theorem Procedure	
Class 18	Application of Thevenin Theorem	
Week 7	**Network Theorem**	CT 3
Class 19	Norton's Theorem	
Class 20	Application of Norton's Theorem	
Class 21	Introduction to Magnetic circuits	
Week 8	**AC Current Analysis**	
Class 22	Electrical Reactive components: Resistor, Capacitor, Inductor	

Class 23	Network theorems for AC circuit analysis	
Class 24	Network theorems for AC circuit analysis (continued)	
Week 9	**Average and RMS values**	
Class 25	Average values of current, voltage and power	
Class 26	RMS values of current, voltage and power	
Class 27	Instantaneous current, voltage and power for pure R, L and C circuits	
Week 10	**RL, RC and RLC circuits**	
Class 28	Instantaneous Current, voltage and power for RL circuits	
Class 29	Mathematical problems for RL circuits	
Class 30	Instantaneous Current, voltage and power for RC circuits	
Week 11	**RL, RC and RLC circuits**	
Class 31	Mathematical problems for RC circuits	
Class 32	Instantaneous Current, voltage and power for RLC circuits	
Class 33	Mathematical problems for RLC circuits	
Week 12	**Familiarization with different types of electrical machines**	
Class 34	Working principles of transformers and induction motors	
Class 35	Applications of transformers and induction motors	
Class 36	Working principles of DC Generators and DC motors	CT 4
Week 13	**Familiarization with different types of electrical machines**	
Class 37	Applications of DC Generators and DC motors	
Class 38	Working principles of Alternators and Synchronous motors	
Class 39	Applications of Alternators and Synchronous motors	
Week 14	**Introduction to Electronics devices with simple application**	
Class 40	Diode	
Class 41	Mathematical problems on diode	
Class 42	Diode rectifiers	

Text and Ref 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 Text Book of Electrical Technology- B L Theraja and A K Theraja; S.Chand& Company Ltd.

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

6.3 Dept of Mechanical Engineering

L-1, T-1

6.3.1. EECE 159: Fundamentals of Electrical Engineering

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of electrical engineering as well as the application of this field of engineering.

Course Contents:

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 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 value, average value, 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 Y loads and balanced delta loads. Power in balanced systems and power factor. Balanced three phase circuit analysis and power measurement.

Objectives:

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 understand the basic working principle of various energy storage devices like capacitors, inductors and resistors.
4. To study basics of alternating current circuits.
5. To understand the physical concepts underlying the operation of simple magnetic circuits
6. To introduce with the poly phase circuits and their physical applications.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Apply** different laws of circuit theorems to solve various engineering problems.

2. **Analyze** different circuit related complex engineering problems efficiently.
3. **Design** different elementary circuit related projects using circuit theorems and components.
4. **Solve** practical three phase circuit problems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** different laws of circuit theorems to solve various engineering problems.	√											
2. **Analyze** different circuit related complex engineering problems efficiently.		√										
3. **Design** different elementary circuit related projects using circuit theorems and components.			√									
4. **Solve** practical three phase circuit problems.	√											

<u>Lectures Schedule</u>

Week 1	**Laws of Electrical Circuit**	
Class 1	Ohm’s law, Kirchhoff’s voltage and current laws.	CT 1

Class 2	Kirchhoff's voltage and current laws.	
Class 3	Delta-wye transformation.	
Week 2	**Electrical networks analysis**	
Class 4	Delta-wye transformation.	
Class 5	Network analysis methods of branch currents	
Class 6	Network analysis methods of loop currents	
Week 3	**Network Theorems**	
Class 7	Method of node pair voltages	
Class 8	Thevenin's theorems.	
Class 9	Thevenin's theorems.	
Week 4	**Network Theorems**	CT 2
Class 10	Norton's theorems.	
Class 11	Norton's theorems.	
Class 12	Magnetic field, right hand rule, magnetic flux density	
Week 5	**Magnetic concepts and units**	
Class 13	Biot - Savart law, magnetic field intensity, measurement of magnetic flux, energy of magnetic field	
Class 14	Characteristic of ferromagnetic materials, theory of ferromagnetism	
Class 15	B-H curve, Hysteresis loss, Eddy current and Eddy current loss	
Week 6	**Magnetic Circuits**	
Class 16	Total core loss	
Class 17	Introduction to magnetic circuits.	
Class 18	Introduction to magnetic circuits.	
Week 7	**Electromagnetic forces**	CT 3
Class 19	Forces upon a current carrying conductor and charges particle moving in a magnetic field, electromagnetic torque, electric motor	
Class 20	Electromagnetic induction and emf: Lenz's law, Blv rule	
Class 21	Elementary ac generator.	
Week 8	**AC Currents**	
Class 22	General concepts and definitions, instantaneous current, voltage and power	
Class 23	R, L, C, RL Branches	
Class 24	RC and RLC branches	
Week 9	**AC Currents**	
Class 25	Effective value, average value, form factor	
Class 26	Crest factor, power real and reactive.	

Class 27	Real Power and Reactive Power	
Week 10	**Introduction to vector algebra**	
Class 28	Impedance in polar and Cartesian forms	
Class 29	Sinusoidal single phase circuit analysis.	
Class 30	Sinusoidal single phase circuit analysis.	
Week 11	**AC Network Analysis**	
Class 31	Impedance in series, parallel branches	
Class 32	Problems in series parallel circuits	CT 4
Class 33	Thevenin's theorem.	
Week 12	**Balanced poly phase circuits**	
Class 34	Three phase, four wire system of generated emfs,	
Class 35	three phase three wire systems,	
Class 36	three phase three wire systems,	
Week 13	**Balanced poly phase circuits**	
Class 37	Balanced Y loads and balanced delta loads.	
Class 38	Balanced Y loads and balanced delta loads.	
Class 39	Power in balanced systems and power factor	
Week 14	**Balanced Circuit Analysis**	
Class 40	Balanced three phase circuit analysis and power measurement.	
Class 41	Balanced three phase circuit analysis and power measurement.	
Class 42	Open Discussion	

Text and Ref Books:

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Alternating Current Circuits- Russell M Kerchner and George F Corcoran; John Wiley & Sons.
3. 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.**

6.3.2. EECE 160: Fundamentals of Electrical Engineering Laboratory

1.50 Contact Hour; 0.75 Credit Hour;

Level: Level-1, Term-I

Pre-requisite: Fundamentals of Electrical Engineering (EECE 159)

Rationale:

To learn and familiarize the basics of electrical circuit components as well as the analysis of DC and AC circuit practically.

Course Contents:

In this course students will get a hands on experience about electrical circuits. They will observe the uses of electrical circuits practically.

Objectives:

1. To learn about basic circuit components 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 (CO):

Upon completion of the course, the students will be able to:

1. **Apply** the knowledge of basic electrical components and networks practically.
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcome**

	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the knowledge of basic electrical components and networks practically.	√											
2. Analyze the differences between theoretical knowledge with the practical observations.		√										
3. Design different elementary circuit related projects using circuit theorems and components.			√									

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Construction & Operation of Simple Electrical Circuits	
2	Verification of KVL	
3	Verification of KCL	
4	Verification of Thevenin's Theorem	
5	Practice Lab-01	
6	Lab Test-01	
7	Familiarization with alternating current (ac) waves	
8	Study of R-L-C series circuit	
9	Different types of filters and its characteristics with different input frequency	
10	Series Resonance and Parallel Resonance	
11	Practice Lab-02	
12	Lab Test-02	
13	Quiz	
14	Viva	

Text and Ref Books:

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Alternating Current Circuits- Russell M Kerchner and George F Corcoran; John Wiley & Sons.
3. 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.**

L-2, T-1

6.3.3. EECE 259: Electrical and Electronics Technology

4.00 Contact Hour; 4.00 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: EECE 159.

Rationale:

To learn and familiarize the basics of electrical machines as well as the analysis of electronic circuit.

Course Contents:

Single phase transformer: Equivalent circuit and laboratory testing; Introduction to three phase transformers.
DC generators: Principles, types, performances and characteristics.
DC Motors: Principles, types, performances and characteristics. Speed control and starters of motors.
AC Machines: Principles of three phase induction motor and equivalent circuits. Introduction to synchronous machines and fractional horse power motors.
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.

Objective:

1. To learn the basic of electrical machines, their applications and unit.
2. To study the different electronic circuits and apply those in solving complex engineering problem.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Describe** the structure and main features of Electrical Machines and their applications.
2. **Explain** the basic operation of diodes, BJT, oscilloscope & transducers and their applications.
3. **Design** different elementary circuit related projects using electronic circuits.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Describe** the structure and main features of Electrical Machines and their applications.	√											
2. **Explain** the basic operation of diodes, BJT, oscilloscope & transducers and their applications.	√											
3. **Design** different elementary circuit related projects using electronic circuits.			√									

Lecture Schedule:

Week 1	**Single phase transformer**	CT 1
Class 1	Single phase transformer: Equivalent circuit and laboratory testing	
Class 2	Vector diagrams of transformer under different conditions, Losses in transformer and their explanations.	
Class 3	Mathematical problems of Transformer	
Week 2	**Three phase transformers**	
Class 4	Equivalent circuit and laboratory testing	
Class 5	Vector diagrams of transformer under different conditions, Losses in transformer and their explanations.	
Class 6	Mathematical problems of Transformer	
Week 3	**DC generators**	
Class 7	Construction of DC generator and different parts.	
Class 8	Emf equation of DC generator and related maths.	

Class 9	Types and errors of DC generator.	
Week 4	**DC Motors**	CT 2
Class 10	Back emf and related equations for DC motor	
Class 11	Differences between DC generator and DC motor	
Class 12	Losses in DC motor	
Week 5	**Speed control**	
Class 13	Speed control of DC motor.	
Class 14	Torque-speed characteristics	
Class 15	Starting and speed regulation	
Week 6	**AC Machines**	
Class 16	Principles of three phase induction motor and equivalent circuits.	
Class 17	Squirrel cage induction motors	
Class 18	Single phase induction motor: Types of operation, equivalent circuit, starting and torque speed characteristics.	
Week 7	**Synchronous machines**	CT 3
Class 19	Introduction to synchronous machines and fractional horse power motors.	
Class 20	Effect of loading under different excitation condition, effect of changing excitation.	
Class 21	V-curves and starting.	
Week 8	**Diodes**	
Class 22	Operational principle of p-n junction diode, contact potential, current-voltage characteristics of a diode.	
Class 23	Simplified dc and ac diode models, dynamic resistance and capacitance.	
Class 24	Diode circuits: Half wave and full wave rectifiers, rectifiers with filter capacitor.	
Week 9	**Transistors**	
Class 25	Bipolar junction transistor current components.	
Class 26	BJT characteristics and regions of operation.	
Class 27	BJT as an amplifier.	
Week 10	**Biasing of transistors**	CT 4
Class 28	Self-biasing circuits.	
Class 29	Emitter follower amplifiers.	
Class 30	Push pull amplifier.	
Week 11	**SCR**	
Class 31	Operating principle of SCR and its I-V characteristic curve.	
Class 32	Holding current, latching current.	
Class 33	SCR operation in AC and DC circuits.	
Week 12	**SCR cont. and Oscilloscope**	
Class 34	Transistor model of SCR.	
Class 35	Cathode Ray Tube, Vertical and Horizontal Deflection Systems.	

Class 36	Specification of an Oscilloscope, Oscilloscope measurement Techniques.	
Week 13	**Oscilloscope and Transducer**	
Class 37	Special Oscilloscopes – Storage Oscilloscope, Sampling Oscilloscope.	
Class 38	Introduction to transducer and its Static Characteristics and dynamic characteristics.	
Class 39	Principle Of Operation, Construction Details of transducer.	
Week 14	**Transducer cont.**	
Class 40	Transducers types; Strain Gages, Displacement Transducers.	
Class 41	Speed and torque measurement of transducers.	
Class 42	Review.	

Text and Ref 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 Kothan; McGraw-Hill.
4. Electrical Machinery Fundamental - Stephan J. Chapman; McGraw-Hill.
5. Micro Electronics Circuits – Adel S. Sedra & Keneth C. Smith; Oxford University Press.
6. Power Electronics (Circuits, devices & Application) - MD. H. Rashid; Prentice Hall of India.

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

6.3.4. EECE 260: Electrical and Electronic Technology Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: Electrical and Electronic Technology (EECE 259).

Rationale:

To learn and familiarize the basics of electrical machines as well as the analysis of electronic circuit.

Course Contents:

In this course students will get a hands on experience about various electrical machines and electronic circuits. They will observe the uses of electrical machines and their construction and electronic circuits practically. They will also analyze different electrical circuits and find out different values of elements inside the electronic circuits.

Objective:

1. To learn the basic of electrical machines, their applications and unit.

2. To study the different electronic circuits and apply those in solving complex engineering problem.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the theoretical idea of electronic devices to small practical systems to understand the operation of that system.
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the theoretical idea of electronic devices to small practical systems to understand the operation of that system.		√										
2. **Analyze** the differences between theoretical										√		

knowledge with the practical observations.												
3. Design different elementary circuit related projects using circuit theorems and components.											√	

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Study the characteristic of single and three phase transformer.	
2	Study the characteristic of DC generators.	
3	Study the characteristic of DC motors.	
4	Study the speed control and voltage regulation of DC motors.	
5	Study the characteristic of synchronous generator.	
6	Lab Test-01	
7	Study the characteristic of diode in DC.	
8	Study the characteristic of diode in AC with the introduction to oscilloscope.	
9	Study the characteristic of BJT.	
10	BJT biasing.	
11	Quiz	
12	Practice Lab-02	
13	Lab Test-02	
14	Viva	

Text and Ref 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 Kothan; McGraw-Hill.
4. Electrical Machinery Fundamental - Stephan J. Chapman; McGraw-Hill.
5. Micro Electronics Circuits – Adel S. Sedra & Keneth C. Smith; Oxford University Press.
6. Power Electronics (Circuits, devices & Application) - MD. H. Rashid; Prentice Hall of India.

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

6.4 Dept of Naval Architecture and Marine Engineering

L-1, T-2

6.4.1. EECE 181: Electrical Engineering Principles

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-1, Term-II

Pre-requisite: None.

Rationale:

To learn and familiarize the basics of electrical circuit components as well as the analysis of DC and AC circuits and Electrical machines.

Course Contents:

Direct Current: Theorems of electric circuit, electrical network analysis, measuring instruments.

Alternating current: AC quantities and waveforms, phasor algebra, AC circuit analysis, three phase circuits.

Transformers: Single phase and three phase, auto transformer.

Fundamentals of DC generators, DC motors: principle and operation.

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 basic working principle of various electrical machines like transformers, generators and motors.
5. To understand the DC circuit, AC circuit, Electrical machines and their practical applications in day to day life uses.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Apply** different laws of circuit theorems to solve various engineering problems.
2. **Analyze** different circuit related complex engineering problems efficiently.
3. **Explain** the operations and applications of different electrical machines.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply different laws of circuit theorems to solve various engineering problems.		√										
2. Analyze different circuit related complex engineering problems efficiently.		√										
3. Explain the operations and applications of different electrical machines.			√									

Lecture Schedule:

Week 1	**Fundamental Electric Concepts**	
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage	CT 1
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	**Y-Δ conversion and Measuring Units**	
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	**Nodal Analysis**	CT 2
Class 10	Method of Obtaining Node voltages	
Class 11	Super node analysis	
Class 12	Various mathematical problems solving nodal analysis	
Week 5	**Mesh Analysis**	
Class 13	Method of obtaining mesh currents using mesh analysis	
Class 14	Mesh analysis with current source	
Class 15	Mathematical problems related to Mesh Analysis	
Week 6	**Network Theorem**	
Class 16	Superposition Theorem and applications	
Class 17	Thevenin's Theorem Procedure	
Class 18	Application of Thevenin Theorem	
Week 7	**Network Theorem**	CT 3
Class 19	Norton's Theorem	
Class 20	Application of Norton's Theorem	
Class 21	Introduction to Magnetic circuits	
Week 8	**AC Current Analysis**	
Class 22	Electrical Reactive components: Resistor, Capacitor, Inductor	
Class 23	Network theorems for AC circuit analysis	
Class 24	Network theorems for AC circuit analysis (continued)	
Week 9	**Average and RMS values**	
Class 25	Average values of current, voltage and power	
Class 26	RMS values of current, voltage and power	
Class 27	Instantaneous current, voltage and power for pure R, L and C circuits	
Week 10	**RL, RC and RLC circuits**	CT 4
Class 28	Instantaneous Current, voltage and power for RL circuits	
Class 29	Mathematical problems for RL circuits	
Class 30	Instantaneous Current, voltage and power for RC circuits	
Week 11	**RL, RC and RLC circuits**	
Class 31	Mathematical problems for RC circuits	
Class 32	Instantaneous Current, voltage and power for RLC circuits	
Class 33	Mathematical problems for RLC circuits	
Week 12	**Phasor Representation**	
Class 34	Basics of Phasor Algebra	

Class 35	Phasor representation of AC quantities	
Class 36	Leading Lagging Power factor	
Week 13	**Familiarization with different types of electrical machines**	
Class 37	Working principles of transformers and induction motors	
Class 38	Applications of transformers and induction motors	
Class 39	Working principles of DC Generators and DC motors	
Week 14	**Familiarization with different types of electrical machines**	
Class 40	Applications of DC Generators and DC motors	
Class 41	Working principles of Alternators and Synchronous motors	
Class 42	Applications of Alternators and Synchronous motors	

Text and Ref 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 Text Book of Electrical Technology- B L Theraja and A K Theraja; S.Chand& Company Ltd.

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

L-2, T-2

6.4.2. NAME 281: Electrical and Electronic Technology for Marine Application

4.00 Contact Hour; 4.00 Credit Hour;

Level: Level-2, Term-II

Pre-requisite: EECE 181.

Rationale:

To gain basic knowledge on AC machines and Electronic devices and also equipments used for marine application like RADAR, Gyroscope etc.

Course Contents:

DC and AC Circuit Analysis: Kirchhoff's law, Thevenin Theorem, Norton Theorem, Node 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, speedlog, LORAN, RDF and Decca Chain).Power generation and distribution (PGT) system.

Objective:

1. To understand basic operating principle of Electrical machines alternator, induction motor, synchronous motor.
2. Evaluate the basic principles of electrical machinery fitted on a vessel;
3. Develop the idea about the space requirement for electrical and electronic equipment in a vessel

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Describe** and **apply** working idea about the electrical and electronic equipment fitted on a vessel;
2. **Identify** the basic principles about repair and maintenance of electrical and electronic equipment which will help them to work on board as a marine engineer;

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**
1-2	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-2	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Describe** and **apply** working idea about the electrical and electronic equipment fitted on a vessel;					√							
2. **Identify** the basic principles about repair and maintenance of electrical and electronic equipment which will help them to work on board as a marine engineer		√										

Lecture Schedule:

Week 1	**DC Circuit analysis**	
Class 1	Nodal analysis and examples	CT 1
Class 2	Super node with examples, Basic circuit theorems	
Class 3	Thevenin's theorem with examples	
Class 4	Norton's theorem with examples	
Week 2	**Alternator**	
Class 5	Synchronous Generator: Operating principle,	
Class 6	Losses in Alternator	
Class 7	equivalent circuit of synchronous Generator, Excitation systems of Synchronous Generator	
Class 8	Emf equation of synchronous generator, Mathematical problems	
Week 3	**Alternator (Cont..)**	
Class 9	synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations	
Class 10	Vector diagram under different loads	
Class 11	factors affecting voltage regulation	
Class 12	Load sharing and parallel operation	
Week 4	**Induction Motor**	CT 2
Class 13	Three phase induction motor: principle	
Class 14	Rotating magnetic field	
Class 15	Construction of squirrel cage IM, equivalent circuit	
Class 16	vector diagram, torque-speed characteristics	

Week 5	**Induction Motor (Cont..)**	
Class 17	no-load test, blocked rotor test	
Class 18	starting and braking, speed control	
Class 19	Single phase induction motor: Types of operation	
Class 20	starting and torque speed characteristics	
Week 6	**Synchronous Motor**	
Class 21	Synchronous motor: Operation	
Class 22	Vector diagrams of synchronous motor	
Class 23	effect of loading under different excitation condition.	
Class 24	Starting method of synchronous motor	
Week 7	**Synchronous Motor (Cont..)**	CT 3
Class 25	effect of changing excitation, Armature reactions	
Class 26	Variations of power factor with armature reactions, Mathematical Problems.	
Class 27	Maximum load angle	
Class 28	Mathematical Problems	
Week 8	**Diode**	
Class 29	Introduction to semiconductor devices and its classifications	
Class 30	P-type and N-type materials and doping, Semiconductor diode and its band diagram	
Class 31	Biasing of semiconductor diodes, I-V characteristics of diode and equivalent circuit of diodes	
Class 32	Zener diode and related maths of zener diode,	
Week 9	**Diode (Cont..)**	
Class 33	Applications of diode, HWR and FWR using diode	
Class 34	Diode bridge rectifier and Centre tapped transformer rectifier, Clipper circuit and related problems	
Class 35	Clamper circuit and related problems	
Class 36	Ripple factor and related mathematical problems	
Week 10	**BJT**	CT 4
Class 37	Introduction to BJT and construction, Principle and operation of BJT	
Class 38	Operating regions of BJT and its different configurations	
Class 39	CB and CE configurations and characteristics curves	
Class 40	Mathematical problems related to CB and CC configurations.	
Week 11	**MOSFET**	
Class 41	Introduction to MOSFET, Construction and operating principle of MOSFET	
Class 42	Types of MOSFET, Construction and operating principle of depletion type and enhancement type MOSFET	
Class 43	Biasing of MOSFET and related problems, Characteristics curve of MOSFET	
Class 44	threshold voltage, Body effect, current- voltage characteristics of an enhancement MOSFET	

Week 12	SCR	
Class 45	Introduction to power semiconductors witches, Introduction to triggering devices	
Class 46	Introduction to SCR and IGBT, Controlled single phase and threephase 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	

Text and Ref Books:

1. A Textbook of Electrical Technology - B.L Theraja
2. Electrical Machinery Fundamentals- Stephen J Chapman
3. Electrical machines- Samarjit Ghosh
4. Electronic Devices & Circuit theory-Robert L. Boylestad.
5. Principles Of Electronics : V.K. Mehta

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

6.4.3. NAME 282: Electrical and Electronic Technology for Marine Application Sessional

3.00 Contact Hour; 1.50 Credit Hour;

Level: 2nd Level-2, Term-II

Pre-requisite: Electrical and Electronic Technology for Marine Application (NAME 281)

Rationale:

To learn and familiarize with the basics of electrical AC machines and also basic electronic devices.

Course Contents:

In this course students will get a hands on experience about electrical machines. They will observe the uses of electrical machines practically. They will also learn to analyze different electrical machines for evaluating their operations and performances.

Objective:

1. To understand the construction and basic principle of AC machines.
2. To analyze the properties AC machines and electronic devices like diode, transistor, SCR practically.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Analyze** different machines and electronic devices with respect to theoretical knowledge.
2. **Identify** the performance of different machines experimentally and study the properties of electronic devices.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-2	Conduct of Lab Test /Class Performance	**25%**
1-2	Report Writing/ Programming	**15%**
1-2	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-2	Final Evaluation (Exam/Project/assignment)	**30%**
1-2	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** different machines and electronic devices with respect to theoretical knowledge.		√										

2. Identify the performance of different machines experimentally and study the properties of electronic devices.					√							

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Introduction to the lab equipments and safety measures	
2	Expt-01: Study the properties of Three-Phase Alternator in various loads	
3	Expt-02: Study the Three-Phase Alternator synchronizing process in power utility system.	
4	Expt-03: Study the properties of Squirrel-Cage Induction Motor	
5	Expt-04: Study the properties of Wound-Rotor Induction Motor.	
6	Expt-05: Study the properties of Capacitor-Start Motor	
7	Expt-06: Study the characteristics of diode	
8	Expt-07: Study of diode rectifier circuits	
9	Expt-08: Study of common base bipolar junction transistor	
10	Expt-09: Study of the characteristics of SCR	
11	Practice Lab	
12	Lab Test + Viva	
13	Quiz test	
14	Project submission	

Text and Ref Books:

1. A Textbook of Electrical Technology - B.L Theraja
2. Electrical Machinery Fundamentals- Stephen J Chapman
3. Electrical machines- Samarjit Ghosh
4. Electronic devices and circuits- Robert L. Boylestad

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

6.5 <u>Dept of Nuclear Science and Engineering</u>

<u>L-1, T-1</u>

6.5.1. EECE 119: Fundamentals of Electrical Engineering

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None.

Rationale:

To learn and familiarize the basics of electric and magnetic circuit as well as the analysis of DC and AC circuit.

Course Contents:

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.

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 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.
7. To understand the basic working principle of motor and generator along with their corresponding different laws.
8. To learn the concepts of power measurement of balanced and unbalanced system.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Apply** different laws of circuit theorems to solve various engineering problems.
2. **Analyze** different circuit related complex engineering problems efficiently.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply different laws of circuit theorems to solve various engineering problems.		√										
2. Analyze different circuit related complex engineering problems efficiently.		√										
3. Design different elementary circuit related projects using circuit theorems and components.			√									

Lecture Schedule:

Week 1	**Laws of electric circuit**	CT 1
Class 1	Ohm's Law, Kirchhoff's voltage and current laws.	
Class 2	Delta-Wye transformation.	
Class 3	Mathematical Problems related to Ohm's Law, Kirchhoff's voltage and current laws and delta-wye transformation	
Week 2	**Electrical networks**	
Class 4	Network analysis methods of branch and loop currents	
Class 5	Method of nodal analysis	
Class 6	Thevenin's and Norton's theorems.	

Week 3	**Magnetic concepts and units**	
Class 7	Magnetic field, right hand rule	
Class 8	Magnetic flux density, Biot-Savart law,	
Class 9	Magnetic field intensity, measurement of magnetic flux	
Week 4	**Magnetic concepts and units**	CT 2
Class 10	Energy of magnetic field	
Class 11	Characteristic of ferromagnetic materials	
Class 12	Mathematical problems related to magnetic circuits.	
Week 5	**Magnetic concepts and units**	
Class 13	B-H curve, hysteresis loss, eddy current loss	
Class 14	Total core loss. Introduction to magnetic circuits.	
Class 15	Practice problems related to B-H curve	
Week 6	**Electromagnetic forces**	
Class 16	Basic concepts of electric and magnetic field.	
Class 17	Forces upon a current carrying conductor and charged particles moving in a magnetic field.	
Class 18	Electromagnetic torque	
Week 7	**Electromagnetic forces**	CT 3
Class 19	Electric motor	
Class 20	Electromagnetic induction and emf.	
Class 21	Elementary a.c. generator	
Week 8	**General concepts and definitions**	
Class 22	Alternating Current basics.	
Class 23	Instantaneous current, voltage and power	
Class 24	Average and RMS current, voltage and power with mathematical problems	
Week 9	**General concepts and definitions**	
Class 25	Basic concepts of electrical reactive elements: Capacitor and Inductor	
Class 26	Instantaneous Current, Voltage and Power in RL branch	
Class 27	Instantaneous Current, Voltage and Power in RC branch	
Week 10	**General concepts and definitions**	
Class 28	Instantaneous Current, Voltage and Power in RLC branch	
Class 29	Average current and Voltage in RL, RC, RLC branch	
Class 30	Mathematical Problems related to RL, RC and RLC branch	
Week 11	**Effective current and voltage**	
Class 31	Form factor, Crest factor	
Class 32	Introduction to real and reactive power	
Class 33	Mathematical Problems related to power calculation	
Week 12	**Effective current and voltage**	
Class 34	Introduction to vector algebra. Impedance in polar and Cartesian forms. Sinusoidal single phase circuit analysis.	
Class 35	Impedance in series, parallel branches, series-parallel circuits	
Class 36	Network analysis – Thevenin's theorem.	

Week 13	**Balanced poly phase circuits**	CT 4
Class 37	Basic concepts of three phase systems.	
Class 38	Three phase, Four wire system of generated emfs.	
Class 39	Three phase, three wire systems.	
Week 14	**Balanced poly phase circuits**	
Class 40	Balanced wye loads, balanced delta loads	
Class 41	Power factor. Balanced three phase circuit analysis and power measurement.	
Class 42	Mathematical Problem related to power calculations in balanced loads.	

Text and Ref 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.
3. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
4. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
5. Introduction to Electrical Engineering – Robert P. Ward; Prentice Hall of India Private Ltd.
6. Introduction to Electric Circuits – Richard C. Dorf & James A. Svoboda; John Wiley & Sons Inc.

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

6.5.2. EECE 120: Fundamentals of Electrical Engineering Laboratory

1.5 Contact Hour; 0.75 Credit Hour;

Level: Level-1, Term-I

Pre-requisite: Fundamentals of Electrical Engineering (EECE119).

Rationale:

To learn and familiarize the basics of electric and magnetic circuit as well as the analysis of DC and AC circuit.

Course Contents:

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.

Objective:

1. To learn about electrical elements and use them practically.
2. To compare the theoretical and practical values of circuit.
3. To learn to operate electrical motor and generator.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic electrical components and networks practically.
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the knowledge of basic electrical components and networks practically.						√						
2. **Analyze** the differences between theoretical knowledge with the practical observations.										√		
3. **Design** different elementary circuit related projects using circuit theorems and components.											√	

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Construction and operation of simple electrical circuits	

2	Verification of KVL	
3	Verification of KCL	
4	Verification of Thevenin's theorem	
5	Verification of Norton's theorem	
6	Practice Lab-01	
7	Lab Test-01	
8	Study the properties of electric motor	
9	Study the properties of electric generator	
10	Familiarization with alternating current (ac) waves	
11	Study of R-L-C series circuit	
12	Practice Lab-02	
13	Lab Test-02	
14	Viva	

Text and Ref 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.
3. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
4. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
5. Introduction to Electrical Engineering – Robert P. Ward; Prentice Hall of India Private Ltd.
6. Introduction to Electric Circuits – Richard C. Dorf & James A. Svoboda; John Wiley & Sons Inc.

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

L-2, T-1

6.5.3. EECE 219: Electronics, Signals and Measurement

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: None

Rationale:

To provide the undergraduate students in nuclear engineering with the knowledge on basic electronic engineering and introductory nuclear power plant instrumentation and control systems by theoretic analysis and experiments

Course Contents:

Introduction to Transducers, Sensors.

Introduction to Signals and Systems: Time and Frequency Domain, Digital signal processing and conditioning in electronics, Fourier Transform and Fourier Series, Protoboarding Techniques, Sampling and Aliasing.

Resistor Networks: Resistor Networks -1, Resistor Networks-2, Measuring the Temperature Coefficient of Resistors, Equivalent Circuits, Power Transfer. **Dependent Sources:** Op Amps, Current Sources.

Capacitors and Inductors: Sinusoidal Steady State Response of RL and RC Circuits, Impedance, Filters, Bandwidth, Q Factor, Transients, Signal Conditioning, Diodes, Signal Conditioning, Voltage Regulation.

Introduction to BJT and Op Amp: BJT Biasing and Amplification, Introduction to the Op Amp, Building and Testing Op Amp Circuits, Comparators and Schmitt Trigger, Schmitt Trigger Oscillator, IR Transmission and Detection, Digital Design.

Objective:

1. To learn the basics of signal and system analysis.
2. To familiarize with different devices and circuits required for signal processing.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Describe** basics of signals and systems, signal processing and conditioning.
2. **Evaluate** the performance of different electrical and electronic devices in signal conditioning.

Teaching-learning and Assessment Strategy: Lectures, class performance, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**
1-2	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-2	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Describe** basics of signals and systems, signal processing and conditioning.	√											
2. **Evaluate** the performance of different electrical and electronic devices in signal		√										

conditioning.												

Lecture Schedule:

Week 1		
Class 1	**Introduction to Transducers, Sensors**	
Class 2		
Class 3		
Class 4		
Week 2	**Introduction to Signals and Systems**	
Class 5	Time and Frequency Domain, Digital signal processing and conditioning in electronic	CT 1
Class 6		
Class 7		
Class 8		
Week 3	**Introduction to Signals and Systems**	
Class 9	Fourier Transform and Fourier Series	
Class 10		
Class 11		
Class 12		
Week 4	**Introduction to Signals and Systems**	
Class 13	Protoboarding Techniques, Sampling, and Aliasing	
Class 14		
Class 15		
Class 16		
Week 5	**Resistor Networks**	
Class 17	Resistor Networks -1, Resistor Networks-2	CT 2
Class 18		
Class 19		
Class 20		
Week 6	**Resistor Networks**	
Class 21	Measuring the Temperature Coefficient of Resistors, Equivalent Circuits	
Class 22		
Class 23		
Class 24		
Week 7	**Resistor Networks**	
Class 25	Power Transfer	
Class 26		
Class 27		
Class 28		
Week 8	**Dependent Sources**	
Class 29	Op Amps, Current Sources	

Class 30		CT 3
Class 31		
Class 32		
Week 9	**Capacitors and Inductors**	
Class 33	Sinusoidal Steady State Response of RL and RC Circuits	
Class 34		
Class 35		
Class 36		
Week 10	**Capacitors and Inductors**	CT 4
Class 37	Impedance, Filters, Filters, Bandwidth, Q Factor	
Class 38		
Class 39		
Class 40		
Week 11	**Capacitors and Inductors**	
Class 41	Transients, Diodes, Signal Conditioning, Diodes, Voltage Regulation	
Class 42		
Class 43		
Class 44		
Week 12	**Introduction to BJT and Op Amp**	CT 5
Class 45	BJT Biasing and Amplification.	
Class 46		
Class 47		
Class 48		
Week 13	**Introduction to BJT and Op Amp**	
Class 49	Introduction to the Op Amp, Building and Testing Op Amp Circuits, Comparators and Schmitt Trigger	
Class 50		
Class 51		
Class 52		
Week 14	**Introduction to BJT and Op Amp**	
Class 53	Schmitt Trigger Oscillator, IR Transmission and Detection, Digital Design	
Class 54		
Class 55		
Class 56		

Text and Ref 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 and 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.**

6.5.4. EECE 220: Electronics, Signals and Measurement Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: Electronics, Signals and Measurement (EECE 219)

Rationale:

To learn and familiarize with the instrumentation and control systems by theoretic analysis and experiments.

Course Contents:

In this course the students will perform experiments to be apt in instrumentation and control system theories that are discussed in EECE 219.

Objective:

1. To verify practically the theories and concepts learned in EECE 220

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Define** the basic practical electrical and electronic equipment's and their characteristics along with different types of methods of measurement.
2. **Analyze** of data and information with the help of modern technologies, Study, design, implementation and performance analysis of practical measurement systems.
3. **Apply** evaluation, debugging and improvement of the operation of a measurement system to adapt new, unexpected situations in practical instruments.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Define** the basic practical electrical and electronic equipment's and their characteristics along with different types of methods of measurement.	√											
2. **Analyze** synthesis of data and information with the help of modern technologies: Study, design, implementation and performance analysis of practical measurement systems.		√										
3. **Apply** evaluation, debugging and improvement of the operation of a measurement system to adapt new, unexpected situations in practical instruments.			√									

Lecture Schedule:

Weeks	Intended topics to be covered	Remarks
1	Errors in Measurement and Basic Statistical Sampling	
2	Measurement of medium resistance using Wheatstone bridge	
3	Range Extension of Ammeter and Voltmeter	
4	Measurement of Power by 3 Voltmeter Method, Ammeter Method	
5	Design of an Active Low-pass Butterworth Filter	
6	Lab Test-1	
7	Measurement of Capacitance Using 555 Timer IC.	
8	Measurement of self-inductance by Maxwell's Capacitance Bridge	
9	Study of BJT biasing and amplification	
10	Design of comparator circuits	
11	Design of Schmitt trigger oscillators	
12	Lab Test-2	
13	Lab Quiz Viva-voce	
14	Scope of research in nuclear power plant Open discussion	

Text and Ref 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 and 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 Dept of Biomedical Engineering

L-1, T-1

6.6.1. EECE 191: Electrical Circuits

3.00 Contact Hour; 3.00 Credit Hour

Level: Level-1, Term-I

Pre-requisite: None.

Rationale:

To learn and familiarize with the basics of electrical and magnetic circuits as well as utilizing the knowledge in solving complex analytical practical problems related to circuit analysis.

Course Contents:

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.

Magnetic quantities and variables: Flux, permeability and reluctance, magnetic field strength, magnetic potential, flux density, magnetization curve, laws in magnetic circuits: Ohm’s law and Ampere’s circuital law, magnetic circuits: series, parallel and series-parallel circuits.

Objective:

1. To learn the basic of electrical circuit elements and variables.
2. To study the different basic laws and theorems of circuit theory to implement them in practical problems.
3. To be skilled in using various techniques for circuit analysis.

4. To understand the basic characteristics of energy storage elements and utilize them for respective purposes.
5. To be able to learn about the magnetic circuits, their laws and theorems and finally solving the practical problems related to magnetic circuits.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Analyze** the basic electrical and magnetic circuits with their laws and theorems to understand their characteristics and usage.
2. **Apply** the network theorems and circuit analysis techniques in solving the circuit problems.
3. **Compute** the responses of RL and RC circuits to utilize their energy storage nature in practical problems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** the basic electrical and magnetic circuits with their laws and theorem to understand their characteristics and usage.	√											
2. **Apply** the network theorems and circuit analysis techniques in solving the circuit problems.		√										
3. **Compute** the responses of RL and RC circuits to utilize their energy storage nature in practical problems.					√							

Lecture Schedule:

Week 1	**Circuit Variables and Elements**	CT-1
Class 1	Voltage, currents, voltage sources: independent and dependent sources	
Class 2	Conductors, insulators, semiconductors, ammeters and voltmeters	
Class 3	Power, energy, efficiency, ohmmeters and thermistors	
Week 2	**Basic Laws and Simple Resistive Circuits**	
Class 4	Resistances and Ohm's law	
Class 5	Series resistors, series circuits and power distribution in series circuits	
Class 6	Voltage sources in series	
Week 3	**Kirchhoff's Voltage Law and Applications**	
Class 7	Kirchhoff's voltage law	
Class 8	Voltage division in a series circuit	
Class 9	Voltage division in a series circuit	
Week 4	**Kirchhoff's Current Law and Applications**	
Class 10	Parallel resistors, parallel circuits and power distribution in parallel circuits	
Class 11	Kirchhoff's current law, current divider rule	
Class 12	Voltage sources in parallel, open and short circuits	
Week 5	**Techniques of Circuit Analysis**	CT-2
Class 13	Series parallel DC circuits	
Class 14	Current sources and source conversions	
Class 15	Current sources in series and current sources in parallel	
Week 6	**Techniques of Circuit Analysis (Contd.)**	
Class 16	Branch current analysis	
Class 17	Mesh analysis (general approach)	
Class 18	Mesh analysis (format approach) and supermesh	
Week 7	**Techniques of Circuit Analysis (Contd.)**	
Class 19	Nodal analysis (general approach)	
Class 20	Nodal analysis (format approach) and supernode	
Class 21	Bridge network	
Week 8	**Network Theorems**	CT-3
Class 22	Y-Δ and Δ-Y conversions	
Class 23	Superposition theorem	
Class 24	Superposition theorem (contd.)	
Week 9	**Network Theorems (Contd.)**	
Class 25	Thevenin's theorem – independent source	
Class 26	Thevenin's theorem – dependent source (contd.)	
Class 27	Norton's theorem – independent source	
Week 10	**Network Theorems (Contd.)**	
Class 28	Norton's theorem – dependent source (contd.)	
Class 29	Maximum power transfer theorem	
Class 30	Reciprocity theorem	
Week 11	**Energy Storage Elements**	
Class 31	Capacitors, capacitance, electric field	
Class 32	Transients in capacitors: charging and discharging phase	
Class 33	Capacitors in series and parallel with responses and energy stored by	

	capacitor	
Week 12	**Energy Storage Elements (Contd.)**	CT-4
Class 34	Inductance and magnetic field	
Class 35	R-L transients: the storage and release phase	
Class 36	Inductors in series and parallel with responses and energy stored by inductor	
Week 13	**Magnetic Circuits**	
Class 37	Magnetic field, reluctance and magnetizing force	
Class 38	Ohm's Law for Magnetic Circuits, air gaps and hysteresis	
Class 39	Ampere's circuital law, flux, permeability and flux density	
Week 14	**Magnetic Circuits (Contd.)**	
Class 40	Series magnetic circuits	
Class 41	Parallel magnetic circuits	
Class 42	Series parallel magnetic circuits	

Text and Ref 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. Prentice Hall of India Private Ltd.
4. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
5. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
6. Introduction to Electrical Engineering – Robert P. Ward; Prentice Hall of India Private Ltd.
7. Introduction to Electric Circuits – Richard C. Dorf & James A. Svoboda; John Wiley & Sons Inc.

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

<u>L-1, T-2</u>

6.6.2. EECE 193: Electronics

3.00 Contact Hour; 3.00 Credit Hour

Level: Level-1, Term-II

Pre-requisite: None.

Rationale:

To learn and familiarize with the basics of electronic circuit elements as well as utilizing the knowledge in solving complex analytical practical problems related to electronic circuits.

Course Contents:

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

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

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

Single stage mid-band frequency BJT amplifier circuits: Voltage and current gain, input and output impedance of a common base, common emitter and common collector amplifier circuits.

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

Junction field-effect transistor (JFET): Structure and physical operation of JFET, transistor characteristics, and pinch-off voltage.

Differential and multistage amplifiers: Description of differential amplifiers, small-signal operation, differential and common mode gains, RC coupled mid-band frequency amplifier.

Objective:

1. To learn the basic of electronic circuit elements and variables.
2. To study the physical characteristics, structures and operations of various electronic circuits.
3. To be skilled in using various electronic circuits as per requirement.
4. To understand the basic differences among the different electronic devices to utilize them for respective practical purposes.
5. To be able to solve complex practical problems related to the basic electronic circuits

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Analyze** the basic electronic circuit elements with their structures and operations.
2. **Apply** the knowledge of electronic circuits in solving practical problems and also taking decisions about using the appropriate device required for respective purpose.
3. **Compute** the gains and input and output impedances of various electronic and amplifier circuits to utilize them in practical and analytical problems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**

1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze the basic electronic circuit elements with their structures and operations.	√											
2. Apply the knowledge of electronic circuits in solving practical problems and also taking decisions about using the appropriate device required for respective purpose.		√										
3. Compute the gains and input and output impedances of various electronic and amplifier circuits to utilize them in practical and analytical problems.			√									

Lecture Schedule:

Week 1	**Semiconductor Diodes: p-n junctions**	CT-1
Class 1	Semiconductor materials, energy levels and ideal diode	
Class 2	Extrinsic materials- n and p type, semiconductor diodes and resistances	
Class 3	Diode equivalent circuits	
Week 2	**Semiconductor Diodes (contd.)**	
Class 4	Zener diodes and zener diode applications as voltage regulator	
Class 5	Light emitting diodes	
Class 6	Transition and diffusion capacitances	
Week 3	**Diode Circuits**	
Class 7	Load line analysis and diode approximations	
Class 8	Series, parallel and series-parallel circuits with DC inputs	
Class 9	Half wave rectifier circuit	
Week 4	**Diode Circuits (contd.)**	
Class 10	Full wave rectifier circuit	
Class 11	Clippers	

Class 12	Clampers	
Week 5	**Bipolar Junction Transistors**	CT-2
Class 13	Transistor construction and operation	
Class 14	Common base configuration and transistor amplifying action	
Class 15	Common emitter configuration	
Week 6	**Bipolar Junction Transistors (Contd.)**	
Class 16	Common collector configuration	
Class 17	BJT operating points and fixed bias circuit	
Class 18	Emitter stabilized bias circuits	
Week 7	**Bipolar Junction Transistors (Contd.)**	
Class 19	Voltage divider bias circuits	
Class 20	Amplification in AC domain	
Class 21	BJT transistor modeling	
Week 8	**Small Signal Analysis of BJT**	CT-3
Class 22	r_e transistor model	
Class 23	Hybrid transistor model	
Class 24	Voltage divider bias configuration	
Week 9	**BJT Amplifier Circuits**	
Class 25	General considerations of frequency response	
Class 26	Low frequency response-BJT amplifier	
Class 27	High frequency response-BJT amplifier	
Week 10	**Field Effect Transistors**	
Class 28	Constructions, characteristics of JFETs and transfer curve	
Class 29	Depletion type MOSFETs	
Class 30	Enhancement type MOSFETs	
Week 11	**FET Biasing**	
Class 31	Fixed and self bias configuration	
Class 32	Voltage divider bias configuration	
Class 33	CMOS	
Week 12	**FET Small Signal Analysis**	CT-4
Class 34	FET small signal model	
Class 35	JFET fixed bias, self bias, voltage divider bias configuration	
Class 36	JFET source follower, common gate configuration	
Week 13	**FET Small Signal Analysis (contd.)**	
Class 37	E-MOSFET drain feedback configuration	
Class 38	E-MOSFET voltage divider configuration	
Class 39	Designing amplifier networks	
Week 14	**FET Amplifier Circuits**	
Class 40	Low frequency response-FET amplifier	
Class 41	High frequency response-FET amplifier	
Class 42	Multistage amplification effect	

Text and Ref Books:

1. Electronic Devices and Circuit Theory - R.L Boylsted; Prentice Hall of India Private Ltd.
2. Semi Conductor Circuit Approximation - Albert P Malvino; Tata McGraw- Hill.
3. Electronic Devices and Circuits – Jacob Millman& Christos C. Halkias; Tata McGraw-Hill.
4. Electronic Instruments and Instrumentation Technology – M.M.S. Anand; Prentice Hall of India Private Limited.
5. Op Amps & Linear Integrated Circuits - James M. Fiore; Delmar Thomson Learing.
6. Microelectronic 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.**

6.6.3. EECE 194: Electrical circuits and Electronics Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-1, Term-II

Pre-requisite: Electrical Circuits (EECE 191) & Electronics (EECE 193)

Rationale:

To learn and familiarize the basics of electrical circuits as well as electronic devices and also analyze their operation and characteristics.

Course Contents:

In this course students will get a hands on experience about electrical circuits and electronic devices. They will observe the uses of electrical circuits and electronic equipment practically. They will also study their properties. They will also simulate and analyze different electrical circuits and find out different values of elements inside the circuits using PSpice.

Objective:

1. To understand the concept of circuit laws.
2. To verify practically the theories and concepts learned in EECE 191 and EECE193.
3. To understand the concept and operation of electronic devices.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Analyze** the laws and principles of electrical circuits, understand the relationships and differences between theory and practical.
2. **Design** rectifier, multiplier, amplifier etc. with electronic equipment for practical purpose.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-2	Conduct of Lab Test /Class Performance	**25%**
1-2	Report Writing/ Programming	**15%**
1-2	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-2	Final Evaluation (Exam/Project/assignment)	**30%**
1-2	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Analyze the laws and principles of electrical circuits, understand the relationships and differences between theory and practical.		√										
2. Design rectifier, multiplier, amplifier etc. with electronic equipment for practical purpose.				√								

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Construction and operation of simple electrical circuits	
2	Verification of KVL	
3	Verification of KCL	
4	Verification of Superpositon	
5	Verification of Thevenin's theorem	
6	Introduction to PSpice	
7	Simulating circuits with dependent sources in PSpice	
8	Study of diode characteristics.	
9	Study of diode rectifiercircuits	
10	Study of n-p-n CE (common emitter) transistor characteristics.	
11	Practice Lab	
12	Lab Test + Viva	
13	Quiz test	
14	Project submission	

Text and Ref 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.
3. Electronic Devices and Circuit Theory - R.L Boylsted; Prentice Hall of India Private Ltd.

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

<u>L-2, T-2</u>

6.6.4. EECE 295: Digital Electronics

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: Nil.

Rationale:

To learn and familiarize the basic logic gatesas well as to be able to design various combinational and sequential circuits using logic gates.

Course Contents:

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

Objective:

1. To acquire the basic knowledge of digital logic levels and application ofknowledge to understand digital electronics circuits.
2. To prepare students to perform the analysis and design of various combinational and sequential circuits using gates.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Identify** the structure of various number systems and its application in digital design.
2. **Design** various combinational and sequential circuits.
3. **Analyze** the memory elements, state table and state diagrams of the sequential circuit,

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify the structure of various number systems and its application in digital design.	√											
2. Design various combinational and sequential circuits.			√									
3. Analyze the memory elements, state table and state diagrams of the sequential circuit,				√								

Lecture Schedule:

Week 1	**Various Number Systems**	CT 1
Class 1	Number base conversion	
Class 2	Complements and related problems	
Class 3	Binary codes	
Week 2	**Boolean Algebra**	
Class 4	Basic theories and properties of Boolean Algebra	
Class 5	Canonical and standard forms	
Class 6	Mathematical problems on Boolean Algebra	
Week 3	**Simplification of Boolean Function, Universal Gate Introduction**	
Class 7	Simplification of Boolean functions through Map method	
Class 8	Product of Sums simplification	
Class 9	NAND and NOR implementation	

Week 4	**Simplification of Boolean Function**	CT 2
Class 10	Simplification with Don’t Care conditions	
Class 11	The Tabulation method of simplification	
Class 12	Related mathematical problem solving	
Week 5	**Combinational Circuit Design**	
Class 13	Introduction to Combinational Logic	
Class 14	Discussion on Design procedure	
Class 15	Adders and subtractors	
Week 6	**Code Conversion**	
Class 16	Code conversion	
Class 17	Boolean function implementations	
Class 18	Exclusive-OR AND equivalence functions	
Week 7	**Combinational Circuit Design**	CT 3
Class 19	Parity generation and checking	
Class 20	Combinational logic with MSI and LSI	
Class 21	Coder/decoder and multiplexer/demultiplexer design.	
Week 8	**Combinational Circuit Design**	
Class 22	Modular combinational circuit design: Pass transistor, pass gates	
Class 23	Multiplexer, demultiplexer and their implementation in CMOS	
Class 24	Decoder, encoder, comparators, binary arithmetic elements and ALU design	
Week 9	**Logic Arrays**	
Class 25	Programmable logic devices: Logic arrays	
Class 26	Field programmable logic arrays	
Class 27	Programmable read only memory	
Week 10	**Introduction to Memory Element**	CT 4
Class 28	Sequential circuits: Different types of latches	
Class 29	Flip-flops: master-slave, D, JK, T	
Class 30	Design of flip-flops using ASM approach	
Week 11	**Analyze of Sequential Circuits**	
Class 31	Timing analysis	
Class 32	Power optimization of sequential circuits	
Class 33	Modular sequential logic circuit design: shift registers	
Week 12	**Shift Registers**	
Class 34	Parallel I/O shift registers	
Class 35	Series I/O shift registers	
Class 36	Universal shift register	
Week 13	**Different types of Counters**	
Class 37	Counters: Introduction	
Class 38	Asynchronous counters: up and down	
Class 39	Synchronous counters: up and down	
Week 14	**Different types of Counters, Registers**	
Class 40	BCD counters and other modulo counters	

Class 41	Ring counter, Johnson counter	
Class 42	Applications of registers and counters	

Text and Ref 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.

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

6.6.5. EECE 296: Digital Electronics Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: Digital Electronics (EECE 295).

Rationale:

To learn and familiarize with the basics of digital electronic circuits as well as utilizing digital electronic circuits for practical purposes.

Course Contents:

This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EECE 295. In the second part, students will design simple systems using the principles learned in EECE 295.

Objective:

1. To learn about digital electronic circuits.
2. To know and use the digital ICs for theoretical and practical purposes.
3. To learn about sequential digital circuits.
4. To solve complex design problems regarding digital electronics based on realistic aspects.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic digital electronic circuits practically.
2. **Analyze** the necessity and utilization of different types of logic and sequential circuits for real problems.
3. **Design** different circuits with ICs and microprocessor to use for our day to day necessities.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the knowledge of basic digital electronic circuits practically.					√							
2. **Analyze** the necessity and utilization of different types of logic and sequential circuits for real problems.							√					
3. **Design** different circuits with ICs and microprocessor to use for our day to day necessities.									√			

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Familiarization and use of truth table of basic logic Gates.	
2	De Morgan's laws using the logic gates.	
3	Truth tables and 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 - 01	
8	Design and implement of multiplexer & de-multiplexer circuit using logic gates.	
9	Design and implement of various types of clocked flip-flop circuits using logic gates.	

10	Design and implement of up and down counters.	
11	Quiz	
12	Project Presentation	
13	Lab Test-02	
14	Viva	

Text and Ref Books:

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

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

6.6.6. EECE 298: Circuit Simulation Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: Electrical Circuits (EECE 191) and Electronic (EECE 193).

Rationale:

To learn and familiarize with the basics of electrical and electronic circuits through simulation as well as utilizing electrical and electronic circuits for practical purposes.

Course Contents:

This simulation laboratory is based on EECE 191 and EECE 193. Students will use s simulation software like Pspice and Orcad to verify the theories of electrical and electronic circuits. Students will also perform specific design problems of electrical and electronic circuits by simulation.

Objective:

1. To learn about electrical and electronic circuits.
2. To learn the usage of the circuit simulation software Pspice and Orcad.
3. To verify the circuit theories through simulation.
4. To solve complex design problems regarding electrical and electronic based on realistic aspects.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic electrical and electronic circuits practically.
2. **Analyze** the necessity and utilization of different types of electrical as well as electronic circuits for real problems.
3. **Design** different circuits with basic electrical and electronic devices to use for our day to

day necessities.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the knowledge of basic electrical and electronic circuits practically.					√							
2. Analyze the necessity and utilization of different types of electrical as well as electronic circuits for real problems.							√					
3. Design different circuits with electrical and electronic devices to use for our day to day necessities.		√										

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Introduction to Pspice and Orcad	
2	Simulating Circuits with Dependent Sources in PSpice	
3	Determination of equivalent resistance and Circuit analysis with source and resistance sweeping.	
4	First Order Transients and Various Aspects of Transient Analysis.	
5	Lab Test - 01	
6	Study of Diodes and its applications.	

7	Study of characteristics of bipolar junction transistor (BJT).	
8	Study of cascaded and feedback amplifier circuits using bipolar junction transistor (BJT).	
9	Study of characteristics of field effect transistor (FET) and its application in CMOS inverter.	
10	Study of JFET small signal amplifier.	
11	Quiz test	
12	Project Presentation	
13	Lab Test-02	
14	Viva	

Text and Ref Books:

1. Spices for Circuits and Electronic 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.**

6.6.7. EECE 391: Linear Systems and Digital Signal Processing

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-3, Term-1

Pre-requisite: None

Rationale:

To learn and familiarize the basics of linear systems and digital signal processing.

Course Contents:

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.

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: Solution of analog electrical and mechanical systems, 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.

Objective:

1. To understand different signals and systems for modeling purpose.

2. To become skilled at various types of system design tools.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Distinguish** different signals and LTI systems.
2. **Design** practical stable systems.
3. **Apply** the theoretical knowledge in solving various real life problems.

Teaching-learning and Assessment Strategy: Lectures, class performance, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1.**Distinguish** different signals and LTI systems	√											
2. **Design** practical stable systems.		√										
3. **Apply** the theoretical knowledge in solving various real life problems.			√									

Lecture Schedule:

Week 1	Classification of signals and systems	
Class 1	Signals classification, basic operation on signals, elementary signals, representation of signals using impulse function	CT 1
Class 2		
Class 3		

Week 2	**Classification of signals and systems**	
Class 4 Class 5 Class 6	Systems classification, properties of Linear Time Invariant (LTI) systems: Linearity, causality, time invariance, memory, stability	
Week 3	**Time domain analysis of LTI systems**	
Class 7 Class 8 Class 9	Differential equations - system representation, order of the system, solution techniques	
Week 4	**Time domain analysis of LTI systems**	CT 2
Class 10 Class 11 Class 12	Zero state and zero input response, system properties, impulse response - convolution integral, determination of system properties	
Week 5	**Time domain analysis of LTI systems**	
Class 13 Class 14 Class 15	State variable - basic concept, state equation and time domain solution	
Week 6	**Frequency domain analysis of LTI systems**	
Class 16 Class 17 Class 18	Fourier series- properties, harmonic representation	
Week 7	**Frequency domain analysis of LTI systems**	CT 3
Class 19 Class 20 Class 21	System response,frequency response of LTI systems	
Week 8	**Frequency domain analysis of LTI systems**	
Class 22 Class 23 Class 24	Fourier transformation- properties, system transfer function, system response and distortion-less systems	
Week 9	**Applications of time and frequency domain analyses**	
Class 25 Class 26 Class 27	Solution of analog electrical and mechanical systems	
Week 10	**Applications of time and frequency domain analyses**	CT 4
Class 28 Class 29 Class 30	Amplitude modulation and demodulation	
Week 11	**Applications of time and frequency domain analyses**	
Class 32 Class 33	Applications of time and frequency domain analyses	
Week 12	**Laplace transformation**	
Class 34 Class 35 Class 36	Properties of Laplace transformation, inverse Laplace transform	

Week 13	**Laplace transformation**	
Class 37 Class 38 Class 39	Solution of system equations, system transfer function	
Week 14	**Laplace transformation**	
Class 40 Class 41 Class 42	System stability and frequency response and application	

Text and Ref Books:

1. Continues and Discrete Signals & Systems - S.S. Soliman& M. D. Srinath; Prentice Hall of India Private Ltd.

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.**

6.6.8. EECE 392: Digital Signal Processing Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-3, Term-I

Pre-requisite: Linear Systems and Digital Signal Processing (EECE 391).

Rationale:

To learn and familiarize with the basics of linear and digital signals with their processing through simulation as well as utilizing linear and digital signals for practical purposes.

Course Contents:

This simulation laboratory is based on EECE 391. Students will perform experiments to verify practically the theories and concepts learned in EECE 391 with MATLAB software.

Objective:

1. To learn about linear and digital signals.
2. To learn the processing of the linear and digital signals.
3. To verify the learned theories and processing through simulation using MATLAB.
4. To solve complex design problems regarding linear and digital signals based on realistic aspects.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic linear and digital signals practically.

2. **Analyze** the necessity and utilization of different types of processing of linear and digital signals for real problems.
3. **Design** different devices with basic knowledge of linear and digital signal processing to use for our day to day necessities.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the knowledge of basic linear and digital signals practically.					√							
2. **Analyze** the necessity and utilization of different types of processing of linear and digital signals for real problems.							√					
3. **Design** different devices with basic knowledge of linear and digital signal processing to use for our day to day necessities.									√			

Lectures Schedule

Weeks	Intended topics to be covered	Remarks

1	Introduction to MATLAB.	
2	Study of sampling.	
3	Study of quantization and encoding	
4	Time domain analysis of discrete time signals and systems	
5	Time domain analysis of discrete time signals and systems (contd.)	
6	Lab Test - 01	
7	Laplace Transform and it's application	
8	Laplace Transform and it's application (contd.)	
9	Frequency domain analysis of DT signals and systems	
10	Frequency domain analysis of DT signals and systems (contd.)	
11	Quiz	
12	Project Presentation	
13	Lab Test-02	
14	Viva	

Text and Ref Books:

1. Continues and Discrete Signals & Systems - S.S. Soliman& M. D. Srinath; Prentice Hall of India Private Ltd.

2. Signal and System (Continuous & Discrete) - R.E. Ziemer; Pearson Education Asia.

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

6.6.9. EECE 393: Embedded System in Biomedical Engineering (Microprocessors, Microcontroller and Interfacing)

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-3, Term-I
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of how computer works, its language and interfacing between different parts of the memory of the microprocessor.

Course Contents:
Introduction to microprocessors.
Intel 8086 microprocessor: architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt.
Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard, display device and other I/O device interface. Introduction to micro-controllers. Introduction to embedded system, classification and design sample embedded systems with programmable ICs.

Objective:

1. To understand basic architecture of microprocessors and interfacing by programming languages to control the operation of microprocessors.
2. To become skilled at designing embedded systems and simplifying traditional manual process controls with programmable devices.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Identify** the basic architecture of microprocessors and relation between various internal blocks inside any microprocessor.
2. **Interrelate** Intel 8086 microprocessor and programming in assembly language to perform machine dependent programming.
3. **Solve** any mathematical operation to handle with 8086 instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor.
4. **Differentiate** between classical embedded system and programmable interfacing, distinguish between the features and design, implementation and performance analysis of embedded systems.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12

1. **Identify** the basic architecture of microprocessors and relation between various internal blocks inside any microprocessor.	√											
2. **Interrelate** Intel 8086 microprocessor and programming in assembly language to perform machine dependent programming.				√								
3. **Solve** any mathematical operation to handle with 8086 instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor.		√										
4. **Differentiate** between classical embedded system and programmable interfacing, distinguish between the features and design, implementation and performance analysis of embedded systems.				√								

Lecture Schedule:

Week 1	**Introduction to Microprocessor:**	
Class 1	Introduction to the Subject and Evaluation Process	
Class 2	Introduction to Microprocessor: Historical development of microprocessor, generation of 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	Some basic concepts: Register, Counter, Memory, ROM, RAM	
Class 5	Adder-Subtractor, Tri-state output, Bus organization etc.	CT 1
Class 6	Details of architecture of SAP- 1 and SAP-1 Instruction sets.	
Week 3	**Intel 8086 Microprocessor:**	
Class 7	Features and characteristics of 8086, PIN diagram and Detail architecture of 8086	
Class 8	Functions of Bus interface unit (BIU), instruction queue and pipelining, Execution Unit (EU) and memory segmentation, Bus timing diagram of 8086	
Class 9	Address determination of peripheral device/memory, Problems of address determination.	
Week 4	**Numbers and Characters, Registers**	
Class 10	Representation of Numbers and Characters: Review of number system, conversion of number system, Character representation.	
Class 11	Organization of Registers of 8086: General purpose register, segment register	CT 2
Class 12	Pointer and index register, Flag register	
Week 5	**Assembly Language**	
Class 13	Assembly Language: Addressing Modes of 8086	

Class 14	Data addressing Modes, Program memory addressing modes	
Class 15	Stack memory addressing modes.	
Week 6	**Assembly Language**	
Class 16	Assembly Language: Instruction Sets of 8086	
Class 17	Data movement instruction, Arithmetic and Logical instruction,	
Class 18	Program control instruction	
Week 7	**Assembly Language**	CT 3
Class 19	Arithmetic problem solving	
Class 20	Arithmetic problem solving continued	
Class 21	Program flow control	
Week 8	**Assembly language**	
Class 22	Software interrupts	
Class 23	Procedure of interrupts	
Class 24	Miscellaneous data transfer instructions	
Week 9	**Interfacing**	
Class 25	Interfacing: Introduction to 8259 Programmable Interrupt Controller, Internal Architecture of 8259	
Class 26	Initialization Command Words (ICWs) and Operational Command Words (OCWs) of 8259	
Class 27	Cascade mode 8259	
Week 10	**Interfacing**	CT 4
Class 28	Introduction to 8255A Programmable Peripheral Interface	
Class 29	Pin diagram and pin function of 8255A	
Class 30	Internal architecture of 8255A	
Week 11	**Interfacing**	
Class 31	Initialization of control word of 8255A	
Class 32	i/o interface problems with 8255A	
Class 33	Keyboard interfacing and display interfacing with 8255A	
Week 12	**Interfacing**	
Class 34	Introduction to 8254 Programmable Timer/ Counter	
Class 35	Pin diagram, internal architecture, system connection and initialization	
Class 36	Modes of 8254	
Week 13	**Interfacing**	
Class 37	8284 clock generator architecture	
Class 38	Direct Memory Access (DMA)	
Class 39	8237 DMA controller	
Week 14	**Interfacing**	
Class 40	8237 DMA controller	
Class 41	8237 DMA controller	
Class 42	Review	

Text and Ref Books:

1. Microprocessor and Interfacing – Douglas V Hall; Third Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Assembly Language Programming and Organization of IBM PC – Ytha Yu and Charles Marut, International Edition, McGraw Hill, Inc
3. The Intel Microprocessors – Architecture Programming and Interfacing – Barry B Brey, Pearson Education, Inc., Upper Saddle River, New Jersey 07458.
4. Digital Computer Electronics – Albert P. Malvino and Jerald A. Brown, 3rd Edition

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

6.6.10. EECE 394: Embedded System in Biomedical Engineering Lab.

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-3, Term-I

Pre-requisite: None.

Rationale:

To learn and familiarize the basics of how computer works, its language and interfacing between different parts of the memory of the microprocessor.

Course Contents:

Practical System orientation on basis of the course EECE-307: Intel 8086 microprocessor: architecture, addressing modes, instruction sets, assembly language programming, system design and interrupt. Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access, keyboard, display device and other I/O device interface. Introduction to microcontrollers.

Objective:

1. To observe basic architecture of microprocessors and interfacing by programming languages to control the operation of microprocessors.
2. Designing embedded systems and interfacing peripheral I/O devices and memory devices with microprocessors.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Recognize** the basic components inside Intel 8086 microprocessor and relation between various internal blocks inside any microprocessor.
2. **Interpret** intel 8086 microprocessor registers and programming in assembly language to perform machine dependent programming

3. **Apply** mathematical operations to handle with 8086 instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor.
4. **Developing** communication between I/O and memory devices with microprocessor and thereby successfully accomplish error estimation, execution, signal conditioning/conversion, automatic processing and finally transmission of data with various communication protocol.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	**25%**
1-4	Report Writing/ Programming	**15%**
1-4	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-4	Final Evaluation (Exam/Project/assignment)	**30%**
1-4	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Recognize the basic components inside Intel 8086 microprocessor and relation between various internal blocks inside any microprocessor.	√											
2. Interpret intel 8086 microprocessor registers and programming in assembly language to perform machine dependent programming	√											
3. Apply mathematical operations to handle with 8086 instruction set and ability to utilize it in programming and to interface various I/O or memory devices to the microprocessor		√										

4. Developing communication between I/O and memory devices with microprocessor and thereby successfully accomplish error estimation, execution, signal conditioning/conversion, automatic processing and finally transmission of data with various communication protocol			√									

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Introduction to Intel 8086 Microprocessor module and interfacing accessories	
2	Intel 8086 programmer and simulator for assembly language programming	
3	Solve ordinary mathematical operations with 8086 microprocessor	
4	Advanced assembly language programming	
5	Assembly language program flow control, conditional and unconditional loops	
6	Hardware and software interrupts and Intel 8086 supportable interrupts	
7	Interfacing digital lighting display (Dot-matrix) with microprocessor	
8	Interfacing keyboard with microprocessor by peripheral programmable interface	
9	Stepper motor interface and warning message generation by Intel 8086	
10	Programmable peripheral interrupt controlling by 8259 PIC	
11	Liquid crystal device interfacing by Intel 8086 and 8255 PPI	
12	Analog to digital conversion by ADC0804 and Intel 8086	
13	Lab Test Lab Quiz	
14	Viva-voce	

Text and Ref Books:

1. Microprocessor and Interfacing – Douglas V Hall; Third Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Assembly Language Programming and Organization of IBM PC – Ytha Yu and Charles Marut, International Edition, McGraw Hill, Inc
3. The Intel Microprocessors – Architecture Programming and Interfacing – Barry B Brey, Pearson Education, Inc., Upper Saddle River, New Jersey 07458.
4. Digital Computer Electronics – Albert P. Malvino and Jerald A. Brown, 3rd Edition

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

6.7 Dept of Petroleum and Mining Engineering

L-2, T-1

6.7.1. EECE 273: Fundamentals of Electrical Engineering

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of electric and magnetic circuit as well as the analysis of DC and AC circuit.

Course Contents:
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 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 value, average value, 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 Y loads and balanced delta loads. Power in balanced systems and power factor.. Balanced three phase circuit analysis and power measurement.

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 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.
7. To understand the basic working principle of motor and generator along with their corresponding different laws.
8. To learn the concepts of power measurement of balanced and unbalanced system.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Apply** different laws of circuit theorems to solve various engineering problems.
2. **Analyze** different circuit related complex engineering problems efficiently.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** different laws of circuit theorems to solve various engineering problems.		√										
2. **Analyze** different circuit related complex engineering problems efficiently.		√										
3. **Design** different elementary circuit related projects using circuit theorems and components.			√									

Lecture Schedule:

Week 1	**Laws of electric circuit**	CT 1
Class 1	Ohm’s Law, Kirchhoff’s voltage and current laws.	
Class 2	delta-wye transformation.	
Class 3	Mathematical Problems related to Ohm’s Law, Kirchhoff’s voltage and current laws and delta-wye transformation	
Week 2	**Electrical networks**	
Class 4	Network analysis methods of branch and loop currents	
Class 5	Method of nodal analysis	
Class 6	Thevenin’s and Norton’s theorems.	
Week 3	**Magnetic concepts and units**	
Class 7	Magnetic field, right hand rule	
Class 8	Magnetic flux density, Biot-Savart law	
Class 9	Magnetic field intensity, measurement of magnetic flux	
Week 4	**Magnetic concepts and units**	CT 2
Class 10	Energy of magnetic field	
Class 11	characteristic of ferromagnetic materials	
Class 12	Mathematical problems related to magnetic circuits.	
Week 5	**Magnetic concepts and units**	
Class 13	B-H curve, hysteresis loss, eddy current loss	
Class 14	Total core loss. Introduction to magnetic circuits.	
Class 15	Practice problems related to B-H curve	
Week 6	**Electromagnetic forces**	
Class 16	Basic concepts of electric and magnetic field.	
Class 17	Forces upon a current carrying conductor and charged particles moving in a magnetic field.	
Class 18	Electromagnetic torque	
Week 7	**Electromagnetic forces**	CT 3
Class 19	Electric motor	
Class 20	Electromagnetic induction and emf.	
Class 21	Elementary a.c. generator	
Week 8	**AC Circuits**	
Class 22	Alternating Current basics.	
Class 23	Instantaneous current, voltage and power	
Class 24	Average and RMS current, voltage and power with mathematical problems	
Week 9	**AC Circuits**	
Class 25	Basic concepts of electrical reactive elements: Capacitor and Inductor	
Class 26	Instantaneous Current, Voltage and Power in RL branch	
Class 27	Instantaneous Current, Voltage and Power in RC branch	

Week 10	**AC Circuits**	CT 4
Class 28	Instantaneous Current, Voltage and Power in RLC branch	
Class 29	Average current and Voltage in RL, RC, RLC branch	
Class 30	Mathematical Problems related to RL, RC and RLC branch	
Week 11	**AC Circuits**	
Class 31	Form factor, Crest factor	
Class 32	Introduction to real and reactive power	
Class 33	Mathematical Problems related to power calculation	
Week 12	**Introduction to Vector Algebra**	
Class 34	Introduction to vector algebra. Impedance in polar and Cartesian forms. Sinusoidal single phase circuit analysis.	
Class 35	Impedance in series, parallel branches, series-parallel circuits	
Class 36	Network analysis – Thevenin's theorem.	
Week 13	**Balanced poly phase circuits**	
Class 37	Basic concepts of three phase systems.	
Class 38	Three phase, Four wire system of generated emfs.	
Class 39	Three phase, three wire systems.	
Week 14	**Balanced poly phase circuits**	
Class 40	Balanced wye loads, balanced delta loads	
Class 41	Power factor. Balanced three phase circuit analysis and power measurement.	
Class 42	Mathematical Problem related to power calculations in balanced loads.	

Text and Ref 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.
3. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
4. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
5. Introduction to Electrical Engineering – Robert P. Ward; Prentice Hall of India Private Ltd.
6. Introduction to Electric Circuits – Richard C. Dorf & James A. Svoboda; John Wiley & Sons Inc.

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

6.7.2. EECE 274: Electrical Engineering Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: Fundamentals of Electrical Engineering (EECE273).

Rationale:

To learn and familiarize the basics of electric and magnetic circuit as well as the analysis of DC and AC circuit.

Course Contents:

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.

Objective:

1. To learn about electrical elements and use them practically.
2. To compare the theoretical and practical values of circuit.
3. To learn to operate electrical motor and generator.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Apply** the knowledge of basic electrical components and networks practically.
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply the knowledge of basic electrical components and networks practically.						√						
2. Analyze the differences between theoretical knowledge with the practical observations.									√			
3. Design different elementary circuit related projects using circuit theorems and components.											√	

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Construction and operation of simple electrical circuits	
2	Verification of KVL	
3	Verification of KCL	
4	Verification of Thevenin's theorem	
5	Verification of Norton's theorem	
6	Practice Lab-01	
7	Lab Test-01	
8	Study the properties of electric motor	
9	Study the properties of electric generator	
10	Familiarization with alternating current (ac) waves	
11	Study of R-L-C series circuit	
12	Practice Lab-02	
13	Lab Test-02	
14	Viva	

Text and Ref 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.
3. Basic Electrical Engineering – Fitzgerald; McGraw-Hill International.
4. Electricity and Magnetism - Mary Atwater; McGraw-Hill.
5. Introduction to Electrical Engineering – Robert P. Ward; Prentice Hall of India Private Ltd.

6. Introduction to Electric Circuits – Richard C. Dorf & James A. Svoboda; John Wiley & Sons Inc.

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

L-3, T-1

6.7.3. EECE 373: Electrical Machines and Electronic Engineering

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-3, Term-I

Pre-requisite: None.

Rationale:

To gain basic knowledge on electrical machines and DC drives and also their principle of operation, characteristics and applications.

Course Contents:

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.

Objective:

1. To understand basic operating principle of Electrical machines like DC motor, DC generator and Transformer etc.
2. To equip the students with the basic knowledge of Power semiconductor Devices.
3. To expose the students to the basic concepts of electronic devices, DC drives and their properties

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Explain** the structure, operating principle and main features of Electrical Machines and their applications.
2. **Understand** principle of working of various transducers used to measure Temperature, comparative study of various transducers.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**
1-2	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-2	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain** the structure, operating principle and main features of Electrical Machines and their applications.	√											
2. Understand principle of working of various transducers used to measure Temperature, comparative study of various transducers.		√										

Lecture Schedule:

Week 1	**DC Generator**	
Class 1	Basic idea about Electrical Machines, Introduction to DC generator and its principle of operation	CT 1
Class 2	Commutation principle and slip rings, Construction of DC generator and different parts	
Class 3	Lap winding and wave winding and its comparison, Emf equation of DC generator and related maths	
Week 2	**DC Motor**	

Class 4	Introduction to DC motor, Construction and operating principle of DC motor	
Class 5	Differences between DC generator and DC motor, Back emf and related equations for DC motor	
Class 6	Speed control of DC motor, Torque –speed characteristics of DC motor	
Week 3	**Transformer**	
Class 7	Introduction to Transformer and its principle of operations, Types of transformer and ideal characteristics	
Class 8	Equivalent circuit of Transformer, Vector diagrams of transformer under different conditions	
Class 9	Mathematical problems of Transformer, Efficiency calculation and condition for maximum efficiency	
Week 4	**Alternator**	CT 2
Class 10	Synchronous Generator: Operating principle, Excitation systems of Synchronous Generator	
Class 11	Losses in Alternator, equivalent circuit of synchronous Generator	
Class 12	Emf equation of synchronous generator, Mathematical problems	
Week 5	**Synchronous Motor**	
Class 13	Synchronous motor: Operation	
Class 14	Vector diagrams of synchronous motor	
Class 15	effect of loading under different excitation condition.	
Week 6	**Induction Motor**	
Class 16	Three phase induction motor: principle, Rotating magnetic field	
Class 17	Construction of squirrel cage IM, equivalent circuit	
Class 18	starting and braking, speed control	
Week 7	**Diode**	CT 3
Class 19	Introduction to semiconductor devices and its classifications	
Class 20	P-type and N-type materials and doping, Semiconductor diode and its band diagram	
Class 21	Biasing of semiconductor diodes, I-V characteristics of diode and equivalent circuit of diodes	
Week 8	**Diode (Cont..)**	
Class 22	Applications of diode, HWR and FWR using diode	
Class 23	Diode bridge rectifier and Centre tapped transformer rectifier, Clipper circuit and related problems	
Class 24	Clamper circuit and related problems	
Week 9	**BJT**	
Class 25	Introduction to BJT and construction, Principle and operation of BJT	
Class 26	Operating regions of BJT and its different configurations	
Class 27	CB and CE configurations and characteristics curves	

Week 10	**Power Supply**	
Class 28	Choice of voltage, surface and underground supply, Mine cable construction	CT 4
Class 29	installation, fault location, Switchgears, Earthing methods	
Class 30	Protective devices: over current and over voltage	
Week 11	**Control and Instrumentation**	
Class 31	Introduction to control system, open loop and closed loop system	
Class 32	remote control, sequence control	
Class 33	introduction to programmable logic controller, embedded controller	
Week 12	**Control and Instrumentation (Cont..)**	
Class 34	Drives: DC drives: single phase half wave converter drives	
Class 35	AC drives: Induction motor drives-Stator voltage and rotor voltage control	
Class 36	Transducers: Electrical Transducers, Advantages of Electrical Transducer	
Week 13	**Control and Instrumentation (Cont..)**	
Class 37	Resistance Thermometers, Thermistor, Thermocouple	
Class 38	Integrated Circuit temperature sensors, Linear Variable Differential Transformer (LVDT)	
Class 39	Capacitive Transducer: Piezo-electric Transducer, Opto-electronic transducers.	
Week 14	**Control and Instrumentation (Cont..)**	
Class 40	Sensors for measurement of various operational parameters	
Class 41	Environmental parameters and safety parameters in underground and open pit mines.	
Class 42	Review Class	

Text and Ref Books:

1. A Text Book of Electrical Technology (AC, DC Machines) –B L Theraja and A. K. Theraja.
2. Electronics Devices and Circuit Theory - R.L Boylsted; Prentice Hall of India Private Ltd.
3. Linear Control System Analysis and Design. - John J.D. Azzo & Constantine H. Houpis; McGraw-Hill International

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

6.7.4. EECE 374: Electrical Machines and Electronic Engineering Laboratory

3.00 Contact Hour; 1.50 Credit Hour;

Level: Level-3, Term-I

Pre-requisite: Electrical Machines and Electronic Engineering (EECE 373).

Rationale:

To learn and familiarize the basics of electrical DC machines as well as AC machines and also analyze the construction and performance of these machines.

Course Contents:

In this course students will get a hands on experience about electrical machines. They will observe the uses of electrical machines practically. They will also learn to analyze different electrical machines for evaluating their operations and performances.

Objective:

1. To understand the construction and basic principle of DC & AC machines.
2. To understand the basics of electronic devices and instrumental devicespractically.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Evaluate** the performance of different machines experimentally.
2. **Apply** practical knowledge for designing Electrical machines and electronic equipments.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-2	Conduct of Lab Test /Class Performance	**25%**
1-2	Report Writing/ Programming	**15%**
1-2	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-2	Final Evaluation (Exam/Project/assignment)	**30%**
1-2	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Evaluate** the performance of different machines experimentally.					√							
2. Apply practical knowledge for designing Electrical machines and electronic equipments.				√								

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Introduction to the lab equipments and safety measures	
2	Expt-01: Regulation of the Transformer in Various Loads.	
3	Expt-02: Study the properties of DC Separately Excited Shunt Generator	
4	Expt-03: Study the properties of DC Self-Excited Shunt Generator	
5	Expt-04: Study the properties of DC Shunt Motor	
6	Expt-05: Study the properties of Three-Phase Alternator in various loads	
7	Expt-06: Study the Three-Phase Alternator synchronizing process in power utility system.	
8	Expt-07: Study the diode characteristics	
9	Expt-08: Study of diode rectifier circuits	
10	Expt-09: Study the characteristics of common emitter BJT	
11	Practice Lab	
12	Lab Test + Viva	
13	Quiz test	
14	Project submission	

Text and Ref Books:

1. A Text Book of Electrical Technology (AC, DC Machines) –B L Theraja and A. K. Theraja.
2. Electronics Devices and Circuit Theory - R.L Boylsted; Prentice Hall of India Private Ltd.
3. Linear Control System Analysis and Design. - John J.D. Azzo&Constantine H. Houpis; McGraw- HillInternational

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

6.8. Dept of Industrial and Production Engineering

L-1, T-2

6.8.1. EECE 171: Basic Electrical and Electronic Circuit

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-1, Term-II

Pre-requisite: None.

Rationale:

To learn and familiarize the basics of electrical and electronic circuit as well as the application of this area of electrical engineering.

Course Contents:

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.

Objectives:

1. To become familiarized with the basic laws and theorems of AC and DC circuit.
2. To learn the basics of semiconductor and diodes and their applications in different engineering fields.
3. To get familiarized with all the rules required to solve basic circuit problems and apply them accordingly.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Implement** basic rules of circuit and know their application to solve different problems.
2. **Analyze** different simple and complex circuit networks, know and their uses in different engineering fields.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**

1-2	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-2	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Implement basic rules of circuit and know their application to solve different problems.	√											
2. Analyze different simple and complex circuit networks, know and their uses in different engineering fields.		√										

<u>Lectures Schedule</u>

Week 1		CT 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 divider and voltage divider rule.	
Week 4		CT 2
Class 10	Introduction: Concept of phasor and complex impedance / admittance (Lec-01)	
Class 11	Introduction: Concept of phasor and complex impedance / admittance (Lec-02)	
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-ciurcuited 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.	

Text and Ref Books:

1. Fundamentals of Electric Circuits – Matthew Sadiku, Charles Alexander
2. Electronic Device and Circuit Theories – Robert L. Boylstead
3. Introductory Circuit Analysis - Robert L. Boylstead
4. 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.**

6.8.2. EECE 172: Basic Electrical and Electronic Circuits Sessional

3.0 Contact Hour; 1.5 Credit Hour;
Level: 1st Year, **2nd** Semester
Pre-requisite: Fundamentals of Electrical and Electronic Circuits (EECE 171)
Rationale:
To learn and familiarize the basics of electrical circuit components as well as the analysis of DC and AC circuit practically.

Course Contents:

In this course students will get a hands on experience about electrical circuits. They will observe the uses of electrical circuits practically and can use this knowledge in future project works.

Objectives:

1. To learn about basic circuit components in building up and development of any required circuit.
2. To have the knowledge to design and implement basic circuit.
3. To learn to generate desired output of any circuit and analyze the outputs and compare them to find the most efficient condition of the basic circuits.
4. To compare the theoretical and practical values of circuit.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Apply** the knowledge of basic electrical components and networks practically.
2. **Analyze** the differences between theoretical knowledge with the practical observations.
3. **Design** different elementary circuit related projects using circuit theorems and components.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the knowledge of basic electrical components and networks practically.	√											
2. **Analyze** the differences between theoretical knowledge with the practical observations.		√										
3. **Design** different elementary circuit related projects using circuit theorems and components.			√									

<u>Lectures Schedule</u>

Weeks	Intended topics to be covered	Remarks
1	Construction & Operation of Simple Electrical Circuits	
2	Verification of KVL	
3	Verification of KCL	
4	Verification of Thevenin's Theorem	
5	Practice Lab-01	
6	Lab Test-01	
7	Familiarization with alternating current (ac) waves	
8	Study of R-L-C series circuit	
9	Different types of filters and its characteristics with different input	

	frequency	
10	Series Resonance and Parallel Resonance	
11	Practice Lab-02	
12	Lab Test-02	
13	Quiz test	
14	Viva	

Text and Ref Books:

1. Introductory Circuit Analysis - R.L. Boylestad; Prentice Hall of India Private Ltd.
2. Alternating Current Circuits- Russell M Kerchner and George F Corcoran; John Wiley & Sons.
3. 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.**

<u>L-2, T-2</u>

6.8.3. EECE 271: Electrical Machines and Electronics
3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-2, Term-I

Pre-requisite: None.

Rationale:
To gain basic knowledge on electrical machines and also their principle of operation, characteristics and applications.

Course Contents:

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.

Objective:
1. To understand basic operating principle of Electrical machines like DC motor, DC generator and Transformer etc.

2. To become acquainted with the applications of these machines in the power system
3. To learn about operational amplifiers and various applications of it.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Explain** the structure, operating principle and main features of Electrical Machines and their applications.
2. **Demonstrate** the basic concepts of electronic devices and switching devices.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**
1-2	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-2	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Explain the structure, operating principle and main features of Electrical Machines and their applications.	√											
2. Demonstrate the basic concepts of electronic devices and switching devices.		√										

Lecture Schedule:

Week 1	**DC Generator**	CT 1
Class 1	Basic idea about Electrical Machines, Introduction to DC generator and its principle of operation	
Class 2	Commutation principle and slip rings, Construction of DC generator and different parts	
Class 3	Lap winding and wave winding and its comparison, Emf equation of DC generator and related maths.	
Week 2	**DC Generator (Cont..)**	
Class 4	Types of DC generator, Mathematical problems of series-shunt configurations	
Class 5	Losses in DC generator and efficiency calculation, Mathematical problems related to loss and efficiency	
Class 6	Mathematical problems related to loss and efficiency (Cont..)	
Week 3	**DC Motor**	
Class 7	Introduction to DC motor	
Class 8	Construction and operating principle of DC motor	
Class 9	Differences between DC generator and DC motor	
Week 4	**DC Motor (Cont..)**	CT 2
Class 10	Back emf and related equations for DC motor	
Class 11	Flemings right hand rule and left hand rule	
Class 12	Speed control of DC motor, Torque –speed characteristics of DC motor	
Week 5	**Transformer**	
Class 13	Introduction to Transformer and its principle of operations, Types of transformer and ideal characteristics	
Class 14	Equivalent circuit of Transformer, Vector diagrams of transformer under different conditions	
Class 15	Mathematical problems of Transformer, Efficiency calculation and condition for maximum efficiency	
Week 6	**Transformer (Cont..)**	
Class 16	Losses in transformer and their explanations	
Class 17	Short circuit test and open circuit test of transformer	
Class 18	Parallel operation of transformer	
Week 7	**Alternator**	CT 3
Class 19	Synchronous Generator: Operating principle, Excitation systems of Synchronous Generator	

Class 20	Losses in Alternator, equivalent circuit of synchronous Generator	
Class 21	Emf equation of synchronous generator, Mathematical problems	
Week 8	**Synchronous Motor**	
Class 22	Synchronous motor: Operation	
Class 23	Vector diagrams of synchronous motor	
Class 24	effect of loading under different excitationcondition.	
Week 9	**Synchronous Motor (Cont..)**	
Class 25	Starting method of synchronous motor	
Class 26	effect of changing excitation, Armature reactions	
Class 27	Variations of power factor with armaturereactions, Mathematical Problems.	
Week 10	**Induction Motor**	
Class 28	Three phase induction motor: principle	
Class 29	Rotating magnetic field	
Class 30	Construction of squirrel cage IM, equivalent circuit	
Week 11	**Induction Motor (Cont..)**	
Class 31	vector diagram, torque-speed characteristics	
Class 32	no-load test, blocked rotor test	
Class 33	starting and braking, speed control	CT 4
Week 12	**Operational Amplifier**	
Class 34	Properties of Ideal Op-Amp, Inverting and Non-inverting Amplifiers	
Class 35	Inverting Integrators and Summer, Differentiator and Weighted summer, other applications of Op-Amp circuits	
Class 36	Mathematical Problems based on differentapplications of Om-Amp.	
Week 13	**SCR**	
Class 37	Introduction to power semiconductor switches, Introduction to triggering devices	
Class 38	Introduction to SCR and IGBT, Controlled single phase and threephase Rectifiers	
Class 39	Introduction to AC voltage controllers, Introduction to Single and three phase Choppers, Working principle of Single and three phase Choppers	
Week 14	**Transducer**	
Class 40	Introduction to instrumentation and measurement	
Class 41	Strain gauge construction and operating principle, temperature, pressure, speed and torque measurements	
Class 42	Review Class	

Text and Ref 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; Prentice Hall of India Private Ltd
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.**

6.8.4. EECE 272: Electrical Machines and Electronics Sessional

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: Electrical Machines and Electronics (EECE 271)
Rationale:
To learn and familiarize the basics of electrical DC & AC machines as well as some electronic devices and also analyze the construction and performance of these machines.
Course Contents:

In this course students will get a hands on experience about electrical machines. They will also learn to analyze different electrical machines for evaluating their operations and performances.

Objective:

1. To understand the construction and basic principle of DC & AC machines.
2. To analyze the properties DC machines and AC machines practically.
3. To get required idea about operational amplifier and its application practically.

Course Outcomes (CO)

Upon completion of all sessional, the students will be able to:

1. **Analyze** different machines with respect to theoretical knowledge.
2. **Identify** the performance of different machines experimentally.
3. **Apply** basic knowledge of operational amplifier to design a configuration for performing mathematical operations.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.
Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**

1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** different machines with respect to theoretical knowledge.		√										
2. **Identify** the performance of different machines experimentally					√							
3. **Apply** basic knowledge of operational amplifier to design a configuration for performing mathematical operations.				√								

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Introduction to the lab equipments and safety measures	
2	Expt-01: Regulation of the Transformer in Various Loads.	
3	Expt-02: Study the properties of DC Separately Excited Shunt Generator	
4	Expt-03: Study the properties of DC Self-Excited Shunt Generator	
5	Expt-04: Study the properties of DC Shunt Motor	
6	Expt-05: Study the properties of Three-Phase Alternator in various loads	
7	Expt-06: Study the Three-Phase Alternator synchronizing process in power utility system.	
8	Expt-07: Study the properties of Squirrel-Cage Induction Motor	
9	Expt-08: Mathematical operation using operational amplifier (Adder and Subtractor)	
10	Expt-09: Mathematical operation using operational amplifier (Integrator and Differentiator)	

11	Practice Lab	
12	Lab Test + Viva	
13	Quiz test	
14	Project submission	

Text and Ref 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; Prentice Hall of India Private Ltd

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

6.9. Dept of Environmental, Water Resources & Coastal Engineering (EWCE)

L-1, T-2

6.9.1. EECE 167: Basic Electrical Technology

3.00 Contact Hour; 3.00 Credit Hour;

Level: Level-1, Term-II

Pre-requisite: None.

Rationale:

To gain basic knowledge on basic AC and DC electrical circuits,electrical machines and also their principle of operation, characteristics and applications.

Course Contents:

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 multimeter. 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.

Objective:

1. To understand basic operating principle of Electrical machines like DC motor, DC generator and Transformer etc.
2. To understand basics of electrical circuits and different problem solving techniques.
3. To understand the concept of active, reactive and apparent powers, power factor and resonance in series and parallel circuits.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Apply** network theorems to simplify real life complex networks.
2. **Explain** the structure, operating principle and main features of Electrical Machines and their applications.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**
1-2	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-2	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Apply network theorems to simplify real life complex networks.	√											

2. Explain the structure, operating principle and main features of Electrical Machines and their applications.		√										

Lecture 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	CT 1
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 (Lec-01)	
Class 11	Introduction: Concept of phasor and complex impedance / admittance (Lec-02)	
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 (volt ampere)	
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.	CT 2
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	CT 3
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**	CT 4
Class 28	Introduction to semiconductor devices and its classifications	
Class 29	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 multimeter	
Class 36	Analysis of three phase circuits: Threephase supply	
Week 13	**Polyphase system**	
Class 37	Balanced and Unbalanced circuits, Power calculation (Lec-01)	
Class 38	Balanced and Unbalanced circuits, Power calculation (Lec-02)	
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	

Text and Ref Books:

1. Alternating-Current Circuitsby Russell M.; Corcoran, George F. Kerchner
2. Fundamentals of Electric Circuits by Charles Alexander, Matthew Sadiku

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

6.10. <u>Dept of Architecture</u>

<u>L-3, T-2</u>

6.10.1. Arch 3251: Building Services III: Electrical Equipment
2.00 Contact Hour; 2.00 Credit Hour;

Level: Level-3, Term-II

Pre-requisite: None.

Rationale:

To learn and familiarize the basics of electrical circuit components as well as the analysis of DC, AC circuits and Electrical wiring.

Course Contents:

Electrical units and standards, Electrical networks and circuit theorems.

Alternating current: RLC series and parallel circuits.

Introduction to electrical wiring for residential, commercial and industrial installations and buildings.
Illumination and different types of lighting.

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 (CO):

Upon completion of the course, the students will be able to:

1. **Apply** different laws of circuit theorems to solve various engineering problems.
2. **Analyze** different circuit related complex engineering problems efficiently.
3. **Apply** different electrical wiring techniques in practical building design.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment	**15**

	(Exam/Project)	
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** different laws of circuit theorems to solve various engineering problems.		√										
2. **Analyze** different circuit related complex engineering problems efficiently.		√										
3. **Apply** different electrical wiring techniques in practical building design.					√							

Lecture Schedule:

Week 1	**Fundamental Electric Concepts**	
Class 1	Electricity, Electric element and components, Electric Circuit, Current (AC or DC), Voltage	CT 1
Class 2	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	
Week 3	**Nodal Analysis**	
Class 7	Method of Obtaining Node voltages and super node analysis	
Class 8	Various mathematical problems solving nodal analysis	
Week 4	**Mesh Analysis**	CT 2
Class 10	Method of obtaining mesh currents using mesh analysis	
Class 11	Mathematical problems related to Mesh Analysis	
Week 5	**Network Theorem**	
Class 13	Superposition Theorem and applications	
Class 14	Thevenin’s Theorem Procedure and applications	
Week 6	**Network Theorem**	
Class 16	Norton’s Theorem and applications	
Class 17	Maximum power transfer theorem	

Week 7	**AC Current Analysis**	CT 3
Class 19	AC RLC Circuits	
Class 20	AC parallel circuits	
Week 8	**Electrical Wiring**	
Class 22	Introduction to electrical wiring	
Class 23	Rules and Regulations for electrical wiring	
Week 9	**Electrical Wiring**	
Class 25	Electrical wiring for residential buildings	
Class 26	Electrical wiring for residential buildings (continued)	
Week 10	**Electrical Wiring**	CT 4
Class 28	Electrical wiring for industrial buildings	
Class 29	Electrical wiring for industrial buildings (continued)	
Week 11	**Electrical Wiring**	
Class 31	Electrical wiring for commercial buildings	
Class 32	Electrical wiring for commercial buildings (continued)	
Week 12	**Electrical Wiring**	
Class 34	Cost estimation for electrical wiring of a building	
Class 35	Cost estimation for electrical wiring of a building (continued)	
Week 13	**Illumination**	
Class 37	Introduction to illumination	
Class 38	Illumination for different types of building	
Week 14	**Lighting**	
Class 40	Lighting	
Class 41	Different types of lighting	

Text and Ref 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

7.1 Department of Science and Humanities

7.1.1. Physics

L-1, T-1

Course: PHY-111: Wave & Oscillation, Optics and Thermal physics
3.00 Contact Hour; 3.00 Credit Hour
Level: Level-1, Term-I
Pre-requisite: None.

Rationale:
To learn and explain natural physical processes and related technological advances.

Course Contents:

Waves and oscillation: Differential equation of Simple harmonic oscillator, total energy and average energy, combination of Simple harmonic oscillations, spring mass system, and torsional pendulum; two body oscillations, reduced mass , damped oscillation, forced oscillation , resonance, progressive wave, power and intensity of wave, stationary wave, group and phase velocities.

Optics: Defects of images: spherical aberration, astigmatism, coma, distortion, curvature and chromatic aberration. Theory of light: Interference of light, Young's double slit experiment, displacement of fringes and its uses, Fresnel bi-prism. Interference in thin films, Newton's rings, Interferometers, diffraction by single slit, diffraction from a circular aperture, Resolving power of optical instrument, diffraction by double slits and N-slits, diffraction gratings, polarization of light: production and analysis of polarized light, Brewster's law, Malus law, polarization by double refraction Nicole prism, optical activity and polarimeters.

Thermal Physics: 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, 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 and Clapeyron equation.

Objectives:

1. To understand different parameters regarding waves and oscillations, optics and thermal physics.
2. To describe different laws and theories related to waves and oscillations, optics and thermal physics.
3. To apply different laws and theories to practical applications.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to:

1. **Define** different parameters regarding waves and oscillations, optics and thermal physics.
2. **Demonstrate** different laws and theories related to waves and oscillations, optics and thermal physics.
3. **Analyze** different laws and theories to practical applications.
4. **Solve** different problems associated waves and oscillations, optics and thermal physics.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Define** different parameters regarding waves and oscillations, optics and thermal physics.	√											
2. **Demonstrate** different laws and theories related to waves and oscillations, optics and thermal physics.	√	√										
3. Analyze different laws and theories to practical applications.	√	√	√									
4. Solve different problems associated waves and oscillations, optics and thermal physics	√	√	√	√								

Lecture Schedule:

Week 1		CT 1
Class 1	Introduction to waves and oscillations, vibrations	

Class 2	Simple harmonic motion (SHM) and its differential equations	
Class 3	Simple harmonic motion (SHM) and its differential equations related problems	
Week 2		
Class 4	Graphical representation of SHM	
Class 5	Average K.E and total energy	
Class 6	Spring-mass system	
Week 3		
Class 7	Simple, compound and torsional pendulum	
Class 8	Two body oscillations, reduced mass	
Class 9	Composition of two SHM	
Week 4		CT 2
Class 10	Composition of two SHM	
Class 11	Free, damped, forced and resonance vibrations	
Class 12	Wave motion and its different parameters	
Week 5		
Class 13	Energy of a wave	
Class 14	Stationary waves, group and phase velocities	
Class 15	Introduction to lens and its defects	
Week 6		
Class 16	Spherical aberration, astigmatism, coma, distortion, curvature and chromatic aberration	
Class 17	Huygen’s principle and construction	
Class 18	Interference of light, Young’s double slit experiment,	
Week 7		CT 3
Class 19	Displacement of fringes and its uses, Fresnel bi-prism	
Class 20	Interference in thin films, Newton’s rings, Interferometers	
Class 21	Diffraction by single slit, diffraction from a circular aperture	
Week 8		
Class 22	Diffraction by double slits and N-slits,	
Class 23	Diffraction gratings	
Class 24	Resolving power of optical instrument	
Week 9		
Class 25	Polarization of light, production and analysis of polarized light	
Class 26	Brewster’s law, Malus law	
Class 27	Polarization by double refraction	
Week 10		CT 4
Class 28	Nicole prism, optical activity and polarimeters	
Class 29	Kinetic theory of gases	

Class 30	kinetic interpretation of temperature	
Week 11		
Class 31	Specific heats of ideal gas	
Class 32	Equipartition of energy, mean free path	
Class 33	Maxwell's distribution of molecular speeds	
Week 12		
Class 34	Heat and work	
Class 35	Laws of thermodynamics	
Class 36	First law of thermodynamics and its applications	
Week 13		
Class 37	Reversible and irreversible process	
Class 38	Reversible and irreversible process	
Class 39	Second law of thermodynamics	
Week 14		
Class 40	Entropy, thermodynamics functions	
Class 41	Maxwell relations	
Class 42	Clausius-Clapeyron equation	

Text and Ref Books:

1."A Text Book of Optics" - Brijlal and Subramannyam
2. "Heat and Thermodynamics" -Brijlal and Subramannyam
3."A Text Book of Sound" - Brijlal and Subramannyam
4."Waves and oscillation"- Brijlal and Subramannyam
5."Fundamentals ofPhyscis"- Halliday, Resnick and Walker
6. "Physics part-I" - Resnick and Halliday
7."Physics part-II" - Resnick and Halliday

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

<u>L-1, T-2</u>

Course: PHY-113: Electricity & Magnetism, Modern physics and Mechanics.
3.00 Contact Hour; 3.00 Credit Hour
Level: Level-1, Term-II
Pre-requisite: None.

Rationale:
To understand and apply different parameters and laws regarding electricity, magnetism, modern physics and mechanics.

Course Contents:

Electricity & magnetism: Electricity: electric charges and Coulomb's law. Electric field E, concept of electric flux and the Gauss's law- some application of Gauss's law in vector form.Electric potential V, relation between V and E; capacitance and dielectrics.current, current density, resistivity. The Magnetic Field, Ampere's law, Biot-Savart law and their applications, Laws of electromagnetic induction-Maxwell's laws.

Modern physics: Galilean relativity and Einstein's special theory of relativity: Michelson Morley's experiment, Guliean transformation, Lorentz transformation equation, length contraction, time dilation, mass energy relation, photoelectric effect, Compton effect, de-Broglie matter waves and its success in explaining Bhor's theory, Pauli's exclusion principle. Constituents of atomic nucleus atomic, nuclear binding energy, different types of radioactivity, radioactive decay law, nuclear reactions, nuclear fission, nuclear fusion, and atomic power plant.

Mechanics: Linear momentum of a particle, .Linear momentum of system of particles, conservation of linear momentum, some applications of the momentum particle; angular momentum of system of particles, Keplar's law of planetary motion, the laws of universal gravitation, the motion of planets and satellites. **Introduction of quantum mechanics:** wave function, uncertainty principle, postulates, Schrodinger's time dependent equation, expectation value, probability, particle in a zero potential box, calculation of energy.

Objectives:

1. To understand different parameters regarding electricity, magnetism, modern physics and mechanics.
2. To describe different laws and theories related toelectricity, magnetism, modern physics and mechanics.
3. To apply different laws and theories to practical applications.

Course Outcomes (CO):
Upon successful completion of the course, the students will be able to:
1. **Define** different parameters regarding electricity, magnetism, modern physics and mechanics.
2. **Demonstrate** different laws and theories related toelectricity, magnetism, modern physics and mechanics.
3. **Analyze** different laws and theories to practical applications.
4. **Solve** different problems associated electricity, magnetism, modern physics and mechanics.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment	**15**

	(Exam/Project)	
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Define** different parameters regarding electricity, magnetism, modern physics and mechanics.	√											
2. **Demonstrate** different laws and theories related to electricity, magnetism, modern physics and mechanics.	√	√										
3. Analyze different laws and theories to practical applications.	√	√	√									
4. Solve different problems associated electricity, magnetism, modern physics and mechanics.	√	√	√	√								

Lecture Schedule:

Week 1		CT 1
Class 1	Electric charges and Coulomb's law	
Class 2	Electric field, field lines	
Class 3	Electric field due to charges	
Week 2		
Class 4	Electric field due to charged objects	
Class 5	Electric flux	
Class 6	Gauss's law and related problems	
Week 3		
Class 7	Electric potential and related problems	
Class 8	Electric potential and related problems	
Class 9	Capacitance and derivation of capacitance of different capacitors	
Week 4		CT 2
Class 10	Dielectrics	
Class 11	Current and resistance, Ohm's law	
Class 12	Different parameters of magnetic properties	

Week 5		
Class 13	Classification of magnetic materials	
Class 14	Discussion on magnetization curves	
Class 15	Galilean and Lorentz transformation	
Week 6		
Class 16	Theory of relativity: length contraction, time dilation, velocity addition	
Class 17	relative mass, Mass and Energy relation	
Class 18	Concept of Massless particle and its expression.	
Week 7		CT 3
Class 19	Photoelectric Effect and its related parameter.	
Class 20	Compton effect and its related parameter.	
Class 21	De Broglie wave concept, Uncertainty principle, Bohr atom model	
Week 8		
Class 22	Bohr radius of the hydrogen atom, energy levels	
Class 23	Composition of atomic nucleus, Classification of Nucleus,	
Class 24	Nuclear binding energy	
Week 9		
Class 25	Radioactivity, Radioactive transformation	
Class 26	Radioactive Decay Law, half life,	
Class 27	Nuclear reaction, Fusion, Fission and nuclear chain reaction	
Week 10		CT 4
Class 28	Nuclear reactor	
Class 29	Linear momentum of a particle.	
Class 30	Linear momentum of system of particles. Conservation of linear momentum.	
Week 11		
Class 31	Some applications of the momentum particle; angular momentum of system of particles.	
Class 32	Keplar's law of planetary motion.	
Class 33	Derivation of Keplers' 2^{nd} law.	
Week 12		
Class 34	Derivation of Keplers' 3^{rd} law.	
Class 35	The motion of planets and satellites	
Class 36	The laws of universal gravitation.	
Week 13		
Class 37	Introduction of quantum mechanics.	
Class 38	Uncertainty principle, expectation value, probability.	
Class 39	Schrodinger's time dependent and time independent wave equation.	
Week 14		
Class 40	Particle in a zero potential box.	
Class 41	Calculation of energy.	
Class 42	wave function and postulates.	

Text and Ref Books:

1. “Elementary solid state physics” -M.AliOmar,person education.
2. “Introduction solid state physics” -C.Kittle; John Wilry,& Sons Inc.
3. “Concept of Modern Physics ”-ArtherBeiser; McGraw Hill .
4. “Perspective of Modern Physics” -ArtherBeiser; McGraw Hill
5. “Modern Physics” -B.L Theraja.
6. “ Physics part-I” - Resnick and Halliday
7. “Physics part-II” - Resnick and Halliday
8. “Fundamentals of Physcs”- Halliday, Resnick and Walker

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

PHY-114: Physics Laboratory
3.00 Contact Hour; 1.50 Credit Hour
Level: Level-1, Term-II
Pre-requisite: PHY 111 and PHY 113

Rationale:
To understand and apply different parameters and laws regarding electricity, magnetism, modern physics and mechanics practically.

Course Contents:

Different experiments related to course Phy-111 and Phy-113.

Objectives:
1. To understand different parameters regarding electricity, mechanics, waves and oscillations, thermal
physics and optics.
2. To do team work.
3. To apply different laws and theories to practical applications.
4. To write a project report.

Course Outcomes (CO):
Upon successful completion of the course, the students will be able to:
1. **Define** different parameters regarding electricity, mechanics, waves and oscillations, thermal
physics and optics
2. **Analyze** different laws and theories to practical applications.
3. W**rite** a project report.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-3	Conduct of Lab Test /Class Performance	**25%**
1-3	Report Writing/ Programming	**15%**
1-3	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-3	Final Evaluation (Exam/Project/assignment)	**30%**
1-3	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Define** different parameters regarding electricity, mechanics, waves and oscillations, thermal physics and optics.	√											
2. **Analyze** different laws and theories to practical applications.	√	√										
3. W**rite** a project report.	√	√	√	√								

Lecture Schedule

Weeks	Intended topics to be covered	Remarks
1	Orientation and Introductory lecture	
2	Experiment no-1	
3	Experiment no-2	
4	Experiment no-3	
5	Experiment no-4	
6	Experiment no-5	
7	Experiment no-6	
8	Experiment no-7	
9	Experiment no-8	
10	Experiment no-9	
11	Revision class and final lecture	

12	Final exam & viva voce	
13	Final exam & viva voce	
14	Quiz exam	

Text and Ref Books:

1. "Practical Physics" by – Dr. Giasuddin.

2. "Practical Physics" by – C.L Arora.

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

Mathematics

L -1, T-1

1. MATH-111: Differential and Integral Calculus

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None

Course Contents:
Limit, continuity and differentiability, successive differentiation, Leibnit'z theorem, Rolle's theorem, Mean-value theorem, Taylor's theorem, expansions of functions differentiation and integration, indeterminate form, Partial differentiation, Euler's theorem, tangent and normal in Cartesian and polar coordinates, maxima and minima of functions of single variables, curvature, asymptotes.

Definition of integrations, integration by the method of substitution, integration by parts, standard integrals, definite integrals and its use in summing series, reduction and more reduction formula, Walli's formula, improper integrals, beta function and gamma function, multiple integral and its application, area, volume of solid revolution, area under a plain curve in Cartesian and polar coordinates, area of the region enclosed by two curves in Cartesian and polar coordinates, arc lengths of curves in Cartesian and polar coordinates.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Define** and solve the problems of the limit, continuity and differentiability of functions.
2. **Identify** the rate of change of a function with respect to independent variables.
3. **Learn** the behavior of function.
4. **Describe** the different techniques of evaluating indefinite and definite integrals.
5. **Calculate** the length, area, volume, center of gravity and average value related to engineering study.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-6	Class Tests/Assignments	**20**
1-6	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-6	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course		Program Outcome											
		1	2	3	4	5	6	7	8	9	10	11	12
1.	**Define** and solve the problems of the limit, continuity and differentiability of functions.	√	√										
2.	**Identify** the rate of change of a function with respect to independent variables.	√	√										
3.	**Learn** the behavior of function.	√	√	√									
4.	**Describe** the different techniques of evaluating indefinite and definite integrals.	√	√										
6.	**Calculate** the length, area, volume, center of gravity and average value related to engineering study.	√	√										

Text and Ref Books:

1. A Text Book on Differential Calculus - Mohammad &Bhattacharjee; Students' Publication.
2.Differential Calculus – M. L. Khanna; JoiProkashNath and Company.
3.Differential Calculus – Shanti Narayan; S. Chand and Company Ltd.
4.A Text Book on Integral Calculus - Mohammad &Bhattacharjee; Students' Publication.
5.Integral Calculus – Das and Mukherjee; U.N. Dhur and Sons Pvt. Ltd, Calcutta.
6.Integral Calculus – M. L. Khanna; JoiProkashNath and Company.

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

L-1, T-2

2. MATH-115: Vector Analysis, Matrices and Coordinate Geometry
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: Electrical Circuit Analysis

Course Contents:
Vector analysis: Definition of vector, Equality of direction ratios and vectors, Addition and multiplication of vectors, Triple products and multiple products, Differentiation of vectors, Gradient of scalar functions, Divergence and curl of point functions, Physical significance of gradient, divergence and curl, integration of vectors (line, surface and volume integrals); Green's, Stoke's and Gauss's theorem and their application.

Matrices: Definition of matrix, algebra of matrices, multiplication of matrices, transpose of a matrix, inverse of matrix, rank and elementary transformation of matrices, solution of linear equations, linear dependence and independence of vectors, quadratic forms, matrix polynomials, determination of characteristic roots and vectors, null space and nullity of matrix, characteristic subspace of matrix.

Two Dimensions: Transformation of co-ordinates, equation of conics, its reduction to standard forms, pair of straight lines, homogeneous equations of second degree, angle between straight lines, pair of lines joining the origin to the point of intersection of two given curves, circles and system of circles, orthogonal circles, radical axis and its properties, radical centers, coaxial circles and limiting points, equations of parabola, ellipse in Cartesian and polar coordinates.

Three Dimensions: System of coordinates, projection, direction cosines, equations of planes and lines, angle between lines and planes, distance from a point to a plane, co-planner lines.Shortest distance between two given straight lines, standard equation of conicoides, sphere and ellipsoid.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Learn** the physical explanation of different vector notation.
2. **Explain** differentiation and integration of vector valued functions in cartesian, cylindrical and spherical geometry.
3. **Calculate** length, volume and area of objects related to engineering study by using vector.
4. **Find** the technique to obtained the inverse matrix that solve the system of linear equations.
5. **Understand** the nature of the vectors in a vector space.
6. **Solve** the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc.
7. **Apply** the knowledge of geometry in engineering study.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
3-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
5-7	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
Learn the physical explanation of different vector notation.	√	√										

Explain differentiation and integration of vector valued functions in cartesian, cylindrical and spherical geometry.	√	√										
Calculate length, volume and area of objects related to engineering study by using vector..	√	√	√									
Find the technique to obtained the inverse matrix that solve the system of linear equations.	√	√										
Understand the nature of the vectors in a vector space.	√	√										
Solve the problems of the pair of straight lines, circles, system of circles, parabola, ellipse etc.	√	√										
Apply the knowledge of geometry in engineering study.	√											

Text and Ref Books:

1. Vector analysis - Dr. Muhammad AbdusSattar; Ali Publication.
2. Vector analysis - Murray R Spiegel (Schaum Series); McGraw-Hill.
3. Matrices and Linear Transformations – Mohammad Iman Ali; Imans Mathematical Publication.
4. Martices – Frank Ayres, Jr(Schaum Series); McGraw-Hill
5. A text Book on Co-ordinate Geometry (Two and Three Dimensions) with vector analysis.- Rahman & Bhattacharjee

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

<u>L-2, T-1</u>

3. Math-211: **Ordinary and Partial Differential Equations**
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-I
Pre-requisite: None.

Course Contents:
Formulation of Differential Equations.Degree and order of Ordinary differential equations, Solution of first order but higher degree differential equations Solution of first order differential equations by various methods Solution of general linear equations of second and higher orders with constant co-efficient.Solution of Homogeneous linear equations and its applications. Solution of differential equations by the methods based on the factorization of the operators, Frobenious methods, Bessel's functions, Legendre's polynomials and properties.

Introduction, Linear and non-linear first order equations. Standard forms of linear equations of higher order, Equation of second order with variable coefficients. Wave equations, Particular solutions with boundary and initial conditions, Integral surface passing through given curve; Nonlinear PDE of order One (Complete, particular, singular and general integrals), Charpit's Method, Second order PDE and classifications to canonical (standard)-parabolic, elliptic, hyperbolic solution by separation of variables, Linear PDE with constant coefficients.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Identify** differential equations of various types
2. **Solve** different types of differential equations
3. **Analyze** the classifications of partial differential equations.
4. **Apply** the boundary value problems in Engineering fields.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Identify differential equations of various types	√	√										
2. Solve different types of differential equations	√	√										

3. Analyze the classifications of partial differential equations.	√	√	√									
4. Apply the boundary value problems in Engineering fields.	√	√										

Text and Ref Books:

1.Differential Equation – M.D. Raisinghania
2.Differential Equation -Schaum's Series; McGraw-Hill.

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

<u>L-2, T-2</u>

4. Math-213: Complex Variable & Statistics
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2, Term-II
Pre-requisite: None

Course Contents:

Complex Variables:
Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Complex function, differentiation and the Cauchy-Riemann Equations, Convergence and uniform convergence, Line integral of a complex function, Cauchy' s Integral Formula, Liouville's Theorem, Taylors and Laurents Theorem, Singular Residues, Cauchys Residue Theorem.

Statistics:
Introduction.Sets and probability.Random variable and its probability distribution.Treatment of grouped sampled data.Some discrete probability distribution.Normaldistribution.Samplingtheory.Estimationtheory.Tests of hypothesis, regression, and correlation. Analysis of variance

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

1. **Apply** the concept of limit, continuity, differentiability and analyticity of complex functions**,** categorize and integrate the complex functions by line integrals Cauchy's integral formulae and Cauchy's residue theorem.
2. Presenting data in easy way in which information can easily be **expressed** in numerical form and it makes the understandable to the student.
3. **Collect** and compare data on specific field and analysis, interpretation and finally take the best decision among alternative.

4. **Learn** sampling theory and different test in which giving concept about future situation.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Apply** the concept of limit, continuity, differentiability and analyticity of complex functions**,** categorize and integrate the complex functions by line integrals Cauchy's integral formulae and Cauchy's residue theorem.	√	√										
2. Presenting data in easy way in which information can easily be **expressed** in numerical form and it makes the understandable to the student.	√	√										
3. **Collect** and compare data on specific field and analysis, interpretation and finally take the best decision among alternative.	√	√	√									
4. **Learn** sampling theory and different test in which giving concept about future situation.	√	√										

Text and Ref Books:

1.Complex Variables – Frank Ayres (Schaum's Outline Series); McGraw-Hill.
2.Functions of Complex Variables – Dewan Abdul Kuddus; TitasPrakashani, Dhaka.
3.Functions of Complex Variables – Goyal and Gupta; ProgotiProkashan, Meerut.
4. Statistics and Probability - Spiegel (Schaum Series); McGraw-Hill.
5.Business Statistics - M.P. Gupta and S.P. Gupta; Sultan Chand and Sons.

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

7.1.2.<u>Humanities</u>

<u>L-1, T-1</u>

1. Hum-127
Sociology and Engineering Ethics/Moral Philosophy
Credit Hr- 3.00, Contract Hr-3.00

<u>SECTION A (SOCIOLOGY)</u>

Basic concepts of sociology; Science, technology and social evolution; Globalization and changing world; Techniques of production, Culture and civilization, Population and world resources; Historical background of emergence of Bangladesh; Groups and Organizations; Government and Politics.

Socialization;Poverty social exclusion and welfare; Women and Development; Crime, deviance and social control; Environment and risk; Sustainable development; Rural sociology; Family urbanization and industrialization; Urban ecology; Collective behavior and social movements.

<u>SECTION B: ENGINEERING ETHICS</u>

Introduction to Engineering ethics and professionalism; History and development of engineering ethics and Ethical theories; Moral Reasoning and Codes of Ethics; Moral Frameworks for Engineering Ethics; Applied ethics in engineering: Case Studies of ethics and Ethical Problem-Solving Techniques; Risk, Safety, and Accidents; Engineer's Responsibilities and Rights; Human qualities of an engineer. Obligation of an engineer to the clients. Attitude of an engineer to other engineers. Measures to be taken in order to improve the quality of engineering profession. Ethical expectation: Employers and employees, inter-professional relationship, Professional Organization – maintaining a commitment of ethical standards. Desired characteristics of a professional code. Institutionalization of ethical conduct. Environmental Ethics;

<u>Reference:</u>

1.Sociology by Richard Schaefer

2.Sociology by Anthony Giddens
3.Sociology by C N Shankar Rao
4.Engineering ethics by Charles B. Fleddermann

2. CHEM -101:Chemistry I
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None.
Rationale:
To learn the basic concepts of inorganic, organic and physical chemistry.

Course Contents:

Concepts of atomic structure, Different atom models, Quantum numbers, Electronics configuration, Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases, Chemical bonding (types, properties, Lewis theory, VBT, MOT), Hybridization and shapes of molecules, Selective organic reactions such as - addition, substitution, oxidation- reduction, alkylation and polymerization, Phase rule, Phase diagram of mono component system.
Solutions and their classification, Unit expressing concentration, Colligative properties of dilute solutions, Thermo chemistry, Chemical kinetics, Chemical equilibrium, pH and buffer solutions, Electrical properties of solution and Eletro-chemical cell reactions.

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 (CO):
Upon completion of the course, the students will be able to:
1. **Define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.
2. **Define** the different types of solutions.
3. **Apply** different theory on chemical bonding and hybridization to evaluate structure of molecules.
4. **Classify** and **explain** Phase rule, Phase diagram of mono component system.
5. **Explain** chemical equilibrium, thermochemistry, chemical and ionic equilibria, electrochemical cells.
6. **Describe** basic reaction mechanism of selective organic reactions.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
3-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
5-6	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Define** the different parameter and concepts regarding atomic structure, periodic table, chemical bonding, acids and bases.	√											
2. **Define** the different types of solutions.	√											
3. **Apply** different theory on chemical bonding and hybridization to evaluate structure of molecules.	√											
4. **Classify** and **explain** Phase rule, Phase diagram of mono component system.	√											
5. **Explain** chemical equilibrium, thermochemistry, chemical and ionic equilibria, electrochemical cells.		√										
6. **Describe** basic reaction mechanism of selective organic reactions.			√									

Lecture Schedule:

Week 1	**Atomic Structure**	
Class 1	Concepts of atomic structure, Different atom models	CT 1

Class 2	Concepts of atomic structure, Different atom models	
Class 3	Quantum numbers	
Week 2	**Periodic table**	
Class 4	Periodic classification of elements, Periodic properties of elements	
Class 5	Periodic classification of elements, Periodic properties of elements	
Class 6	Properties and uses of noble gases	
Week 3	**Chemical bonding**	
Class 7	Chemical bonding (types, properties, Lewis theory, VBT, MOT)	
Class 8	Chemical bonding (types, properties, Lewis theory, VBT, MOT)	
Class 9	Chemical bonding (types, properties, Lewis theory, VBT, MOT)	
Week 4	**Chemical bonding**	CT 2
Class 10	Hybridization and shapes of molecules	
Class 11	Hybridization and shapes of molecules	
Class 12	Hybridization and shapes of molecules	
Week 5	**Basic Organic Chemistry**	
Class 13	Selective organic reactions such as - addition	
Class 14	Selective organic reactions such as -substitution	
Class 15	oxidation- reduction	
Week 6	**Basic Organic Chemistry**	
Class 16	Oxidation- reduction	
Class 17	Alkylation	
Class 18	Polymerization	
Week 7	**Phase Rule and Phase Diagram**	CT 3
Class 19	Phase rule, Phase diagram of mono component system	
Class 20	Phase rule, Phase diagram of mono component system	
Class 21	Phase rule, Phase diagram of mono component system	
Week 8	**Solution and Properties of the Dilute Solution**	
Class 22	Solutions and their classification, Unit expressing concentration	
Class 23	Solutions and their classification, Unit expressing concentration	
Class 24	Colligative properties of dilute solutions	
Week 9	**Properties of the Dilute Solution and Thermo-chemistry**	
Class 25	Colligative properties of dilute solutions	
Class 26	Colligative properties of dilute solutions	
Class 27	Thermo chemistry	
Week 10	**Thermo-Chemistry and Chemical Kinetics**	CT 4
Class 28	Thermo chemistry	

Class 29	Thermo chemistry	
Class 30	Chemical kinetics	
Week 11	**Chemical Kinetics and Chemical Equilibrium**	
Class 31	Chemical kinetics	
Class 32	Chemical kinetics	
Class 33	Chemical equilibrium	
Week 12	**Chemical Equilibrium and Buffer Solution**	
Class 34	Chemical equilibrium	
Class 35	Chemical equilibrium	
Class 36	pH and buffer solutions	
Week 13	**Buffer Solution and Electro Chemistry**	
Class 37	pH and buffer solutions	
Class 38	Electrical properties of solution	
Class 39	Electrical properties of solution	
Week 14	**Electro Chemistry**	
Class 40	Eletro-chemical cell reactions	
Class 41	Eletro-chemical cell reactions	
Class 42	Eletro-chemical cell reactions	

Text and Ref Books:

1.Principles of Physical Chemistry – Haque&Nawab; Students' Publications.
2.Fundamentals of Physical Chemistry- Samuel H. Maron& Jerome B. Lando; MacMillan Publishing Co., Inc., Newyork.
3.Physical Chemistry P. W. Atkins; Oxford University Press.
4.Essentials of Physical Chemistry- B.S. Bahl& G.D. Tuli; S. Chand and Company Ltd.
5.General Chemistry- Ebbing; Houghton Mifflin Company.
6.Organic Chemistry – M. Ahmed &JabbarMian; Mrs. Sufia Ahmed and Mrs. Jahan-Ara Begum.
7.Organic Chemistry- IL Finar; ELBS Longman Group Ltd.
8.Organic Chemistry- Morison & Boyd; Prentice Hall of India.
9.Introduction to Modern Inorganic Chemistry – S.Z. Haider; Friend's International.
10. Modern Inorganic Chemistry – R. D. Madan; S. Chand and Company Ltd.
11. Advanced Inorganic Chemistry – F. Albert Cotton &Geoffey Wilkinson; John Wiley & Sons.

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

3. CHEM – 114 :Inorganic Quantitative Analysis Laboratory
Credit Hr-1.50, Contract Hr-3.00
3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: Chemistry I (CHEM -101)
Rationale:

To learn the basic concepts of inorganic, organic and physical chemistry.

Course Contents:
Volumetric analysis: Acid-base titration, Oxidation-reduction titration: Determination of Cu, Fe and Ca content volumetrically.

Objective:

Course Outcomes (CO):

Upon completion of all sessional, the students will be able to:

1. **Define**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.
2. **Explain** the different phenomena regarding iodimetric and iodometric method, complexometric titration etc.
3. **Estimate** zinc, ferrous content in water sample by using various titrimetric methods.
4. **Summarize** a report of any project work and apply in real life.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-4	Conduct of Lab Test /Class Performance	**25%**
1-4	Report Writing/ Programming	**15%**
1-4	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-4	Final Evaluation (Exam/Project/assignment)	**30%**
1-4	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Define** 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.	√											
2. **Explain** the different phenomena regarding iodimetric and iodometric method, complexometric titration etc.		√										
3. **Estimate** zinc, ferrous content in water sample by using various titrimetric methods.			√									
4. **Summarize** a report of any project work and apply in real life.				√								

Lectures Schedule

Weeks	Intended topics to be covered	Remarks
1	Introduction	
2	Standardization of Sodium Hydroxide (NaOH) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) Solution.	
3	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Hydroxide (NaOH) Solution.	
4	Standardization of Hydrochloric Acid (HCl) Solution with Standard Sodium Carbonate (Na_2CO_3) Solution.	
5	Determination of Calcium (Ca) Content in a Calcium Chloride dihydrate ($CaCl_2.2H_2O$) Solution with Standard Di-Sodium Ethylene DiammineTetraAceticAcid (Na_2EDTA) Solution.	
6	Standardization of Sodium ThiosulphatePentahydrate ($Na_2S_2O_3.5H_2O$) Solution with Standard Potassium Dichromate ($K_2Cr_2O_7$) Solution.	
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.	
8	Standardization of Potassium Permanganate ($KMnO_4$) Solution with Standard Oxalic Acid dihydrate ($C_2H_2O_4.2H_2O$) Solution.	
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.	
10	Determination of Zinc (Zn) Content in a Zinc SulphateHeptahydrate ($ZnSO_4 .7H_2O$) Solution with Standard Di-Sodium EDTA (Na_2-EDTA) Solution by using Eriochrome black T indicator.	
11	Practice Lab	
12	Lab Test	
13	Quiz Test	
14	Viva	

Text and Ref Books:

1.Principles of Physical Chemistry – Haque&Nawab; Students' Publications.
2.Fundamentals of Physical Chemistry- Samuel H. Maron& Jerome B. Lando; MacMillan Publishing Co., Inc., Newyork.
3.Physical Chemistry P. W. Atkins; Oxford University Press.
4.Essentials of Physical Chemistry- B.S. Bahl& G.D. Tuli; S. Chand and Company Ltd.
5.General Chemistry- Ebbing; Houghton Mifflin Company.
6.Organic Chemistry – M. Ahmed &JabbarMian; Mrs. Sufia Ahmed and Mrs. Jahan-Ara Begum.
7.Organic Chemistry- IL Finar; ELBS Longman Group Ltd.
8.Organic Chemistry- Morison & Boyd; Prentice Hall of India.
9.Introduction to Modern Inorganic Chemistry – S.Z. Haider; Friend's International.
10. Modern Inorganic Chemistry – R. D. Madan; S. Chand and Company Ltd.
11. Advanced Inorganic Chemistry – F. Albert Cotton &Geoffey Wilkinson; John Wiley & Sons.

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

<u>L-1, T-II</u>

4. Hum-177
Fundamental of Economics
Credit Hr- 3.00, Contract Hr-3.00

SECTION A

Microeconomics: Definition of economics; Fundamentals of economics; Market and government in a modern economy; Basic elements of supply and demand; Choice and utility;

indifference curve technique; Analysis of cost; Short run long run theory of production; Analysis of Market; Optimization; Theory of distribution

SECTION B

Macroeconomics:keyconcept of macroeconomics**;** Saving, consumption, investment; National income analysis; Inflation, Unemployment; Fiscal and monetary policy.
Development: Theories of developments**;** Economic problem of developing countries; Planning in Bangladesh

Reference:

1.Economics by Samuelson
2.Economics by John Sloman
3.Economic Development by Michael Todaro

L-2, T-1

5. Hum 235: English

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None.

Course Contents:

General discussion: Introduction, various approaches to learning English, Grammatical Problem: Construction of sentences, grammatical errors, sentence variety and style, conditionals, vocabulary and diction; Reading Skill: Discussion readability, scan and skin reading, generating ideas through purposive reading, reading selective stories, Approaches to Communication: Communication today, business communication, and different types of business communication, Listening Skill: The phonetics and correct English pronunciation, Speaking Skill: Practicing dialogue, story telling.

Writing Skill: Principles of effective writing, organization, planning and development of writing, composition (Paragraph, Comprehension), précis writing, amplification, General Strategies for the Writing process: Generating ideas, identifying audiences, and purposes, construction arguments, stating problems, drafting and finalizing, Report Writing: Defining a report, classification of reports, structure of a report and writing of report.

Course Outcomes (CO):

1. **Organize** themselves within the shortest possible time to present their ideas and opinions,
2. **Understand** and speak English quickly and smartly using the technics learnt in the class
3. **Apply** the technics to find out the main points of any long article within a very limited time as well as know the technics of any effective writing. In short with consistent practice they will be able to overcome language barrier.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcome**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Organize** themselves within the shortest possible time to present their ideas and opinions,									√			√
2. **Understand** and speak English quickly and smartly using the technics learnt in the class										√		√
3. **Apply** the technics to find out the main points of any long article within a very limited time as well as know the technics of any effective writing. In short with consistent practice they will be able to overcome language barrier.		√							√	√		√

Text and Ref Books:

1. Prose of Our Time-AhsanulHaque, Serajul Islam Chowdhury& M. Shamsuddoha; NawrozeKitabistanBanglabazar, New Market.
2.A Guide to Correct speech- S.M. Amanullah;
3.Business Correspondence and Report Writing –R.C. Sharma & Krishna Mohan; Tata McGraw- Hill Publishing Company Ltd.

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

L-2, T-I

6. Hum 272: Developing English Skills Laboratory
3.00 Contact Hour; 1.5 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None.

Course Contents:
Listening skills and note taking: Listening to recorded texts and class lectures and learning to take useful notes based on listening; Developing speaking skill: Communicative expressions for personal identification, life at home, giving advice and opinion, instruction and directions, requests, complains, apologies, describing people and places, narrating events, Tutorial Discussion – On a given topic to test the proper use of phonetics, pronunciation, grammar, logic and confidence; Public Speaking – Demonstration by teacher for a short specific period, speaking by students (each student minimum twice) on different but easy given topic well in advance as per a schedule maximum for 3.00 to 4 minutes for each student; Extempore – Minimum two presentations by each student for a duration of maximum 3.00 to 4 minutes; Debriefing on public speaking and extempore presentation ; Presentation – On a given professional topic or on a given research paper using power point for 40 minutes followed by question and answer session, Group presentation on different given topics by the students using power point.

Course Outcomes (CO):
Upon completion of the course, the students will be able to:

4. **organize** themselves within the shortest possible time to present their ideas and opinions,
5. **understand** and speak English quickly and smartly using the technics learnt in the class
6. **apply** the technics to find out the main points of any long article within a very limited time as well as know the technics of any effective writing. Students will be able to prepare report on any issue and present it in front of others. They will be able to speak fluently on any topic. In short with consistent practice they will be able to overcome language barrier.

Teaching-learning and Assessment Strategy: Lecture, Class Performance,Assignment, Group Work,Group/Individual Presentation, Debate/Public Speaking

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	**Assessment Method**	**(100%)**
	Class Assessment	
1-3	Class Performance	**10%**

	/observation	
1-3	Written Assignment	**15%**
1-3	Oral Performance	**25%**
1-3	Listening Skill	**10%**
1-3	Group Presentation	**30%**
1-3	Viva Voce	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Organize** themselves within the shortest possible time to present their ideas and opinions,									√			√
2. **Understand** and speak English quickly and smartly using the technics learnt in the class										√		√
3. **Apply** the technics to find out the main points of any long article within a very limited time as well as know the technics of any effective writing. Students will be able to prepare report on any issue and present it in front of others. They will be able to speak fluently on any topic. In short with consistent practice they will be able to overcome language barrier.		√							√	√		√

Text and Ref Books:

1. Introduction to Linguistics – Prof Dr. Maniruzzaman.
2. A Guide to Correct Speech – S M Amanullah
3. Oxford Advanced Learners' Dictionary
4. English Grammar in Use – Raymond & Murphy
5. From Paragraph to Essay - Maurice Imhoof and Herman Hudson
6. Headway Series – Advanced Level (2 parts with CDs): Oxford University Press Ltd.
7. IELTS and TOEFL practice book – Cambridge University Press

L-2, T-I

7. Hum 279 Financial and Managerial Accounting
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None.
Rationale:
To learn and familiarize the basics of electrical circuit components as well as the analysis of DC circuits.

Pre-requisite: None

Rationale:

This course introduces the preliminaries of accounting principles, cost classification and a variety of financial analysis - ratio analysis, capital budgeting, break-even analysis, cost-volume-profit analysis, contribution margin analysis etc. that is helpful for making important decisions of the management control system of any organization or business.

Objective:

1. To discuss the fundamentals of accounting, the use and effects of financial statement for a particular organization.
2. To analyze different types of cost and cost management for different components of a management control system or a business.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:
1. Discuss, describe and interpret a financial accounting statement and the use of financial ratios. The student should be able to understand how the reporting might be affected by a particular (creative) business.
2. Enhance the various elements of a management control system (role, scope, drawbacks, implementation etc.).
3. Determine the variety of cost concepts to be applied in a management control system.
4. Select and analyze the nature of a business and outline main features of an appropriate control system.

Course Content:
Financial Accounting: Objectives and importance of accounting; Accounting as an information system. Computerized system applications in accounting. Recording system,

double entry mechanism; account and their classification; Accounting equation: Accounting cycle: Journal, ledger, trial balance. Preparation of financial statements considering adjusting and closing entries; Accounting concepts (principles) and conventions. Financial statement analysis and interpretation: Ratio analysis. Cost and Management Accounting: Cost concepts and classification; Overhead cost: meaning and classification; Distribution of overhead cost: Overhead recover method/rate; Job order costing: preparation of job cost sheet and question price, Inventory valuation: absorption costing and marginal/variable costing technique; Cost-Volume-Profit analysis: meaning, break-even analysis, contribution margin analysis sensitivity analysis. Short-term investment decisions; relevant and differential cost analysis. Long-term investment decisions: capital budgeting, various techniques of evaluation of investments.

Teaching-learning and Assessment Strategy:

Lectures, class performances, assignments, presentation, class tests, final exam.

Linkage of CO with Assessment Methods & their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-4	Class Tests/Assignments	**20**
1-4	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-4	Final exam	**60**

Mapping of Course Outcomes (CO) and Program Outcomes:

Course Outcomes(CO) of the Course	Program Outcome (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Discuss, describe and interpret a financial accounting statement and the use of financial ratios. The student should be able to understand how the reporting might be affected by a particular (creative) business.	√											
2.Enhance the various elements of a management control system (role, scope, drawbacks, implementation etc.).								√				
3. Determine the variety of cost concepts to be applied in a management control system.						√			√			
4. Select and analyze the nature of a business											√	

and outline main features of an appropriate control system.												

Lecture Schedule

Week	Lecture	Topics	Class Test
1	Lec 1 Lec 2 Lec 3	Financial Accounting Objectives of Accounting Importance of Accounting	
2	Lec 4 Lec 5 Lec 6	Accounting as an Information System. Computerized Applications in Accounting Computerized Applications in Accounting (Contd.)	**Class Test 1**
3	Lec 7 Lec 8 Lec 9	Recording System Double Entry Mechanism Double Entry Mechanism (Contd.)	
4	Lec 10 Lec 11 Lec 12	Account Classification Accounting Equation Account Cycle	
5	Lec 13 Lec 14 Lec 15	Journal Ledger Trial Balance	**Class Test 2**
6	Lec 16 Lec 17 Lec 18	Financial Statement Preparation Adjusting Entries Closing Entries	
7	Lec 19 Lec 20 Lec 21	Accounting Principles Accounting Convention Accounting Convention (Contd.)	
8	Lec 22 Lec 23 Lec 24	Financial Statement Analysis Financial Statement Interpretation Ratio Analysis	
9	Lec 25 Lec 26 Lec 27	Cost Accounting Management Accounting Cost Concept and Classification	**Class Test 3**
10	Lec 31 Lec 32 Lec 33	Distribution of Overhead Cost Overhead Recover Method/Rate Job Order Costing	
11	Lec 28	Preparation of Job Cost Sheet and Question Price	

	Lec 29 Lec 30	Inventory Valuation Absorption Costing	**Class Test 4**
12	Lec 34 Lec 35 Lec 36	Marginal/Variable costing Technique Cost- Volume-Profit Analysis Break-Even Analysis	
13	Lec 37 Lec 38 Lec 39	Contribution Margin Analysis Sensitivity Analysis. Relevant and Differential Cost Analysis	
14	Lec 40 Lec 41 Lec 42	Long-term Investment Decisions Capital Budgeting Various Techniques of Evaluation of Investments	

Text and Ref Books:

1. Managerial Accounting (14th Edition) - Ray Garrison, Eric Noreen and Peter Brewer; McGraw Hill (2011)
2. Accounting Principles (12th Edition) - Jerry J. Weygandt Paul D. Kimmel Donald E. Kieso; Wiley (2015)

7.2Department of Mechanical Engineering
L-2,T-I

7.2.1. ME 263: Fundamentals of Mechanical Engineering

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2,Term-I
Pre-requisite: None.
Rationale:
To study the basics of mechanical engineering.

Course Contents:
Circuit variables and elements:
Voltage, current, power, energy, independent and dependent Study of fuels, steam generating units with accessories and mountings, study of steam generators and turbines.
Introduction to internal combustion engines and their cycles, study of SI engines, CI engines and gas turbines with their accessories.
Refrigeration: Study of different refrigeration methods, refrigerants, refrigeration equipment, compressors, condensers, evaporators, expansion devices, other control and safety devices. Psychometrics, study of air-conditioning systems with their accessories.
Types of fluid machinery, study of impulse and reaction turbines, Pelton wheel and Kaplan turbines, study of centrifugal and axial flow machines, pumps, fans, blowers and compressors, study of reciprocating pumps.

Objective:

1. To understand the basics of Mechanical Engineering.
2. To understand the operation of engine, refrigeration and air conditioning system and turbines.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Explain** the operations of Mechanical Engineering equipments.
2. **Grow** the ability to evaluate practical systems related to machinery.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-2	Class Tests/Assignments	**20**
1-2	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-2	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain** the operations of Mechanical Engineering equipment.	√											
2. **Grow** the ability to evaluate practical systems related to machinery.		√										

Lecture Schedule:

Week 1		CT 1
Class 1	Introduction to mechanical Engineering	
Class 2	Basics on Thermodynamics and Thermodynamic systems	
Class 3	Classifications of thermodynamics systems	
Week 2		
Class 4	Properties of a system and state of a system	
Class 5	Thermodynamic process and Thermodynamic laws	
Class 6	Fuels and classification of fuels	
Week 3		

Class 7	Merits and demerits of liquid fuel over gaseous fuel	
Class 8	Calorific values of fuel and related mathematical problems	
Class 9	Bomb calorimeter and related mathematical problems	
Week 4		
Class 10	Heat engine , internal combustion engine and external combustion engine	
Class 11	Classification of IC engine	
Class 12	Main component of IC engine	
Week 5		
Class 13	Engine terminology	
Class 14	4-stroke cycle	CT 2
Class 15	Introduction to steam generator or boiler	
Week 6		
Class 16	Important terms and boiler construction	
Class 17	Classification of steam generator/boiler	
Class 18	Fire tube boiler, water tube boiler	
Week 7		
Class 19	Horizontal boiler and vertical boiler	
Class 20	Boiler mountings	
Class 21	Boiler accessories	
Week 8		
Class 22	Fire tube vs water tube boiler	
Class 23	Performance analysis of steam boiler	CT 3
Class 24	Equivalent evaporation and boiler efficiency	
Week 9		
Class 25	Mathematical problems	
Class 26	Air conditioner and principle of operation	
Class 27	Types of air conditioner	
Week 10		
Class 28	Energy consumption and energy efficiency	
Class 29	Energy saving methods and safety systems	
Class 30	Low temperature cut off switch, high temperature cut off switch and ambient switch	
Week 11		
Class 31	application of refrigeration	
Class 32	The refrigeration cycle	CT 4
Class 33	Non-cyclic and cyclic methods of refrigeration	
Week 12		
Class 34	Vapor compression refrigeration and COP	
Class 35	Pump and pump classifications	
Class 36	Main parts of centrifugal pump	
Week 13		
Class 37	Pump efficiency and cavitation of pumps	
Class 38	Fluid machinery and Turbine	
Class 39	Types of turbine and related maths	

Week 14		
Class 40	Classification of turbine	
Class 41	Carno cycle and Rankin cycle	
Class 42	Open Discussion	

Text and Ref Books:

1. A Text Book of Thermal Engineering – R. S. Khurmi& J. K. Gupta; S. Chand & Company Ltd.
2. Basic Mechanical Engineering – R. K. Rajput; Laxmi Publishers Private Ltd.

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

7.2.2. ME 264: Fundamentals of Mechanical Engineering Laboratory

3.00 Contact Hour; 1.50 Credit Hour;
Level: Level-2,Term-I
Pre-requisite: Fundamentals of Mechanical Engineering(ME 263)
Rationale:
To apply the basic knowledge of mechanical engineering in various experiments.

Course Contents:
In this course students will perform experiments to verify practically the theories and concepts learned in ME 263.

Objective:

1. To understand basic operations of Mechanical Engineering equipment practically in relation with theory.
2. To relate and distinguish between theoretical knowledge and practical knowledge.

Course Outcomes (CO)
Upon completion of all sessional, the students will be able to:

1. **Analyze** different thermodynamic systems with respect to theoretical knowledge.
2. **Explain** the basic operating principle of engine, air conditioning and refrigeration cycles etc theoretically.

Teaching-learning and Assessment Strategy: Daily lab performance, Lab Attendance, Lab reports, Lab test, Lab quiz, Lab viva.

Linkage of Course Outcome with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
1-2	Conduct of Lab Test /Class Performance	**25%**
1-2	Report Writing/ Programming	**15%**

1-2	Mid-Term Evaluation (Exam/Project/assignment)	**20%**
1-2	Final Evaluation (Exam/Project/assignment)	**30%**
1-2	Viva Voce / Presentation	**10%**
	Total	**100%**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	**Program Outcomes**											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Analyze** different thermodynamic systems with respect to theoretical knowledge.				√								
2. **Explain** the basic operating principle of engine, air conditioning and refrigeration cycles etc theoretically.		√										

Lectures Schedule

Weeks	**Intended topics to be covered**	**Remarks**
1	Introduction to the lab equipments and safety measures	
2	Expt-01: Determination of flash point of liquid fuel	
3	Expt-02: Viscosity test of liquid substance	
4	Expt-03: Study of refrigeration and air conditioning cycle.	
5	Expt-04: Study of an automotive engine, different system and performance test.	
6	Expt-05: Determination of water flow rate.	
7	Expt-06:Study of sling Psychometer.	
8	Expt-07:Performance test of a cooling tower.	
9	Expt-08:Study of propeller turbine characteristics	
10	Practice Lab	
11	Practice Lab	
12	Lab Test + Viva	
13	Quiz test	
14	Project submission	

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

L-2,T-2

7.2.3 ME 293: Industrial Management
3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-2,Term-II

Pre-requisite: None.
Rationale:
To learn and familiarize with the basics of industrial management.

Course Contents:
Cost management: Elements of cost of products, cost centers and allocation of overhead costs.
Management accounting: marginal costing, standard costing, cost planning and control, budget and budgetary control;
Development and planning process: Annual development plan; National budget.
Financial management: Objectives, strategy, financing, performance analysis of enterprises, investment appraisal, criteria of investment.
Personnel management: Importance, scope, need hierarchy, motivation; Defense mechanism; Productivity and satisfaction; Leadership; Group dynamics; Job evaluation and merit rating;
Personnel development: hiring, training, wage systems.
Project Management: Project Lifecycle, Project Scheduling, Project Budgeting, Project Monitoring

Objective:
1. To understand basic elements of cost management and managerial accounting.
2. To enhance knowledge in developing budget plan for government purpose or business purpose or any other company

Course Outcomes (CO):
Upon completion of the course, the students will be able to:
1.Define the elements of cost managements and management accounting.
2.Analyze synthesis of data and information with the help of modern technologies: Study and prepare plan for different types of budget.
3.Apply evaluation, debugging and improvement of the planning process for financial and project management.
4.Initiate leadership quality through managing all sorts of group dynamics application.
5.Estimate to develop an awareness and understanding of the crucial part that management in industrial and scientific activities and to be familiar with criteria for business activities in industry.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	

	Class Performance	**05**
1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1.Definethe elements of cost managements and management accounting.	√											
2.Analyzesynthesis of data and information with the help of modern technologies: Study and prepare plan for different types of budget.		√										
3.Applyevaluation, debugging and improvement of the planning process for financial and project management.			√									√
4. Initiate leadership quality through managing all sorts of group dynamics application.								√		√		
5.Estimate to develop an awareness and understanding of the crucial part that management in industrial and scientific activities and to be familiar with criteria for business activities in industry.											√	

Lecture Schedule:

Week 1		CT 1
Class 1	Introduction to Management. Managing and management	
Class 2		
Class 3		
Week 2		
Class 4	Theories of Management. Elements of Management	
Class 5		
Class 6		
Week 3		
Class 7	Cost-Volume-Profit Relationships: Organizational design and structure	
Class 8		
Class 9		
Week 4		CT 2
Class 10	Basics of Personnel Management, theories of Motivation	

Class 11		
Class 12		
Week 5		
Class 13	Profit Planning: Leadership	
Class 14		
Class 15		
Week 6		
Class 16	Introduction to Marketing Management	
Class 17		
Class 18		
Week 7		CT 3
Class 19	Standard Costs and the Balanced Scorecard	
Class 20		
Class 21		
Week 8		
Class 22	Technology management	
Class 23		
Class 24		
Week 9		
Class 25	Capital Budgeting Decisions	
Class 26		
Class 27		
Week 10		CT 4
Class 28	Analysis of enterprises, investment appraisal	
Class 29		
Class 30		
Week 11		
Class 31	Criteria of investment	
Class 32	Financial Statement Analysis	
Class 33		
Week 12		
Class 34	Job-Order Costing	
Class 35		
Class 36		
Week 13		
Class 37	Different industrial management system analyze: Elementary systems, Different industrial management system analyze: Elaborate systems, Scope of research in management system	
Class 38		
Class 39		
Week 14		
Class 40	Project Management: Project Lifecycle, Project Scheduling, Project Budgeting, Project Monitoring	
Class 41		
Class 42		

Text and Ref Books:

1. Management – Jams A. F. Stoner, R. Edward Freeman, Daniel R. Gilbert.

2. Managerial Accounting – Ray H. Garrison, Eric W. Noreen

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

7.3 Department of Computer Science and Engineering

L-1, T-II

7.3.1 CSE 109 Computer Programming

3.00 Contact Hour; 3.00 Credit Hour;
Level: Level-1, Term-I
Pre-requisite: None.
Rationale:
To introduce with the most recent technology and to teach students the basic concepts of computer programming.

Course Contents:
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. Object oriented Programming using C++: Introduction, classes and objects. Polymorphism, function and operator overloading, inheritance.

Objective:
1. To understand the basics of computer programming in C/C++.
2. To solve elementary programming problems.

Course Outcomes:
Upon completion of the course, the students will be able to:
1. **Explain** the difference between object oriented programming and procedural oriented language and data types.
2. **Apply**C/C++ features such as composition of structures, objects, Operator overloading, inheritance, Polymorphism etc.
3. **Solve** the problem in the subjects like Operating system, Computer networks and real world problems at the end of the course.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-3	Class Tests/Assignments	**20**
1-3	Mid-Term Assessment (Exam/Project)	**15**

	Exam	
1-3	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO) of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. **Explain** the difference between object oriented programming and procedural oriented language and data types.	√											
2. **Apply**C/C++ features such as composition of structures, objects, Operator overloading, inheritance, Polymorphism etc.		√	√									
3. **Solve** the problem in the subjects like Operating system, Computer networks and real world problems at the end of the course.				√								

Lecture Schedule:

Week 1		CT 1
Class 1	Introduction to digital computers	
Class 2		
Class 3		
Week 2		
Class 4	Programming languages, algorithm	
Class 5		
Class 6		
Week 3		
Class 7	Programming flow charts and Structured Programming using C	
Class 8		
Class 9		
Week 4		CT 2
Class 10	Variable and constants, operators, expressions	
Class 11		
Class 12		
Week 5		
Class 13	Control statements, function, arrays	
Class 14		

Class 15		
Week 6		
Class 16	Pointers	
Class 17		
Class 18		
Week 7		CT 3
Class 19	Structure unions	
Class 20		
Class 21		
Week 8		
Class 22	User defined data types, Input output and files	
Class 23		
Class 24		
Week 9		
Class 25	Object oriented Programming using C++: Introduction	
Class 26		
Class 27		
Week 10		CT 4
Class 28	Classes and objects	
Class 29		
Class 30		
Week 11		
Class 31	Polyorphism	
Class 32		
Class 33		
Week 12		
Class 34	Function and operator overloading	
Class 35		
Class 36		
Week 13		
Class 37	Inheritance - I	
Class 38		
Class 39		
Week 14		
Class 40	Inheritance - II	
Class 41		
Class 42		

Text and Ref Books:

1. Programming with C - John Hubbard; Schaum‟s Outlines.
2. Programming with C++ - John Hubbard; McGraw-Hill Int. Edn.

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

L-1, T-II

7.3.2 CSE 110 Computer Programming Laboratory

Credit 1.50 Contact Hours 3.00

This course consists of two parts. In the first part students will perform experiments to verify practically the theories and concepts learned in CSE 209. In the second part students will learn program design.

Optional and Non Credit:

HUM- 241: Bangladesh Studies

2.00 Contact Hour; 0 Credit Hour;

Pre-requisite: None.

Rationale:

This course has been designed to help the students in obtaining comprehensive idea about the history, culture and heritage of Bangladesh. It will introduce students with economy, society, politics, diplomacy and foreign policy of Bangladesh. Students will learn about the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future. It will also assist the students in assessing roles and contribution of Bangladesh in the regional and international bodies which are dedicated to establish world peace.

Course Contents:

Ancient period and muslim period of bengal, British period, pakistan period: an overview (1952-1971),The problem of national integration under ayub regime, Elite in crisis during pakistan rule, nation-building in the new state, The ideals and philosophy of constitution-making of Bangladesh, Study on the coup and assassination of mujib, Philosophy and fundamental changes of zia regime, Constitutional amendments of Bangladesh, Corruption and good governance in Bangladesh, Issues of governance of bangladesh, bangladesh economy, Ideas on political and ethnic conflict in Bangladesh, Geographical setting of bangladesh, environmental challenges of Bangladesh, Bangladesh foreign policy: realities and challenges, Foreign policy-decision-making process in Bangladesh, Bangladesh-soviet union relations.

Objective:

1. Introduce students with rich history, culture and heritage of Bangladesh.
2. Providing them in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.

3. Improve their understanding on political, economic and social development of Bangladesh.
4. Help them think critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.
5. Increase understanding on the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future.

Course Outcomes (CO):

Upon completion of the course, the students will be able to:

1. **Enrich** knowledge with brief history, culture and heritage of Bangladesh.
2. **Provide** in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.
3. **Improve** understanding on political, economic and social development of Bangladesh.
4. **Think** critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.
5. **Increase** understanding on the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future.

Teaching-learning and Assessment Strategy: Lectures, class performances, assignments, class tests, final exam.

Linkage of Course Outcomes with Assessment Methods and their Weights:

COs	Assessment Method	(100%)
	Class Assessment	
	Class Performance	**05**
1-5	Class Tests/Assignments	**20**
1-5	Mid-Term Assessment (Exam/Project)	**15**
	Exam	
1-5	Final exam	**60**

Mapping of Course Outcomes and Program Outcomes:

Course Outcomes (CO)of the Course	Program Outcome											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Enrich with brief history, culture and heritage of Bangladesh.												√
2. Provide in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.							√					
3. Improve understanding on political,											√	

economic and social development of Bangladesh.												
4. Think critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.								√				
5. Increase understanding on the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future.												√

Lecture Schedule:

Week 1		CT 1
Class 1	Ancient period and Muslim period of Bengal	
Class 2		
Week 2		
Class 3	British period, Pakistan period: an overview (1952-1971)	
Class 4		
Week 3		
Class 5	British period, Pakistan period: an overview (1952-1971)	
Class 6		
Week 4		CT 2
Class 7	Elite in crisis during Pakistan rule, nation-building in the new state	
Class 8		
Week 5		
Class 9	The ideals and philosophy of constitution-making of Bangladesh	
Class 10		
Week 6		
Class 11	Study on the coup and assassination of Mujib	
Class 12		
Week 7		CT 3
Class 13	Philosophy and fundamental changes of Zia regime	
Class 14		
Week 8		
Class 15	Constitutional amendments of Bangladesh	
Class 16		
Week 9		
Class 17	Corruption and good governance in Bangladesh	
Class 18		
Week 10		CT 4
Class 19	Issues of governance of Bangladesh, Bangladesh economy	
Class 20		

Week 11		
Class 21	Ideas on political and ethnic conflict in Bangladesh	
Class 22		
Week 12		
Class 23	Geographical setting of Bangladesh, environmental challenges of Bangladesh	
Class 24		
Week 13		
Class 25	Bangladesh foreign policy: realities and challenges	
Class 26		
Week 14		
Class 27	Foreign policy-decision-making process in Bangladesh	
Class 28	Bangladesh-soviet union relations	

Text and Ref Books:

1. "Bangladesh in International Politics" - Muhammad Shamsul Huq (1995), The University Press Limited, Dhaka-1000
2. "Constitution, Constitutional Law and Politics: Bangladesh Perspective"- Md. Abdul Halim, CCB Foundation, Dhaka-1000
3. "Bangladesh in the Twenty-First Century: Towards an Industrial Society" - A M A Muhith (1999), The University Press Limited, Dhaka-1000
4. "Bangladesh Foreign Policy: Realities, Priorities and Challenges" - Harun ur Rashid (2012, 2nd Edition), Academic Press and Publishers Library, Dhaka-1209
5. "The Changing Pattern of Bangladesh Foreign Policy: A Comparative Study of Mujib and Zia Regimes" - Zaglul Haider (2008), The University Press Limited, Dhaka-1000

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

ANNEX-A

Program Outcomes

No.	Program Outcomes
1.	Ability to understand and apply knowledge of mathematics, science, and engineering
2.	Ability to identify, formulate, and solve engineering problems
3.	Ability to design a system or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4.	Ability to design and conduct experiments, as well as to analyze and interpretation of data
5.	Ability to adopt and use appropriate techniques, skills, and select appropriate modern engineering tools necessary for engineering practice
6.	The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
7.	A knowledge of contemporary issues
8.	An understanding of professional and ethical responsibility
9.	Ability to function on a multidisciplinary teams and contribution
10.	Ability to communicate effectively
11.	Project Management and Finance
12.	A recognition of the need for, and an ability to engage in life-long learning

ANNEX-B

Grading Policy

Numeric Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00