UNIVERSITY OF RAJSHAHI

Faculty of Engineering

Bachelor of Science in

ELECTRICAL AND ELECTRONIC ENGINEERING

Course Curriculum for Affiliated Colleges

Session: 2021–2022

Part-I Examination	: 2022
Part-II Examination	: 2023
Part-III Examination	: 2024
Part-IV Examination	: 2025

RULES AND REGULATIONS FOR THE UNDERGRADUATE PROGRAM FOR AFFILIATED COLLEGES

1. Duration of Course and Course Structure (Ref. Academic Ordinance for Affiliated Colleges, Faculty of Engineering (AOFAC)article no-4)

1.1 The B.Sc. Engg. Programs shall extend over a period of four academic years, each of a normal duration of one calendar year, divided into 2 Semesters; (details are given in Section 7 of the ordinance).

1.2 The curricula of the B. Sc. Engg. Degree shall be as proposed by the curricula committee formed in the Faculty and approved by the Syndicate on the recommendation of the Faculty of Engineering and of the Academic Council. The formation of the curricula committee will be as follows:

(i) Dean, Faculty of Engineering, RU will be the chair
(ii) Department heads of the concerned department of RU campus and affiliated colleges campus
(iii) Two expert members from any recognized university outside the institute
(iv) Two members nominated by the Faculty of Engineering, RU.

1.3 The Curricula Committee shall review the curricula at least once in every **Academic Year** and recommend changes and revision, if any, to the Faculty and then the Faculty will recommend to the Academic Council through IQAC of the university.

1.4 Teaching of the courses is reckoned in terms of credits and the credits allotted to various courses will be determined by the Curricula Committee under the following guidelines

Nature of course	Contact hour/credit(in a semester)
Theoretical Lecture Laboratory/Project Field work	: 1 hour/week : 2 - 3 hours/week : 2 weeks

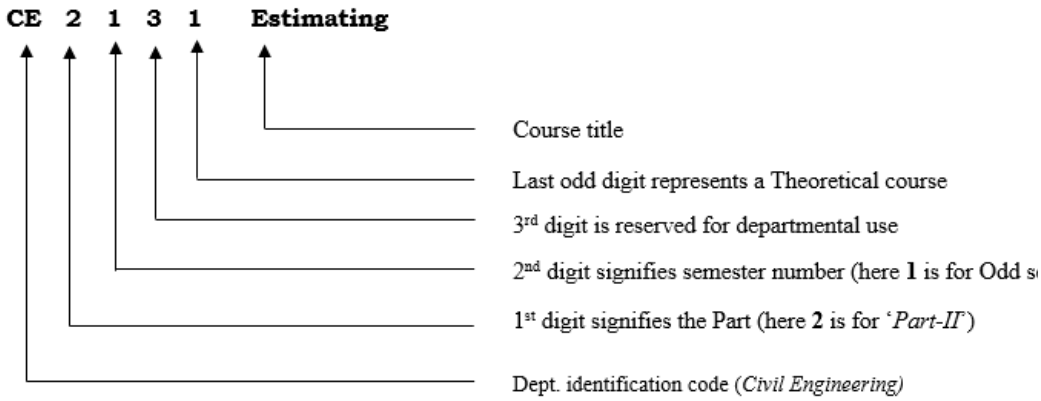
1.5 **Contact Hours/week:** The total contact hours for the regular students including lecture, tutorial and laboratory shall be between **24 - 42** periods per week, each period being **40 to 60** minutes in duration.

1.6 **Course Adviser**: A course teacher is nominated by the principal/head of the department shall act as **Course Advisor** for each Semester.

1.7 Course Advisor will prepare and announce the class routine, showing details of the lectures, course plan, class test, etc. at the start of each semester.

1.8 C**ourse Designation:** Each course is designated by **a two to four letter** word usually identifying the course offering department followed by **a four-digit** number with the following criteria without any space between letters and numerical.

(a) The first digit will correspond to the Part (year) in which the course is normally taken by the students,(b) The second digit will correspond the semester (**1 for odd and 2 for even**) in which the course is normally taken by the students, (c)The third digit will be reserved for departmental use for such things as to identify different areas within a department, (d) The last digit will be **odd for theoretical, even for laboratory courses and '0' for Board Viva voce** and (e)The course designation system is illustrated by the following example.



2. Duration of Examination [Ref.:**AOFAC**article no- 6]

Duration of Theoretical examination of different coursesat the end of semester shall be as follows:

Courses less than or equal to 2 Credits	2 Hours
Courses greater than 2 credits but less than or equal to 4 Credits	3 Hours

3. Academic Calendar [Ref.: **AOFAC** article no- 7]

3.1 The academic year shall be divided into two semesters each having duration of not less than 11 teaching weeks.

3.2 There shall be final examinations at the end of each semester conducted by the respective Examination Committee Formed by the Faculty of Engg.

3.3 An academic schedule for the academic year shall be announced for general notification before the start of the academic year, on the approval of the Faculty of Engineering. The dean of the faculty will announce the schedule. The schedule may be prepared according to the following guidelines:

Semester-Odd (19 weeks)	Number of weeks
Teaching Preparatory Leave Examination Period Result Publication	**13** weeks **2** **2 - 3** **2 - 3**
	19
Inter Semester Recess	**1**
Semester-Even (20 weeks)	
Teaching Preparatory Leave Examination Period Result Publication	**13** weeks **2** **2 - 3** **2-3**
	20
Vacation (Summer, Ramadan, and Others)	**12**
Total:	**52**

4.Attendance[Ref. **AOFAC** article no-13]

4.1 In order to be eligible for appearing, as a regular candidate, at the semester final examinations, a student shall be required to have attended at least 70%of the total number of periods of lectures/tutorials/laboratory classes held during the semester in every course as defined in the curricula. The laboratory courses mean all laboratory/project/fieldwork/in-plant training and any other similar courses.

4.2 A student whose attendance falls short of 70% but not a below 60% in any course as mentioned above may be allowed to appear at the final examinations as non-collegiate student and he/she shall not be eligible for the award of any scholarship or stipend. A student, appearing at the examination under the benefit of this provision shall have to pay, in addition to the regular fees, the requisite fine prescribed by the syndicate for the purpose.

4.3 The Courses mentioned above shall mean a course of study as described in the curricula and it may be a theoretical or a laboratory course.

4.4 Students having less than 60% attendance in lecture/tutorial/ laboratory of any course will not be allowed to appear at the final examinations of the semester.

4.5 An attendance report of the students shall be prepared by the concerned course teacher for his/her Class. Awarded marks for class attendance of the students will be posted in the prescribed marks sheet. A copy of that marks sheet will send to the chairman of the examination committee and to the controller of examinations in a sealed envelope within Seven (7) days of the last class of the course.

Table-1 Distribution of Marks in Attendance

Attendance	Marks (%)	Remarks
90% and above	100	**Regular**
85% to less than 90%	90	
80% to less than 85%	80	
75% to less than 80%	70	
70% to less than 75%	60	
65% to less than 70%	50	**Non-collegiate**
60% to less than 65%	40	
less than 60%	0	

5. Class Test [Ref. **AOFAC** article no- 16]

5.1 For theoretical courses of less than or equal to 2 credits there shall be at least three class tests and at least four class tests for more than 2 credits in a semester.

5.2 The course teacher must submit the detailed class test marks and their average in percentage to the Chairman of the Examination Committee in a sealed envelope. A copy will be also sent to the controller of the examination. If a course is conducted by more than one course teacher, class test marks will be processed by the examination committee.

5.3 Previous class test marks will remain valid for the reported/ course improvement student if he/she is unable to appear at class test.

6. The Grading System [Ref. **AOFAC** article no-14]

6.1 The letter grade system for assessing the performance of the students shall be as follows:

Marks	LetterGrade (LG)	Grade Point (GP)
80% or above	A+	4.0
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.5
65 to less than 70%	B+	3.25
60% to less than 65%	B	3.0
55% to less than 60%	B-	2.75
50 to less than 55%	C+	2.5
45% to less than 50%	C	2.25
40 to less than 45%	D	2.0
less than 40%	F	0.0
Incomplete	I	0.0

A letter grade 'I' (incomplete) shall be awarded for courses in the odd semester which Continue through to the even semester.

6.2 A **Grade Point Average (GPA)** shall be calculated for each semester as follows:

$$\mathrm{GPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \qquad \text{(i)}$$

where, n is the number of courses offered during the semester, C_i is the number of credits allotted to a particular course and G_i is the grade point earned for that course.

6.3 A **Yearly Grade Point Average (YGPA**) shall be calculated for each academic year as follows:

$$YGPA = \frac{\sum_{j=1}^{2} C_j G_j}{\sum_{j=1}^{n} C_j} \qquad \text{(ii)}$$

where 2 is the number of semester, C_j is the number of credits allotted to a semester and G_j is the GPA earned for that semester.

6.4 The **Cumulative Grade Point Average (CGPA)** gives the cumulative performance of the students from the 1st year up to the end of the year to which it refers, and will be calculated as follows:

$$CGPA = \frac{\sum_{k=1}^{m} C_k G_k}{\sum_{k=1}^{m} C_k} \qquad \text{(iii)}$$

where, m is the total number of years being considered, C_k is the total number of credits registered during a year and G_k is the YGPA of that particular year.

6.5 A Cumulative Grade Point Average (CGPA) shall be calculated at the end of each academic year and to be communicated to the students along with the YGPAs. The individual grades of courses obtained by them for the semesters of the academic year will, however, be communicated at the end of individual semester by the Chairman of the Examination Committee.

6.5 The YGPA will be rounded down to the third place of decimal for reporting. **For instance, YGPA=3.4999 shall be rounded down as YGPA=3.499.**

The CGPA will be rounded off to the second place of decimal for reporting. **For instance, C GPA=3.485 shall be rounded down as CGPA=3.49, CGPA=3.354shall be rounded down as CGPA=3.35**

6.6 **Earned Credit:** The courses in which a student obtains minimum 'D' in 'Theoretical courses' and 'C' in 'Laboratory courses & Board Viva-voce' or higher grade will be counted as credits earned by the student. Any course in which a student obtains 'F' grade will not be counted towards his/her earned credit. 'F' grade will not be counted for GPA calculation but will stay permanently on the Grade Sheet and transcripts.

7. Conducting Examination and Rules for Promotion [Ref. **AOFAC** article no-15]

7.1 The academic year shall be divided into two semesters each having duration of not less than 13teaching weeks (details are given in Section 7 of the Ordinance).

7.2 There shall be final examinations conducted by the concerned Examination Committee of the Departments at the end of each semester.

7.3 The results shall be finalized at the end of the even semester of the academic year. A student entering in an odd semester **shall automatically move** on to the next semester, unless he/she was **barred** from appearing at the final examinations at the end of the semester. Individual **course** grades and **GPA** shall be announced within a date ordinarily not later than three weeks after the end of the semester final examinations.

7.4 **Minimum passing grade:** The minimum passing grade in a theoretical course will be D and the minimum passing grade in a laboratory/project/field work/in-plant training/workshop/similar Courses(henceforth referred to as laboratory course) and **Viva voce** will **be C.**

7.5 **Promotion to higher class:** In order to be promoted to higher class a student must obtain the following requirements:

i) Yearly Grade Point Average(YGPA) of 2.25 or higher
ii) Credit point loss (F or I Grade) in the theoretical courses not more than 10.
iii) Minimum C grade in the laboratory courses and viva-voce.

7.6 **Course Improvement**: A promoted student may appear for course improvement in the immediate next academic year for maximum 10 credit points to clear his/her F grade or to improve the grades on the courses in which less than B grade (including those of F grade) was obtained in Part-1, Part-2 and Part-3 examinations. In such case, the student has to give his/her choice of course/courses for course improvement in writing. If the student fails to clear his/her F grades in the first attempt, he/she shall got another (last) chance in the immediate next year to clear the F grades**.** In the case of student's failure to improve his/her course grade at the course improvement examination, the previous grade shall remain valid.

7.7 **Course Exemption:** Students who fail to be promoted to the next higher class shall be exempted from taking the theoretical and laboratory courses where they obtained grades **equal to B or above.** These grades would be counted in calculating GPA in the next year's examination results.

7.8 **Merit Position:** The YGPA obtained by a student in the **semester final examinations** will be considered for determining the **merit position for the award of scholarships, stipends etc.**

8. Publication of Results [Ref. **AOFAC** article no-17]

8.1 **Award of degree:** In order to qualify for the B.Sc. Engg. degree, a student must have to earn minimum 150 credits and a minimum CGPA of 2.25 within a maximum of six academic years. The result will be published in accordance with merit.

8.2 **Honours:** Candidates for Bachelor degree in engineering will be awarded the degree with Honours if their earned credit is 160 and CGPA is3.75 or higher.

8.3 **Result Improvement:** A candidate obtaining B.Sc. Engg. within 4 or 5 academic years shall be allowed to improve his/her result, of maximum of 10 credit points (courses less than 'B' grade) of the Part-IV theoretical courses in the immediate next regular examination after publication of his/her result. No improvement shall be allowed for laboratory examinations and Board Viva-voce. If a candidate fails to improve CGPA with the block of new GP in total, the previous results shall remain valid.

8.4 **Readmission and Course Exemption:** If a student fails to obtain the degree within 4 or 5 academic year, he/she will be readmitted in Part-4 and will appear for the exam according to the clause 15.6. Course exemption rules will also be valid according to clause 15.7.

8.5 **Dean's List:** As a recognition of excellent performance, the names of students obtaining a YGPA of 3.75 or above in each academic year may be published in the Dean's List in the faculty. Students who have received an 'F' grade in any course during any of the two regular

semesters will not be considered for Dean's List in that year.

8.6 **Recording of Result:** The transcripts in English will show the course designation, course title, credit, letter grade, grade point of individual courses, YGPA of each year, and finally, CGPA.

9. Eligibility for Examination[Ref. **AOFAC** article no-23]:

9.1 A candidate may not be admitted to any semester final examination unless he/she has

9.1.1 Submitted application in the prescribed form to the Registrar/Vice-Chancellor for appearing at the examination,

9.1.2 Paid the prescribed examination fees, and all outstanding University dues,

9.1.3 Fulfilled the conditions for attendance in class and

9.1.4 Been barred by any disciplinary rule.

9.2 On special circumstances the Vice-Chancellor may permit a student to appear at the examination.

9.3 A student whose attendance falls short of 70% but not below 60% in any course as mentioned above may be allowed to appear at the final examinations as a non-collegiate student.

B.Sc. in
Electrical and Electronic Engineering

Undergraduate program in Electrical and Electronic Engineering (EEE)

UNIVERSITY OF RAJSHAHI

Department of Electrical and Electronic Engineering

Vision of the Program: To provide knowledge to the learners to meet high standards of excellence in Electrical and Electronic Engineering needed for a leadership position in the broad aspects of electrical engineering careers and advanced studies in home and abroad.

Mission of the Program: To develop and improve the quality and process of education on the front line with internationally leveled graduates by:

- Providing a quality education in Electrical and Electronic Engineering.
- Disseminating the knowledge by talented academicians in conducive academic and research environment.

Description of the program: The B.Sc. Engg.in EEE will prepare a student to compete for a wide range of job opportunities in home and abroad. While gaining a broad understanding of emerging electrical and electronic engineering, and the engineering business environment, a student will also develop essential leadership, management and communication skills and the global perspective he needs to excel in a career in engineering. This program provides with the necessary skills and experience that will enable a student to take his place in the fast-paced world of electrical and electronic engineering as a creator of next generation, intelligent, connected devices and systems. A senior student will undertake an individual project that is either linked to research within the department or, potentially, linked to industry relevant design activities. He can also pursue his own ideas and undertake a personalized project.

Keeping those in mind the department of EEE has set the following objective and program outcome for its undergraduate program-

Program Education Objectives (PEO)

The Objectives of the B.Sc. in EEE program at the University of Rajshahi are-

- To prepare graduates with the skills necessary to enter careers in the design, application, installation, manufacturing, operation and/or maintenance of electrical/electronic(s) systems.
- To train students of this department for development and implementation of different electrical/electronic(s) systems.
- To produce Engineers who are committed to sustainable development of electrical/electronic(s) industries for the betterment of the society and nation.

Program Outcomes of B.Sc. in EEE Degree (PO)

After completion of the four years bachelor program students of EEE will be able to

PO1:	Apply knowledge of Science, Mathematics and Engineering to solve the complex problems in Electrical and Electronics Engineering.
PO2:	Analyze and troubleshoot electrical and electronic systems comprising of multi-disciplinary (viz. mechanical, acoustic, optical) elements.

PO3:	Design electrical and electronic systems to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as national, global, cultural, social, environmental, and economic factors.
PO4 :	Conduct investigations of complex engineering problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO5:	Use modern tools (software or hardware) for analyzing, solving and designing complex electrical and electronic systems.
PO6:	Apply contextual knowledge to assess social, health, safety and cultural issues and endure the consequent responsibilities relevant to EEE professional engineering practice.
PO7:	Utilize core engineering knowledge in a global, economic, environmental, and societal context for sustainable development
PO8:	Recognize professional and ethical responsibilities in engineering situations and make informed judgments.
PO9:	Function effectively as a team member or a leader to accomplish a common goal in a multi-disciplinary team.
PO10:	Communicate effectively about complex engineering activities with the engineering community and with society at large. Comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.
PO11:	Apply knowledge of engineering and management principles to manage projects effectively in diverse environments as a member or leader of a team
PO12:	Extend their learning in many different fields to cope up with the changing world.

1. Assessment Strategy

1.1.Theory Courses:

a) Continuous assessment (15%): Class tests, Quiz, Assignment etc. as per lecture plan designed by the course teacher. Course teacher will evaluate the student throughout the semester during his/her lecture period.

b) Class attendance (5%): Course teacher will keep records of the attendance of the students and grade them following the Table – 3 at the end of the teaching weeks.

c) Semester final examination(80%): Students will have to sit for written examinations after the teaching weeks. Answer scripts will be evaluated by the assigned teacher(s) for this 80% marks.

1.2.Laboratory Courses:

Class Attendance	10%	Course teacher will keep records of the students' attendance and grade them as per the Table – 3 **.**
Continuous Assessment	20%	Quizzes, Viva-Voce, Class Tests, Assignments etc. as per the course plan designed by course teacher.
Practical/ Design Work/Report	70%	At the end of the teaching weeks, a laboratory examination will be held to evaluate the students' hands on experience. Students will be asked to set-up a particular experiment or design-work, take necessary readings and draw inference.

1.3.Project Work/Field Work/Professional Training

Each student will have to submit two reports on the concerned job after the completion of the project/field work or the industrial training. This will be evaluated as the per the following table:

Internal Examiner/ Supervisor	30%
External Examiner (Any teacher from the panel of examiners)	30%
Presentation and Oral Examination	40%

2. Basis for awarding marks for class participation and attendance:

Table – 3

Attendance	Marks(%)
90% and above	100
85% to less than 90%	90
80% to less than 85%	80
75% to less than 80%	70
70% to less than 75%	60
65% to less than 70%	50
60% to less than 65%	40
less than 60%	0

Semester-wise Distribution of Credits

Sl. No.	Year/ Semester	Theory		Sessional		Total Credits
		No. of Courses	Credits	No. of Courses	Credits	
1.	1st/Odd	5	14	5	6	**20**
2.	1st/Even	6	17	3	3	**20**
3.	2nd/Odd	6	17	3	3	**20**
4.	2nd/Even	6	16	4	4	**20**
5.	3rd/Odd	5	15	4	4	**19**
6.	3rd/Even	6	17	4	4	**21**
7.	4th/Odd	5	15	5	5	**20**
8.	4th/Even	4	12	4	8	**20**
Total		**43**	**123**	**32**	**37**	**160**

Semester Course Plan for B.Sc. Engg. DegreeSession: 2020-2021

Course Offering of the department of Electrical and Electronic Engineering for the B.Sc. Engineering (EEE) degree (Session 2020-21), will be as follows:

B.Sc. Engg. Part-I, Odd Semester, Examination 2021

Sl. No.	Course Codes	Course Titles	Marks	Contact hours/ week	Credits
1.	EEE 1111	Electrical Circuit I	**75**	3	**3**
2.	EEE 1112	Electrical Circuit I Sessional	**25**	2	**1**
3.	CSE 1151	Computer Programming	**75**	3	**3**
4.	CSE 1152	Computer Programming Sessional	**50**	4	**2**
5.	ME 1152	Engineering Drawing	**25**	2	**1**
6.	PHY 1121	Physics I	**75**	3	**3**
7.	PHY 1122	Physics I Sessional	**25**	2	**1**
8.	MATH 1131	Differential and Integral Calculus	**75**	3	**3**
9.	ENG 1111	Technical and Communicative English	**50**	2	**2**
10.	ENG 1112	English Sessional	**25**	2	**1**
Total			**500**	**26**	**20**

B.Sc. Engg. Part-I, Even Semester, Examination 2021

Sl. No.	Course Codes	Course Titles	Marks	Contact hours/ week	Credits
1.	EEE 1211	Electrical Circuit II	**75**	3	**3**
2.	EEE 1212	Electrical Circuit II Sessional	**25**	2	**1**

3.	ME 1251	Mechanical Engineering	**75**	3	**3**
4.	ME 1252	Mechanical Engineering Sessional	**25**	2	**1**
5.	PHY 1231	Physics II	**75**	3	**3**
6.	CHEM 1221	Chemistry	**75**	3	**3**
7.	CHEM 1222	Chemistry Sessional	**25**	2	**1**
8.	MATH 1221	Ordinary and Partial Differential Equations	**75**	3	**3**
9.	ECON 1211	Economics	**50**	2	**2**
Total			**500**	**23**	**20**

B.Sc. Engg. Part-II, Odd Semester, Examination 2022					
Sl. No.	**Course Codes**	**Course Titles**	**Marks**	**Contact hours/ week**	**Credits**
1.	EEE 2111	Electronic Circuit I	**75**	3	**3**
2.	EEE 2112	Electronic Circuit I Sessional	**25**	2	**1**
3.	EEE 2121	Electrical Machine I	**75**	3	**3**
4.	EEE 2122	Electrical Machine I Sessional	**25**	2	**1**
5.	EEE 2131	Computational Methods for Engineers	**75**	3	**3**
6.	EEE 2132	Computational Methods for Engineers Sessional	**25**	2	**1**
7.	EEE 2141	Continuous Signals and Linear Systems	**75**	3	**3**
8.	MATH 2131	Fourier Analysis, Laplace Transform and Linear Algebra	**75**	3	**3**
9.	ACCO 2111	Management and Accountancy	**50**	2	**2**
Total			**500**	**23**	**20**

B.Sc. Engg. Part-II, Even Semester, Examination 2022					
Sl. No.	**Course Codes**	**Course Titles**	**Marks**	**Contact hours/ week**	**Credits**
1.	EEE 2211	Electronic Circuit II	**75**	3	**3**
2.	EEE 2212	Electronic Circuit II Sessional	**25**	2	**1**
3.	EEE 2221	Electrical Machine II	**75**	3	**3**
4.	EEE 2222	Electrical Machine II Sessional	**25**	2	**1**
5.	EEE 2231	Digital Logic Design	**75**	3	**3**
6.	EEE 2232	Digital Logic Design Sessional	**25**	2	**1**
7.	EEE 2242	Circuit Simulation Sessional	**25**	2	**1**
8.	MATH 2251	Complex Variables, Co-ordinate Geometry and Vector Analysis	**75**	3	**3**
9.	STAT 2211	Statistics for Engineers	**50**	2	**2**
10.	MGT 2211	Law and Professional Ethics	**50**	2	**2**
Total			**500**	**24**	**20**

B.Sc. Engg. Part-III, Odd Semester, Examination 2023					
Sl. No.	**Course Codes**	**Course Titles**	**Marks**	**Contact hours/ week**	**Credits**
1.	EEE 3111	Power System I	**75**	3	**3**
2.	EEE 3112	Power System I Sessional	**25**	2	**1**
3.	EEE 3121	Electronic Circuit III	**75**	3	**3**
4.	EEE 3122	Electronic Circuit III Sessional	**25**	2	**1**
5.	EEE 3131	Electromagnetic Fields and Waves	**75**	3	**3**
6.	EEE 3141	Electrical Properties of Materials	**75**	3	**3**
7.	EEE 3151	Measurement and Instrumentation	**75**	3	**3**

8.	EEE 3152	Measurement and Instrumentation Sessional	**25**	2	**1**
9.	EEE 3162	Electrical Services Design	**25**	2	**1**
Total			**475**	**23**	**19**

B.Sc. Engg. Part-III, Even Semester, Examination 2023					
Sl. No.	**Course Codes**	**Course Titles**	**Marks**	**Contact hours/ week**	**Credits**
1.	EEE 3211	Power System II	**75**	3	**3**
2.	EEE 3221	Communication Systems I	**75**	3	**3**
3.	EEE 3222	Communication Systems I Sessional	**25**	2	**1**
4.	EEE 3231	Microprocessors and Embedded Systems	**75**	3	**3**
5.	EEE 3232	Microprocessors and Embedded Systems Sessional	**25**	2	**1**
6.	EEE 3241	Solid State Devices	**75**	3	**3**
7.	EEE 3251	Digital Signal Processing	**75**	3	**3**
8.	EEE 3252	Digital Signal Processing Sessional	**25**	2	**1**
9.	EEE 3261	Project Planning and Management	**50**	2	**2**
10.	EEE3272	Electronic Shop Practice	**25**	2	**1**
Total			**525**	**25**	**21**

B.Sc. Engg. Part-IV, Odd Semester, Examination 2024					
Sl. No.	**Course Codes**	**Course Titles**	**Marks**	**Contact hours/ week**	**Credits**
1.	EEE 4111	Power Plant Engineering and Economy	**75**	3	**3**
2.	EEE 4121	Communication Systems II	**75**	3	**3**
3.	EEE 4122	Communication Systems II Sessional	**25**	2	**1**
4.	EEE 4131	Control System	**75**	3	**3**
5.	EEE 4132	Control System Sessional	**25**	2	**1**
6.	EEE 4141	Power Electronics	**75**	3	**3**
7.	EEE 4142	Power Electronics Sessional	**25**	2	**1**
8.	EEE 41**	Elective I	**75**	3	**3**
9.	EEE 41**	Sessional based on Elective I	**25**	2	**1**
10.	EEE 4182	Industrial Training	**25**	-	**1**
11.	#EEE 4292	Project/Thesis	**0**	2	**0**
Total			**500**	**25**	**20**
#Project evaluation will be made in the Even Semester.					

B.Sc. Engg. Part-IV, Even Semester, Examination 2024					
Sl. No.	**Course Codes**	**Course Titles**	**Marks**	**Contact hours/ week**	**Credits**
1.	EEE 4211	Power System Protection and Switchgear	**75**	3	**3**
2.	EEE 4212	Power System Protection and Switchgear Sessional	**25**	2	**1**
3.	EEE 4221	High Voltage Engineering	**75**	3	**3**
4.	EEE 4222	High Voltage Engineering Sessional	**25**	2	**1**
5.	EEE 42**	Elective II	**75**	3	**3**
6.	EEE 42**	Elective III	**75**	3	**3**
7.	EEE 4292	Project/Thesis	**100**	8	**4**
8.	EEE 4200	Board Viva-voce	**50**	-	**2**
9.		Study Tour	**-**	-	**-**
Total			**500**	**24**	**20**

List of Elective Courses

Elective I			
Course Codes	**Course Titles**	**Marks**	**Credits**
EEE 4113	Computer Networks	75	3
EEE 4114	Computer Networks Sessional	25	1
EEE 4123	VLSI Circuits and Design	75	3
EEE 4124	VLSI Circuits and Design Sessional	25	1
EEE 4133	Microwave Engineering	75	3
EEE 4134	Microwave Engineering Sessional	25	1

Elective II			
Course Codes	**Course Titles**	**Marks**	**Credits**
EEE 4215	Renewable Energy	75	3
EEE 4225	Power System Operation and Control	75	3
EEE 4235	Biomedical Engineering	75	3
EEE 4245	Optoelectronics	75	3
EEE 4255	Compound Semiconductor Devices	75	3
EEE 4265	Cellular Mobile Communication	75	3

Elective III			
Course Codes	**Course Titles**	**Marks**	**Credits**
EEE 4217	Nuclear Power Engineering	75	3
EEE 4227	Processing and Fabrication Technology	75	3
EEE 4237	Plasma Science and Technology-I	75	3
EEE 4247	Optical Fiber Communication	75	3
EEE 4257	Radar and Satellite Communications	75	3
EEE 4267	Telecommunication Engineering	75	3

Course Alignment with the Program Outcome:

		PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
Humanities													
Sl. No.	**Course Code**												
1	**ENG 1111**										√		
2	**ENG 1112**										√		
3	**ECON 1211**							√				√	
4	**ACCO 2111**										√	√	
5	**MGT 2211**								√				
Total													
Basic Sciences:													
1	**PHY 1121**	√	√	√									√
2	**PHY 1122**	√			√								√
3	**PHY 1231**	√											√
4	**CHEM 1221**	√											√
5	**CHEM 1222**	√			√								√
6	**MATH 1131**	√	√			√							√
7	**MATH 1221**	√	√			√							√
8	**MATH 2131**	√				√							√
9	**MATH 2251**	√				√							√
10	**STAT 2211**					√							√
Total													√
Basic Engineering:													
1	**CSE 1151**	√				√							√
2	**CSE 1152**			√		√							√
3	**ME 1152**					√					√		
4	**ME 1251**	√	√										

5	**ME 1252**	**√**	**√**										
Total													
Major Engineering:													
1	**EEE 1111**	**√**	**√**	**√**	**√**								
2	**EEE 1112**	**√**	**√**	**√**	**√**								
3	**EEE 1211**	**√**	**√**	**√**	**√**								
4	**EEE 1212**	**√**	**√**	**√**	**√**								
5	**EEE 2111**	**√**	**√**	**√**	**√**								
6	**EEE 2112**	**√**	**√**	**√**	**√**								
7	**EEE 2121**	**√**	**√**	**√**	**√**		**√**						
8	**EEE 2122**	**√**	**√**	**√**	**√**		**√**						
9	**EEE 2131**				**√**	**√**							
10	**EEE 2132**				**√**	**√**							
11	**EEE 2141**	**√**				**√**							
12	**EEE 2211**	**√**	**√**	**√**	**√**								
13	**EEE 2212**	**√**	**√**	**√**	**√**								
14	**EEE 2221**												
15	**EEE 2222**	**√**	**√**	**√**	**√**		**√**						
16	**EEE 2231**		**√**	**√**									
17	**EEE 2232**		**√**	**√**									
18	**EEE 2242**		**√**	**√**		**√**							
19	**EEE 3111**	**√**	**√**	**√**	**√**		**√**	**√**				**√**	
20	**EEE 3112**	**√**	**√**	**√**	**√**		**√**	**√**				**√**	
21	**EEE 3121**	**√**	**√**	**√**	**√**								
22	**EEE 3122**	**√**	**√**	**√**	**√**								
23	**EEE 3131**	**√**	**√**	**√**	**√**								**√**
24	**EEE 3141**	**√**											
25	**EEE 3151**		**√**	**√**	**√**	**√**							
26	**EEE 3152**		**√**	**√**	**√**	**√**							
27	**EEE 3162**		**√**	**√**									
28	**EEE 3172**		**√**	**√**			**√**	**√**		**√**			
29	**EEE 3211**	**√**	**√**	**√**	**√**								
30	**EEE 3221**	**√**	**√**	**√**	**√**								
31	**EEE 3222**	**√**	**√**	**√**	**√**								
32	**EEE 3231**	**√**	**√**	**√**	**√**								
33	**EEE 3232**	**√**	**√**	**√**	**√**								
34	**EEE 3241**	**√**	**√**		**√**								
35	**EEE 3251**	**√**	**√**	**√**	**√**	**√**							
36	**EEE 3252**	**√**	**√**	**√**	**√**	**√**							
37	**EEE 3261**						**√**	**√**		**√**	**√**	**√**	
38	**EEE 4111**			**√**			**√**				**√**	**√**	
39	**EEE 4121**			**√**	**√**								
40	**EEE 4122**			**√**	**√**								
41	**EEE 4131**	**√**	**√**	**√**		**√**							
42	**EEE 4132**	**√**	**√**	**√**		**√**							
43	**EEE 4141**	**√**	**√**	**√**	**√**								
44	**EEE 4142**	**√**	**√**	**√**	**√**								
45	**EEE 41** : Elective I**												
	EEE 4113		**√**		**√**	**√**							
	EEE 4123			**√**									
	EEE 4133	**√**	**√**										
46	**EEE 41** : Elective I Sessional**												
	EEE 4114		**√**	**√**	**√**	**√**							
	EEE 4124					**√**							
	EEE 4134		**√**										
47	**EEE 4182**						**√**		**√**	**√**	**√**		
48	**EEE 4211**	**√**	**√**	**√**	**√**								
49	**EEE 4212**	**√**	**√**	**√**	**√**								
50	**EEE 4221**	**√**	**√**	**√**	**√**								

51	**EEE 4222**	√	√	√	√								
52	**EEE 42** : Elective II**												
	EEE 4215			√	√		√	√					
	EEE 4225	√	√	√									
	EEE 4235	√	√		√		√						
	EEE 4245	√	√	√									
	EEE 4255	√											
	EEE 4265		√	√	√		√						
53	**EEE 42** : Elective III**												
	EEE 4217	√						√					
	EEE 4227	√	√	√	√		√	√					
	EEE 4237	√			√			√					
	EEE 4247	√	√	√	√								
	EEE 4257	√	√	√	√								
	EEE 4267	√	√	√	√								
54	**EEE 4292**	√	√	√	√	√	√	√	√	√	√	√	
55	**EEE 4200**												

Course Outline

B.Sc. Engg. Part-I, Odd Semester, Examination 2021

Course Code: EEE 1111
Course Title: Electrical Circuit I
Course Credit: 3
Prerequisite: N/A

Course Description:
This course intends to give ideas about the basic electrical quantities of both DC and AC. Different techniques to analyze electrical circuits and applications of network theorem for electric and magnetic circuits will be explained.

Objectives:
1. To introduce the students with the various circuit variables and elements along with their properties in AC and DC circuit so that they can use them in a circuit.
2. To explain the students different laws and theorems for analyzing circuit behavior. This will help them to calculate circuit parameters required for designing and developing an electrical circuit.
3. To explain the students alternating current circuits with passive elements.
4. To introduce students magnetic circuits and their elements.

Course Learning Outcome (CLO): The students will be able to:
1. Understand different laws and theorems related to electrical circuit analysis
2. Analyze both DC and AC electrical circuits using standard theorems.
3. Calculate the circuit parameters of an electrical circuit.
4. Analyze the magnetic circuits.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Circuit Variables and Elements:** Voltage, current, power, energy, independent and dependent sources, resistance, inductance and capacitance. Introduction to non-sinusoidal waveforms, calculation of RMS and average value for non-	Lecture/ Discussion

	sinusoidal waveforms.	
1, 2	**Basic Laws:** Ohm's law, Kirchhoff's current and voltage laws. Voltage divider and current divider rules, Delta-Wye equivalent circuits. Series, parallel and series-parallel circuits and their equivalents.	Lecture/ Discussion, Problem solving
1, 2,3	**Techniques for Circuit Analysis:** Nodal and mesh analysis including supernode and supermesh. Techniques of General DC/AC Circuit Analysis (containing both independent and dependent sources): Node-voltage method, Mesh-current method, Source transformations.	Lecture, Discussion, Problem Solving
1,2,3	**Network Theorems:**Thevenin's theorem, Norton's theorem and superposition theorem with applications in circuits having independent and dependent sources, Millman's theorem, Compensation theorem, Maximum power transfer theorem and Reciprocity theorem.	Lecture, Discussion, Problem solving
	Section B	
1,2	**Energy Storage Elements:** Properties of Inductances and capacitances, Series-parallel combinations of inductances and capacitances, Responses of RL and RC circuits: Natural and step responses.	Lecture, Discussion
1, 2, 3	**Sinusoidal Functions:** Instantaneous current, voltage, power, effective current and voltage, average power, phasors and complex quantities, impedance, admittance, reactance, susceptance of RL, RC and RLC branches.	Lecture, Discussion, Demonstration
1, 2,3	**Analysis of Single Phase AC Circuits:** Vector diagram representation of AC circuits, Series and parallel RL, RC and RLC circuits, Techniques of general ac circuit analysis (containing both independent and dependent sources):nodal and mesh analysis for AC circuits, application of network theorems in AC circuit analysis.	Lecture, Discussion, Problem Solving
4	**Magnetic Circuits:** Quantities and Variables for Magnetic circuits, B-H Curve, reluctance, and magnetic field strength. Ohm's law and Ampere's circuital law for Magnetic Circuits. Analysis of series, parallel and series-parallel magnetic circuits. Comparison between electrical and magnetic quantities, Hysteresis and hysteresis loss. Magnetic materials.	Lecture, Discussion

Suggested Reading Lists/Essential Readings:

1. Charles K. Alexander and Mathew N. O. Sadiku : Fundamentals of Electric Circuits
2. Robert L. Boylestad : Introductory Circuit Analysis
3. G. F. Corcoran and R. M. Kerchner : Alternating-current Circuits
4. R. C. Dorf and J. A. Svoboda : Introduction to Electric Circuits
5. RP Ward : Electrical Engineering
6. Arthur Kip : Fundamentals of Electricity and Magnetism

Course Code: EEE 1112
Course Title: Electrical Circuit - 1 Sessional
Course Credit: 1
Prerequisite: N/A

Course Description: This course provides the student a hands-on experience of verifying the theorems and laws they are taught in EEE 1111 course.

Objectives:
1. To show how the theorems and laws work in non-ideal environment.
2. To provide hands on experience of measuring the AC and DC quantities of a circuit.

3. To show the process of designing and constructing an electrical circuit and then verify it with necessary measuring instrument.
4. To provide knowledge about common errors that may occur during circuit design.

Course Learning Outcome (CLO): Upon completion of the course students will be able to:

1. Understand operation of a practical electrical circuit comprising with passive elements for both AC and DC.
2. Identify the error in the circuit if there is any.
3. Design and construct a simple electrical circuit applying network theorems and laws.
4. Measure electrical quantities using volt meter, ohm meter, ammeter and oscilloscope.

SL. No.	CLO Mapping	Contents	Teaching-Learning Strategy
01.	1,2	Introduction to Computer Programming, Editor, compiler & Integrated Development Environment (IDE)	Demonstration Discussion Lab practice – hardware/simulation
02.	1,3	Variable Declaration & Value Assignment, Working with different Data type Showing on the Screen, Input from Keyboard	Open discussion Lab practice – hardware/simulation
03.	1,3	Use of Arithmetic Operators, Rules of Operator Precedence, Relational operators, Logical operators, Increment and Decrement operators and Keywords	Open discussion Lab practice – hardware/simulation
04.	1,3	Study on Decision making and Branching with if/else if/else statements, switch case statement and goto statement and their real life applications	Open discussion Lab practice – hardware/simulation
05.	1,3	Study on Decision making and Looping: The while loop and problem solving using while loop	Open discussion Lab practice – hardware/simulation
06.	1,3	Study on the do-while Loop, the for Loop, the switch statement with real life applications	Open discussion Lab practice – hardware/simulation
07.	1,3	Study on the for Loop, jumping out of a loop using break Statement and skipping a part of a loop using continue Statement	Open discussion Lab practice – hardware/simulation
08.	1,3	Study on One Dimensional Arrays and problem solving using arrays	Open discussion Lab practice – hardware/simulation
09.	1,3	Study on Multidimensional Arrays, Matrix manipulations, Passing Arrays to Functions and Sorting	Open discussion Lab practice – hardware/simulation
10.	1,3	Study on Character Arrays/ Strings and working with string handling operations	Open discussion Lab practice – hardware/simulation
11.	1,3	Study on Pointers and accessing the value of a variable using pointer variable	Open discussion Lab practice –

			hardware/simulation
12.	1,3	Study on User Defined Functions and real life applications of UDF	Open discussion Lab practice – hardware/simulation

Course Code: CSE 1151
Course Title: Computer Programming
Course Credit:3
Pre-requisite: N/A

Course Description: This course will begin with a brief description of basic programming languages and their classifications. The language of C programming will be taught in detail. The object oriented programming will also be introduced**.**

Objectives:
1. To introduce the students with different types of programming languages.
2. To use the control statements to write primary computer programs.
3. Handle arrays, pointers, and functions to write advanced programs.
4. Use structure, string operations and union along with other tool to solve real life problems using computer programming.
5. Use primary object oriented programming when needed.

Course Learning Outcome (CLO): Upon completion of the course students will be able to:
1. Write Basic program structure of a typical 'C' program, I/O statements.
2. Know variables and Constants, Operators—arithmetic and logical and bitwise.
3. Use control flow statements and blocks: if-else, switch and Break statement, Loop statements: for, while, do-while, break (from loop) and continue.
4. Solve some elementary programming problems.
5. Solve problems using Functions, Arrays, structure, unions, string operations, and pointers.
6. Use functions and object oriented programming to solve real life problems.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1,2	**Introduction to C Programming:** Programming language and their classification, variables and Constants, Operators-arithmetic and logical and bitwise, and expression.	Lecture, Discussion,
2,3	**Control Statements:** Control flow statements and blocks: if-else, switch and Break statement, Loop statements- for, while, do-while, break and continue	Lecture, Discussion, Problem Solving
4,5	**Array and Pointers:** Arrays-single dimensional and multi-dimensional, Strings as array of characters, string Library functions Solving problems using Arrays, Pointers and its application.	Lecture, Discussion, Problem Solving
	Section B	
5	**Functions:** Library functions, User-defined functions, Arguments passing among functions, Variable scope, Recursion.	Lecture, Discussion, Problem Solving
5	**String Operations:** Declaring and Initializing string variables, string I/O operations, Standard library string functions, Problem solving using string operations and arrays.	Lecture, Discussion, Problem Solving,
5	**Structure and Union:** Declaring and processing of structure, arrays and	Lecture, Discussion,

	structure, structure and pointers, Union File: opening and closing a file, creating a file, processing a file, I/O file handling.	Problem Solving,
6	**Basic of Object oriented programming:** Introduction to C++, classes and objects; encapsulation, inheritance, constructors, and destructors, operator and function overloading, polymorphism.	Lecture, Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:

1. Byron S. Gottfried : Theory and Problems of Programming with C
2. Herbert Schild : Teach yourself C
3. Robert Lafore : The Waite Group's C Programming using Turbo C++
4. H.M Deitel and P.J Deitel : C how to program
5. E. Balagurusamy : Programming in ANSI C

Course Code: CSE 1152
Course Title: Computer Programming Sessional.
Course Credit: 2
Prerequisite: N/A

Course Description: To teach the student to write programs in C and to solve the problems using the theoretical knowledge that are taught in CSE 1151 course.

Objectives:

1. To read, understand and trace the execution of programs written in C language.
2. To write the C code for a given algorithm.
3. To implement Programs with pointers and arrays, perform pointer arithmetic.
4. To solve real life problem using functions, structure, union, arrays, pointers and string operations.

Course Learning Outcome (CLO): Upon completion of the course students will be ableto:

1. Write C programs to solve the desired problem.
2. Develop flow chart to solve the real life problem

CLO Mapping	Course Content	Teaching-Learning strategy
1	To design a flow charts for solving mathematical problems such as finding 1. Odd/even number 2. maximum and minimum numbers 3. GCD and LCM, etc.	Lecture/ Hands-on Problem Solving
2	To write C code for finding whether a given number is odd or even.	Hands-on programming
2	To write C code for finding the maximum or minimum among several given numbers.	Hands-on programming
2	To write C code for finding GCD and LCM of given integers.	Hands-on programming
2	To write C code for searching a given number from an array of numbers.	Hands-on programming
2	To write C programs using functions for solving above problems	Hands-on programming
2	To write C program using structure and pointers for implementing linked list	Hands-on programming

2	To write C programs for preparing grade-sheets of students	Hands-on programming
2	To write C program for comparing, searching and concatenating given strings	Hands-on programming
2	To write C programs for file I/O.	Problem Solving by C programming

Course Code: ME 1152
Course Title: Engineering Drawing
Course Credit: 2
Prerequisite: N/A

Course Description: This course intends to develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings.

Objectives:
1. To learn basic engineering sketch.
2. To improve their visualization skills.
3. To develop the surface of an object.
4. To illustrate the engineering object using software.

Course Learning Outcome (CLO): Upon completion of the course students will be able to:
1. Identify and express the isometric and orthographic views.
2. Modify any object from isometric to orthographic and vice versa.
3. Develop the surface of cube/triangular prism/cone/square pyramid etc .
4. Illustrate the simple object using Auto CAD.

Learning Outcomes	Course content	Teaching-learning strategy
1, 2	Introduction, Orthographic projections, Sectional views, Isometric views, Pictorial views, Drawing standards and practices, Machine drawings, Technical sketching	Lecture Drawing Exercise Open discussion
3	Development of surfacescube / triangular prism/ cone /square pyramid	
4	Introduction to computer aided design (CAD/SOLIDWORKS) (Autocad/ Sketchup/SOLIDWORKS software)	Hands on Tutorial Drawing using software Exercise

Suggested Reading Lists/Essential Readings:
1. Reddy, K Venkata : Textbook of Engineering Drawing
2. F.E. Giesecke, A. Mitchell, H C. Spencer et al : Technical Drawing with Engineering Graphics
3. F. Zozzora : Engineering Drawing
4. R.S. Rhodes and L.B. Cook : Basic Engineering Drawing

Course Code: PHY1121
Course Title: Physis I
Course Credit: 3
Pre-requisite: N/A

Course Description: The contents of the course will give fundamental ideas about **t**he basic laws of electrostatics and electromagnetism. Various applications of the laws will be covered. Thermoelectricity generation and the thermoelectric materials are presented. Basic properties of mechanical waves and properties of harmonic oscillator are learnt. The fundamental theory of lights will be presented and their areas of application will be demonstrated.

Objectives:
1. To introduce the fundamentals law of electrostatics and electromagnetism.
2. To know how to apply the basic law of electrostatics and electromagnetism for the calculation of various electrical and magnetic parameters.
3. To know how to generate electricity in the light of Faraday's law of electromagnetic induction.
4. To understand the principle of thermoelectricity and laws of illumination.
5. To familiarize various mechanical wave and their properties for real time applications.
6. To learn not only the fundamental laws and their properties of light but also the interaction of light with matter.

Course Learning Outcome (CLO): Upon completion of the course students will be able to:
1. Understand the basic laws of electrostatics, electromagnetism and theory of light.
2. Apply ideas to solve electrostatics and electromagnetism related problems.
3. Explain the generation process of thermoelectricity and select materials for thermoelectricity.
4. Classify various mechanical waves and their properties.
5. Understand the basic properties of light and explain the effect of interaction of light with matter.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1, 2	**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, capacitors and dielectrics.	Lecture/ Problem solving/ Demonstration
1, 2	**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.	Lecture/ Animation Video/ Presentation/ Problem Solving
1, 2	**Electromagnetic Induction:** Faraday's law of electromagnetic induction, Lenz's law, induced current and voltage, energy stored in a magnetic field.	
3	**Thermoelectricity:** Thermal electromotive forces, Seebeck effect and Peltier effect, laws of addition of thermal electromotive forces, thermoelectric equations and power, practical thermocouple, Illumination laws, various kinds of lamps.	
	Section B	
4	**Waves**: Differential equation of simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillations, spring mass system, torsional pendulum; two body oscillation, reduced mass, damped oscillation, forced oscillation, resonance, progressive wave, power and intensity of wave, stationary wave, group and phase velocities.	Lecture/ Presentation/ Animation Video/ Problem Solving etc.
1, 5	**Interference of Light:** Theories of light, Young's double slit experiment, displacement of fringes and its uses, Fresnel bi-prism, interference in thin films, Newton's rings, interferometers	

1, 5	**Diffraction:** Diffraction by single slit, diffraction from a circular aperture, resolving power of optical instruments, diffraction at double slit and N-slits, diffraction grating	
1, 5	**Polarization:** Production and analysis of polarized light, Brewster's law, Malus law, polarization by double refraction, Nicol prism, optical activity, Polarimeters	
5	**Electro-magneto Optics:** Zeeman effect, Faraday effect, Cotton-Mouton effect, Kerr Magneto-optic effect, Kerr electro-optic effect.	

Suggested Reading Lists/Essential Readings:

1. D.Halliday and R.Resnick : Physics Part I and Part II
2. A. Beiser : Concept of Modern Physics
3. Francis A. Jenkins and Harvey E. White : Textbook of Optics
4. BrijLal : A Textbook of Optics
5. Edward M. Purcell : Electricity and Magnetism
6. Stanley Ramsey : Electricity and Magnetism

Course Code:PHY1122
Course Title: Physics I Sessional
Course Credit: 1
Prerequisite: PHY1121

Course Description: The sessional course will give opportunity to verify the basic laws of electrostatics, magnetism, thermoelectricity, and light taught in the theoretical course PHY1121.

Objectives:

1. To know how to use different instruments used to measure electrical, magnetic and optical quantities.
2. To provide hands on experience of measuring magnetic induction.
3. To know the limitations and errors of measurements in practical.
4. To recognize the process of generation of electricity with temperature.
5. To understand how experimental sample is prepared.

Course Learning Outcome (CLO): Upon completion of the course students will be able to:

1. Explain how magnetic field is varies in and outside of current carrying conductor.
2. Construct the thermocouple using two different metals and know how to calibrate.
3. Utilize diffraction grating to measure wavelength of light.
4. Make use of polarimeter for the measurement of concentration of a solution.

CLO Mapping	Course Content	Teaching-Learning Strategy
1	To study the variation of magnetic induction in a solenoid with current flow	How to use: • Tesla meter • Voltmere • Spectrometer and • Polarimeter Laboratory manual and Instructions are distributed
2	Calibration of a thermocouple and hence determination of unknown temperature	
3	Determination of wavelength of a monochromatic light by plane diffraction grating	
4	Calibration of a polarimeter and hence determination specific rotation of a sugar solution	

Course Code: MATH 1131

Course Title: Differential and Integral Calculus
Course Credit: 3
Pre-requisite: N/A

Course Description:

Topics include in this course are basic analytic geometry of graphs of functions, and their limits, derivatives and integrals, including the Fundamental Theorem of Calculus. Also, some applications of the integral, like arc length and volumes of solids with rotational symmetry, are discussed. Applications to the physical sciences and engineering will be a focus of this course, as this sequence of courses is designed to meet the needs of students in these disciplines.

Objectives:

1. To interpret a function from an algebraic, numerical, graphical and verbal perspective and extract information relevant to the phenomenon modelled by the function. derive the expression for the derivative of elementary functions from the (limit) definition.
2. To compute the expression for the derivative of a function using the rules of differentiation Including the power rule, product rule, and quotient rule and chain rule.
3. To identify the extrema of a function on an interval and classify them as minima, maxima.
4. To find the integral of elementary polynomials, exponential, logarithmic and trigonometric functions.
5. To use the basic integration rules to find indefinite integrals.

Course Learning Outcome (CLO): Upon completion of the course students will be able to:

1. Define the basic concepts and principles of differential and integral calculus of real functions and sequences and series
2. Interpret the geometric meaning of differential and integral calculus.
3. Apply the concept and principles of differential and integral calculus to solve geometric and physical problems.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Functions:** Domain, Range, Inverse function and graphs of functions, Limits, Continuity, Indeterminate form.	Lecture Discussion, Problem solving
1	**Ordinary Differentiation:** Differentiability, Differentiation, Successive differentiation and Leibnitz theorem.	Lecture Discussion, Problem solving
1, 2	**Expansions of Functions:**Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's formulae. Maximum and minimum of functions of one variable.	Lecture, Discussion, Problem Solving
1,2	**Partial Differentiation:** Euler's theorem, Tangents and normalAsymptotes.	Lecture, Discussion, Problem solving
	Section B	
1,2	**Indefinite Integrals:** Method of substitution, Integration by parts, Special trigonometric functions and rational fractions.	Lecture, Discussion, Problem solving
1, 2, 3	**Definite Integrals:** Fundamental theorem, General properties, Evaluations of definite integrals and reduction formulas.	Lecture, Discussion, Demonstration
1, 2,3	**Multiple Integrals:** Determination of lengths, Areas and Volumes.	Lecture, Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:

1. B.C. Das and B.N. Mukherjee : Differential Calculus
2. B.C. Das and B.N. Mukherjee : Integral Calculus
3. Joseph Edwards : Differential Calculus
4. Benjamin Williamson : Integral Calculus

5. Muhammad and Bhattacherjee : Differential Calculus
6. Muhammad and Bhattacherjee : Integral Calculus

Course Code: ENG 1111
Course Title: Technical and Communicative English
Course Credit: 3
Prerequisite:N/A

Course Description:
This course is designed to enable students to develop their competence in reading, writing, speaking, listening and grammar for academic purposes. The students will be encouraged to acquire skills and strategies for using language appropriately and effectively in various situations. .

Objectives:
1. To teach students the tools for writing technical error free English.
2. To grow effective and fast reading skill among the students.
3. To enable to communicate confidently and competently in English language in all spheres.
4. To develop writing competence of scientific reports, journal etc.

Course Learning Outcome (CLO): Upon completion of the course, students should be able to:
1. Understand basic grammar.
2. Speak fluently in English with the correct accent.
3. Read newspaper, technical papers, text books etc. and interpret correctly and swiftly.
4. Write job applications, reports, technical articles and journals.

CLO Mappings	Course content	Teaching-learning strategy
	Section A	
1	**Grammar:** Grammatical Principles, modals, phrases and idiomes, prefixes and suffixes, sentence structures, wh and yes/no questions, conditional sentences.	Lecture Practice Open discussion
2,3,4	**Vocabulary:** Technical and scientific vocabulary, defining terms.	
2	**Spoken English:** Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.	
	Section B	
3	**Reading:** Comprehension of technical and non-technical materials-skimming, scanning, inferring and responding to context.	Lecture Practice Open discussion
1,4	**Technical Writing:** Paragraph and composition writing on scientific and other themes, report writing, research paper writing, library references.	
4	**Professional Communication:** Business commercial correspondence letter, job application, memos, quotations, tender notice, amplification, description, technical report writing, standard forms of term papers, thesis etc.	

Suggested Reading Lists/Essential Readings
1. John M. Lennon : Technical Writing
2. A.J. Thomson and A.V. Martinet : A Practical English Grammar
3. A. Ashley : Oxford Handbook of Commercial Correspondence
4. J. Swales : Writing Scientific English
5. Robert J. Dixson : Complete Course in English
6. Rajendra Pal and J. S. Korlahalli : Essentials of Business Communications

Course Code: ENG 1112
Course Title: English Sessional
Course Credit: 1

Pre-requisite: ENG 1111

Course Description:
This course offers an opportunity to practice reading, writing, listening and speaking in English language and develop the proficiency in English.

Objectives:
1. To provide a platform to practice reading, writing, listening and speaking in English
2. To develop students English skill
3. To improve English vocabulary

Course Learning Outcome (CLO): Upon completion of the course, students will be able to:
1. Read and write smoothly in English
2. Understand English conversation better
3. Speak well in English
4. Improve vocabulary in English

CLO Mapping	Course Content	Teaching-Learning strategy
1,2,4	**Developing Listening Skill and Note Taking:** Listening to recorded texts and class lectures and learning to take useful notes based on listening.	Discussion, Practice
2,3,4	**Developing Speaking Skill:** Oral skills including communicative expressions for personal identification, life at home, giving advice and opinion, instruction and directions, requests, complains, apologies, describing people and places, narrating events.	Discussion, Practice

B.Sc. Engg. Part-I, Even Semester, Examination 2021

Course Code: EEE 1211
Course Title: Electrical Circuit II
Course Credit: 3
Pre-requisite: EEE 1111

Course Description:

Electrical Circuit II is a preferment of the basic course Electrical Circuit-I. This course introduces various phenomena associated with alternating current circuit and polyphase systems. This course intends to give idea about AC Power Concepts, Single Phase and Three Phase Alternating Current Circuits, Coupled Magnetic Circuits, Resonance Phenomena and Filters. Students are required to learn theoretical methods for solving circuit problems in all of these issues.

Objectives:

1. To define sinusoidal quantities with phasor and exponential representation and solve problems related with power measurement and improvement of an AC system.
2. To enhance their performance in analyzing transient response, resonance, and magnetically coupled circuits.
3. To improve their ability about differentiating and analyzing 3-φ systems in both oral presentation and solving related problems.
4. To understand the analysis of two port networks and learn to deal with issues embed in larger networks.

5. To able to design and examine different varieties of passive filters.

Course Learning Outcome (CLO): Upon completion of the course, students should be able to:

1. Apply knowledge of mathematics, science, and engineering to the analysis and improvement of ac systems.
2. Design a system, components or process to meet desired needs within realistic constraints.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**AC Power Concepts:** Classification of AC power. circuits with non-sinusoidal excitations, power and power factor calculation of ac circuits with multiple sources of different frequencies, power factor improvement of AC system.	Lecture Exercise Workshop Visit
1	**Transient Analysis of Linear Circuits:** Transient response of RL, RC and RLC circuits with sinusoidal and step excitation.	Lecture Assignment
1,2	**Resonance in AC Circuits:** Series resonance, Parallel Resonance, Q-value and Bandwidth.	Lecture Exercise
1	**Magnetically Coupled Circuits:** Mutual Inductance, Energy in a Coupled Circuit, Linear Transformers, Ideal Transformers, Ideal Autotransformers.	Lecture Class Test
	Section B	
1	**Analysis of Balanced Three Phase Circuits:** Balanced Three-Phase Voltages, Balanced Wye-Wye Connection, Balanced Wye-Delta Connection, Balanced Delta-Delta Connection, Balanced Delta-Wye Connection, Power in a Balanced System.	Lecture Oral Presentation
1	**Analysis of Unbalanced Three Phase Circuits:** Combination of Wye and Delta connection for unbalanced system, the wye-wye system with neutral connection, methods of checking voltage phase sequence, three phase power measurement, power factor in unbalanced three phase systems.	Lecture Oral Presentation
1,2	**Two-port analysis:** Impedance parameters, Voltage gains, Current gains, Cascaded systems, admittanceparameters, Hybrid parameters.	Lecture Exercise
1,2	**Passive Filter Networks:** Properties of symmetrical networks,Characteristic impedance and attenuation, ladder network, Filter fundamentals,different types of filters, propagation coefficient and time delay in filter sections, practical composite filters, Constant-K filter, design considerations.	Lecture Class Test

Suggested Reading Lists/Essential Readings:

1. C. K. Alexander and Mathew N. O. Sadiku : Fundamentals of Electric Circuits
2. Russell M Kerchner andGeorge F Corcoran Alternating-Current Circuits
3. Robert L. Boylestad : Introductory Circuit Analysis
4. Wallace L Cassell : Linear Electric Circuits
5. R. C. Dorf and J. A. Svoboda : Introduction to Electric Circuits

Course Code: EEE 1212
Course Title: Electrical Circuit II Sessional
Course Credit: 3

Course Description:

This laboratory course is designed to be the experimental companion to EEE 1211-Electrical Circuit II. The course is intended to enhance the students' understanding of important analytical principles developed in EEE 1211 by engaging them in developing practical ac systems in the laboratory.

Objectives:

1. To build and examine and alternating current circuits based on AC concepts.
2. To identify circuit faults and provide corresponding solutions.

3. To demonstrate the reason behind real time deviations (if any) from theoretical analysis.
4. To learn safety measurement rules in handling ac circuits.

Course Learning Outcome (CLO): Upon completion of the course, students should be able to:
1. Evaluate and test alternating current circuits.
2. Use electrical measuring equipment used for modern industry.
3. Write technical reports using collected experiment data.

CLO Mapping	Name of The Experiment	Teaching-Learning Strategy
1,2,3	Measurement of Capacitance using Wattmeter, Voltmeter and Ammeter.	Open discussion Lab practice – hardware and simulation
1,2,3	Measurement of Inductance using Wattmeter, Voltmeter and Ammeter.	Open discussion Lab practice– hardware and simulation
1,3	Measurement of Single Phase Average Power.	Open discussion Lab practice– hardware and simulation
1,3	Analysis of Y-Δ configurations.	Open discussion Lab practice– hardware and simulation
1,2,3	Measurement of three phase power by using two wattmeter method.	Open discussion Lab practice– hardware and simulation
1,2,3	Measurement of three phase power by using three wattmeter method.	Open discussion Lab practice– hardware and simulation
1,2,3	Measurement of Power Factor of lagging and leading loads for both single phase and three phase connections.	Open discussion Lab practice– hardware and simulation

Course Code: ME 1251
Course Title: Mechanical Engineering
Course Credit: 3
Pre-requisite: X

Course Description:
This basic engineering course introduces modern machineries and engines to develop combined ideas in mechanics, thermodynamics, structural analysis and electricity.

Objectives:
1. To develop basic ideas in the study of steam generation, steam turbines and internal combustion engines.

2. To understand various refrigeration and air conditioning cycles and enhance their ability in calculating cooling loads in commercial and residential systems.
3. To demonstrate engineering competency in the field of fluid machines, turbines, pumps and different modes of heat transfers.

Course Learning Outcome (CLO):
Upon completion of the course, students should be able to:
1. Design and realize a physical system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
2. Identify, formulate, and solve complex engineering problems related with basic mechanical engineering.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	Study of fuels. Steam generation units with accessories and mountings. Study of steam generation and steam turbines. Introduction to internal combustion engines and their cycles. Study of SI and CI engines and gas turbines with their accessories. Improvement of AC system.	Lecture Oral Presentation
1, 2	Refrigeration and Air-conditioning with their application. Refrigeration equipment: compressors, condensers and evaporators.	Lecture Class Test
	Section B	
1	Type of fluid machinery, Study of impulse and reaction turbine. Pelton wheel and Kaplan turbine. Study of centrifugal and axial flow machines. Pumps, fans, blowers and compressors. Study of reciprocation pumps.	Lecture Workshop Visit
1, 2	Basics of conduction and convection: critical thickness of insulation.	

Suggested Reading Lists/Essential Readings:

1. Terrell Croft : Steam-turbine Principles and Practice
2. T. Al-Shemmeri : Wind Turbines
3. Joseph M. Powers : Fundamentals of Combustion
4. Buddhi N. Hewakandamby : A First Course in Fluid Mechanics for Engineers
5. Daniel Micallef : Fundamentals of refrigeration thermodynamics
6. Shan K. Wang : Handbook of Air Conditioning and Refrigeration

Course Code: ME 1252
Course Title: Mechanical Engineering Sessional
Course Credit: 1
Pre-requisite: ME 1251

Course Description:

This laboratory course is designed to be the experimental companion to ME 1251-Mechanical Engineering. The course is intended to enhance the students' understanding of important analytical principles developed in ME 1251 by engaging them in measuring and analyzing various parameters of engines, turbines, refrigerators, air conditioners and pumps.

Objectives:

1. To identify machinary faults and provide corresponding solutions.

2. To demonstrate the reason behind real time deviations (if any) from theoretical analysis in mechanical systems.
3. To learn dealing with industrial tools and machinaries.

Course Learning Outcome (CLO):

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

1. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
2. Write technical reports using collected experiment data in mechanical systems.

Course Code: PHY 1231
Course Title: Physics II
Course Credit: 3
Pre-requisite: X

Course Description:

This course introduces students with basic concepts of classical and modern physics. The portion of classical mechanics deals with motion and forces on objects and study in gravitation and planetary motion. In modern physics, the concepts are developed with emphasis on quantum mechanical notions. Relativity and quantum ideas are considered first to provide a framework. Atomic nuclei and elementary particles are examined at the end. Finally, thermal physics provides the statistical nature of physical systems from an energetic perspective.

Objectives:

1. To develop a foundation on conceptual approach to physical sciences by uncovering the deep laws behind physical phenomenon/effects.
2. To demonstrate their understanding of the fundamental postulates and principles of special relativity and quantum mechanics.
3. To understand about phenomena of radioactive decay, nuclear fissions and fusion.
4. To enhance analytical reasoning and problem solving skills.

Course Learning Outcome (CLO): The students will be able to:

1. Relate the principles of statics and dynamics to solve engineering problems.
2. Interpret the fundamentals of physics (quantum mechanics, relativity etc.) and discuss the way they challenge our preconceptions.
3. Apply the laws of thermodynamics to real physical systems and processes.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Mechanics:** Linear momentum of a particle, Linear momentum of a system of particles, conservative and non-conservative forces, Conservation of linear momentum, Some applications of the momentum principle; Angular momentum of a particle, Angular momentum of a system of particles, escape velocity,	Lecture Oral Presentation
2	**Gravitational law:**Kepler's Law of planetary motion, The Law of universal gravitation, The motion of planets and satellites,	Lecture Class Test
1,2	**Laws of thermodynamics:** Heat and Work, thermodynamic system, the first law of thermodynamics and its applications, reversible and irreversible processes, entropy, second law of thermodynamics, Carnot cycles, Carnot's theorem.	Lecture Class Test

1,2	**Kinetic theory and thermodynamic potentials:** Kinetic theory of gases, kinetic interpretation of temperature, specific heats of ideal gases, equipartition of energy, Maxwell's distribution of molecular speeds, thermodynamic functions, thermodynamic potentials, Maxwell relations, Clausius and Clapeyron equation.	Lecture Open discussion
	Section B	
3	**Wave particle duality:** Photoelectric effect, Quantum theory of light, Compton effect, Photons and gravity, Wave Properties of Particles: De Broglie waves, Wave equations, Phase and Group velocities, Uncertainty principle and applying the uncertainty principle.	Lecture Open discussion
1,3	**Quantum Mechanics:** Limitations of classical mechanics, Postulates of quantum mechanics, Linear operators, Eigen values, Eigen functions, Time dependent and time independent Schrodinger's equations, Particle in a box, Reflection and transmission by a barrier, Tunnel effect.	Lecture Open discussion
3	**Relativity:** Galilean relativity and Einstein's special theory of relativity; Lorentz transformation equations, Length contraction, Time dilation and mass-energy relation	Lecture Open discussion
3	**Radioactivity and Nuclear reaction:** Constituent of atomic nucleus, Nuclear binding energy, Different types of radioactivity, Radioactive decay Law; Nuclear reactions, Nuclear fission, Nuclear fusion, Atomic power plant.	Lecture Open discussion

Suggested Reading Lists/Essential Readings:

1. F.W. Sears and G.L. Salinger : Thermodynamics, Kinetic Theory and Statistical Thermodynamics
2. A. Beiser : Concept of Modern Physics
3. F.W. Sears : Thermodynamics
4. D. Elwell and A.J. Pointon : Classical Thermodynamics
5. S.D. Mathur Mechanics
6. R. Resnik and D. Halliday : Physics Part-I and II
7. C.W. Sherwin : Introduction to Quantum Mechanics
8. P.T. Mathews : Introduction to Quantum Mechanics
9. K. Ziock : Basic Quantum Mechanics

Course Code: CHEM 1221
Course Title: Chemistry
Course Credit: 3
Pre-requisite: N/A

Course Description:

This course aims to give basic ideas about various aspects of inorganic and physical Chemistry including basic theories, chemical calculations, and their applications in different industries and in various fields of our everyday life.

Objectives:

1. To identify the electronic configuration and structure of atoms for different elements and their periodic properties and atomic interactions to each others
2. To explain different concepts of acids and bases and their relative strengths
3. To prepare different types of solutions and perform chemical calculations related to the concentration of solution

4. To know about chemical kinetics and chemical equilibria and also learn how energy changes, occur during chemical reaction
5. To explain inter-conversion of energy in the chemical, thermal and electrochemical process and their energy calculation.

Course Learning Outcome (CLO): After successful completion of the course, the students will be able to:

1. Understand electronic structure of atoms for different elements, interactions among them
2. Explain periodic properties of each element
3. Elucidate different theories of acids and bases and their comparative strengths.
4. Prepare various solutionsandmake necessary dilutions.
5. Determine the order, half-life, spontaneity etc. of chemical reactions and their equilibria.
6. Calculate the energy changes occur during a chemical reaction.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Atomic Structure:** Modern concept of atomic structure (Rutherford's and Bohr's atomic model), quantum numbers, distribution of electrons in atoms, Aufbau principle, Pauli exclusion principle, Hund's rule of maximum multiplicity, wave nature of electron, de Broglie relation, Heisenberg uncertainty principle, preliminary idea of orbitals, physical significance of *s, p* and *d* orbitals.	Lecture/Discussion Problem solving
1, 2	**Periodic Table:** Periodic law, classification of elements, modern periodic table in the light of electronic configurations of elements, different types of elements, periodic properties, atomic, covalent and ionic radii, ionization energy, electronegativity, electron affinity, effective nuclear charge. Important uses of noble gases and lanthanide elements.	Lecture/Discussion,
1, 2	**Chemical Bonding**: Different types of chemical bonds (ionic, covalent, co-ordinate, hydrogen and metallic), valence bond theory (VBT), hybridization of orbitals, molecular orbital theory (MOT), electronic configurations of simple molecules in terms of MO concept (He_2, N_2, O_2, F_2, Cl_2).	Lecture, Discussion, Problem Solving
1,2,3	**Modern concept of Acids and Bases:** Arrhenius, Bronsted-Lowry, Lewis, Lux-Flood and Usanovich concepts of acids and bases, strength of acids and bases.	Lecture, Discussion
	Section B	
3	**Solutions:** Types of solutions, units of concentration, dilution of solution.	Lecture, Discussion
3,4	**Phase equilibria**: Phase, component and degrees of freedom, phase rule and phase diagram of one component system.	Lecture, Discussion
3,4	**Colligative properties**: Lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmosis and laws of osmotic pressure.	Lecture, Discussion
3,4,5	**Chemical kinetics**: Rate of reactions, rate equations, order and molecularity, zero order, first order and second order reactions, determination of order of reaction, temperature effect on reaction rate.	Lecture, Discussion Problem solving
3,4,5	**Chemical equilibria**: Equilibrium and equilibrium constants, Le Chatelier principle and its applications.	Lecture, Discussion,
2,3,4,5	**pH and buffer solution**: Ionization of water, pH and pH scale, buffer solutions, mechanism of buffer action, Henderson-Hasselbalch equation.	Lecture, Discussion, Problem Solving
4,5,6	**Electrochemistry**: Electrolytes and electrolysis, Faradays laws of electrolysis and their significance, ionic mobility, Kohlrausch`s law, transference number, electrochemical cells, electrode reactions and potentials, reference electrodes, storage batteries.	Lecture, Problem Solving

Suggested Reading Lists/Essential Readings:

1. R. D. Madan : Modern Inorganic Chemistry
2. W.U. Malik, G.D. Tuli and R. D. Madan : Selected Topics in Inorganic Chemistry

3.	Darrel D. Ebbing	:	General Chemistry
4.	Raymond Chang	:	General Chemistry
5.	M. M. Haque and M. Y. A. Mollah	:	Principles of Physical Chemistry
6.	B. S. Bahl and G. D. Tuli and ArunBahl	:	Essentials of Physical Chemistry

Course Code: CHEM 1222
Course Title: Chemistry Sessional
Course Credit: 1
Prerequisites: CHEM 1221

Course Description:
The course will bring to student some basic experimental tests of acid and bases, preparing different kinds of standard chemical solutions based on the course CHEM1221.

Objectives:
The course aims how to prepare chemical solution and standardize the solutions of acid, base, oxidizing and reducing agent via titration. Moreover focus is given to learn the metal ions (such as Fe2+/Fe3+ and Cu2+ ions) in a solution as well as some understanding of the basic laws of electrochemistry.

Course Learning Outcome (CLO):
After successful completion of this course the student will be able to:
1. Prepare different kinds of standard chemical solution.
2. Standardization of some solution through titration.
3. Analyze and estimate different kinds of metal ions in a solution.

Course Content:
To be added by the course instructor

Course Code: MATH 1221
Course Title: Ordinary and Partial Differential Equations
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course will introduce the topic of differential equations as a mean to understand the natural phenomena, their characteristics, response and predictability in the domain of mathematics.

Objectives:
1. To learn different approaches for the formation of ordinary differential equations.
2. To understand different methods for the solution of ordinary differential equations.\
3. To get familiar with different approaches for the formation of partial differential equations.
4. To gain an understanding about of the solution of partial differential equations.
5. To learn different approaches of series solution of differential equations.

Course Learning Outcome (CLO): The students will be able to:
1. Form differential equations for physical systems.
2. Solve differential equations using suitable methods available.
3. Understand and implement differential equation as a mean to explain and forecast physical system.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1, 2, 3	**Ordinary Differential Equations:** Degree and order of ordinary differential equations, formation of differential equations. Solution of first order differential equations by various methods. Solution of general linear equations of second and higher orders with constant coefficients. Solution of homogeneous linear equations. Solution of differential equations of the higher order when the dependent or independent variables are absent. Solution of differential equation by the method based on the factorization of the operators.	Lecture, Discussion, Problem Solving
	Section B	
1, 2, 3	**Partial Differential Equations:** Introduction. Linear and non-linear first order equations. Standard forms. Linear equations of higher order. Equations of the second order with variable coefficients. Wave equations. Particular solution with boundary and initial conditions.	Lecture, Discussion, Problem Solving
2	**Series Solution:** Solution of differential equations in series by the method of Frobenious, Bessel's functions, Legendre's polynomials and their properties.	Lecture, Discussion, Demonstration

Suggested Reading Lists/Essential Readings:

1. Shepley L. Ross : Introduction of Ordinary Differential Equations
2. Frank Ayres : Differential Equations
3. B. D. Sharma : Differential Equations
4. Louis Albert Pipes : Applied Mathematics for Engineers and Physicist

Course Code: ECON 1211
Course Title: Economics
Course Credit: 2
Pre-requisite: N/A

Course Description:
This course provides students with an introduction to a broad range of economic concepts, theories and analytical techniques. It considers both microeconomics – how households and firms make decisions and macroeconomics - the analysis of the economy as a whole.

Objectives:

1. To introduce the students to the disciplines of economics and provide a basic understanding of how it functions in today's modern society.
2. To provide basic macroeconomic knowledge, particularly topics such as national income accounting, inflation, and labour market measurements.

Course Learning Outcome (CLO): On successful completion of this course, students will be able to:

1. Analyze puzzling issues around us rationally.
2. Describe and explain how microeconomic models can be used to consider fundamental economic choices of households and firms.
3. Describe and explain how macroeconomic models can be used to analyse the economy as a whole.
4. Interpret and use economic models, diagrams and tables and use them to analyse economic situations.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Basic Concepts of Economics:** Definition and scope; subject matter of economics; central economic problems, microeconomics vs. Macroeconomics, different economic systems; economics and engineering.	Lecture/ Discussion
1, 2,4	**Demand and Supply:** Concepts of demand; law of demand; demand schedule and demand curve; concepts of supply; supply schedule and supply curve; shift in demand and supply curves; equilibrium in the market; elasticity of demand and supply.	Lecture/ Discussion
1, 2,4	**Production, Cost, and Revenue:** Meaning of production; factors of production; concepts of total, average and marginal costs; fixed and variable costs; total, average and marginal revenue.	Lecture/ Discussion
2,3,4	**Theory of the firm:** Concept of market; perfect competition and monopoly; total, average, and marginal revenue of a firm under perfect competition and monopoly; equilibrium of a firm under perfect competition and monopoly.	Lecture/ Discussion
	Section B	
1,3,4	**Basic Concepts of Macroeconomics:** Aggregate demand; aggregate supply; aggregate economic behaviour; macroeconomic objective.	Lecture/ Discussion
3,4	**Measuring Macroeconomic Variables:** Output growth; unemployment; price level; consumption function; price indexes; inflation; Philips curve; business cycle; circular flow of economy; two, three and four sectors economy.	Lecture/ Discussion
3,4	**National Income Accounting and Determination:** Concepts of GDP, GNP, GNI and national income; methods of national income accounting; Keynesian model of national income determination; the expenditure multiplier; the multiplier effects of determining equilibrium income.	Lecture/ Discussion
3,4	**Budgets of Bangladesh:** Revenue and capital budget; balanced and unbalanced budget; income and expenditure of the government	Lecture/Discussion

Suggested Reading Lists/Essential Readings:

1. Hubbard, G., Garnett, A. M., Lewis, P., & O'Brien, A. P. : Microeconomics
2. Krugman, P., & Wells, R : Essentials of economics
3. Mankiw, N. G : Principles of Economics
4. Samuelson, P. A., &Nordhaus, W. D. : Economics
5. Government of Bangladesh : Budget Document/Five Year Plans

B.Sc. Engg. Part-II, Odd Semester, Examination 2022

Course Code: EEE 2111

Course Title: Electronic Circuit I
Course Credit: 3
Pre-requisite: N/A

Course Description: This course describes basic electronic components (diodes, BJTs and FETs etc.) along with their characteristics. Also discusses their fundamental applications to circuits like rectification and amplification of low frequency small signals.

Objectives:

1. To familiarize the students with construction and electrical characteristics of semiconductor diodes, transistors and FETs.
2. To explain their use and behavior in fundamental application like rectification and amplification.
3. To discuss how the circuit parameters are calculated in order to use them in particular circuit.

Course Learning Outcome (CLO): The students will be able to:

1. Explain the operation of diode, BJT and FET.
2. Identify a particular electronic component in a circuit like diode, BJT and FET.
3. Determine and choose an electronic component necessary for using in a circuit.
4. Design rectifiers, clippers and clamper circuit using diodes.
5. Design amplifier circuit using BJTs.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Semiconductor Diodes:** Semiconductor Materials, Intrinsic and extrinsic semiconductors, Charge carriers, Energy bands,P-N junction, Construction and characteristics of rectifier diode, zener diode, varactor diode, tunnel diode, photo diodes, LDR and LED.	Lecture/ Presentation
2,4	**Diode Circuits:** DC analysis and models, AC equivalent circuits, single phase rectification and regulators, ,clipper and clamper circuits, voltage doublers, multiple diode circuits, DC power supply.	Lecture/ Presentation/ Problem Solving
1	**Bipolar Junction Transistor (BJT):** BJT-PNP and NPN type, CE, CB and CC configurations, action, characteristics; DC analysis of BJT circuits, basic transistor applications, biasing techniques, bias stability, bias compensation, operating point, load line.	Lecture/ Presentation
	Section B	
2,3,5	**BJT Amplifiers:** Concept of amplification, basic configurations, CE amplifiers, CC and CB amplifier, AC load lines, small signal operation, Amplifiers with passive and active loads, loading effect, coupling methods, multistage amplifiers, Emitter Follower, Darlington pair, power consideration.	Lecture/ Presentation/ Problem Solving
5	**Small Signal Low Frequency Amplifiers: T**ransistor equivalent circuits, hybrid parameters, analysis of CE, CB and CC amplifiers using h-parameters. Analysis of multistage amplifier using hybrid model, Large Signal model and compact model for BJT.	Lecture/ Presentation/ Problem Solving
1, 2	**Field-Effect Transistors:** Structure of JFET and MOSFET, Current-Voltage Characteristics, MOS Device Models, DC circuit analysis, basic MOFET applications, Biasing, constant current biasing, multistage MOSFET circuits. DMOS, EMOS, CMOS, VMOS.	Lecture/ Presentation

Suggested Reading Lists/Essential Readings:

1. Robert Boylestad and Louis Nashelsky : Electronic Devices and Circuits
2. Thomas L. Floyd and David M. Buchla : Electronics Fundamentals: Circuits, Devices & Applications
3. Adel S. Sedra and Kenneth C. Smith : Microelectronic Circuits: Theory and Applications
4. J. Millman and C.C. Halkias : Electronic Devices and Circuits
5. Donald A. Neamen : Semiconductor Physics and Devices
6. Albert P. Malvino and David J. Bates : Electronic Principles

Course Code: EEE 2112
Course Title: Electronic Circuit I Sessional
Course Credit: 1
Prerequisite: N/A

Course Description:
This course provides the student a hands on experience of verifying the theorems and laws they are taught in EEE 2112 course.

Objectives:
1. To introduce the students with the electronic devices like diodes and transistors along with their use in the circuit.
2. To explain the students how to choose a particular diode or transistor using its electrical parameters.
3. To help students gain hands-on experience of using such electronic devices in the rectifier and amplifier circuits.

Course Learning Outcome (CLO): The students will be able to:
1. Identify diodes and transistors.
2. Choose diodes and transistors for a particular use in circuit.
3. Design and construct low power rectifier and amplifier circuits using diodes and transistors.

CLO Mapping	Contents	Teaching-Learning Strategy
1,2	Determination of V-I Characteristics of PN junction Diode.	Open discussion Lab practice – Hardware and Simulation
1,2	Determination of V-I Characteristics of Zener Diode.	Open discussion Lab practice – Hardware and Simulation
1,2	Experiment on Zener Diode as voltage regulator.	Open discussion Lab practice – Hardware and Simulation
1,2	Experiment on Half wave rectifier circuit	Open discussion Lab practice – Hardware and Simulation
1,2	Experiment on Full wave rectifier circuit using bridge circuit.	Open discussion Lab practice – Hardware and Simulation
1,2	Experiment on Full wave rectifier with center trapped transformer.	Open discussion Lab practice – Hardware and

		Simulation
1,3	Construction of a voltage-doubler circuit.	Open discussion Lab practice – Hardware and Simulation
1,3	Experiment on parallel clippers Circuit.	Open discussion Lab practice – Hardware and Simulation
1,3	Experiment on series clippers Circuit.	Open discussion Lab practice – Hardware and Simulation
1,3	Experiment on Clampers Circuit.	Open discussion Lab practice – Hardware and Simulation
1,3	Experiment on Input characteristic of BJT (NPN or PNP).	Open discussion Lab practice – Hardware and Simulation
1,3	Experiment on Output characteristic of BJT (NPN or PNP).	Open discussion Lab practice – Hardware and Simulation

Course Code: EEE2121
Course Title: Electrical Machine-1
Course Credit: 3

Course Description:
This course intends to provide conception to work with two widely used electrical machinery- the transformers and induction motors. Both single phase and poly-phase machines will be discussed in detail with regard to their construction, classification, connections, input/output, losses and efficiency.

Objectives:
1. Discuss the basic principle and construction of a transformer.
2. Determine the efficiency and regulation of a transformer
3. Test and identify faults in transformer and induction motor

Course Learning Outcome (CLO):
Upon completion of the course, students should be able to:
1. Explain the basic principle, construction and equivalent circuit of a transformer
2. Identify the physical components of transformer
3. Determine and interpret efficiency and regulation of a single phase transformer
4. Conduct open circuit test and short circuit test of a transformer
5. Describe and Identify the parts of single phase and three phase induction motors
6. Test and identify faults in single phase and three phase induction motor and synchronous motor.

CLO Mapping	**Course content**	**Teaching-learning strategy**
1, 2, 3,4	**Single Phase Transformer:** Principles, Types, Equivalent circuits,	Lecture

CLO Mapping	Course content	Teaching-learning strategy
	Performance and testing, Regulation, Losses and efficiency, Parallel operation, Auto-transformer, Instrument transformers.	Animation Exercise Open discussion
2	**Poly Phase Transformer:** Poly phase transformer construction, Poly phase transformer connections, Harmonics in polyphase transformer, transformer cooling.	Lecture Animation Exercise Open discussion
5,6	**Polyphase Induction Motor:** Principle of operation, Constructional details, Classifications, Equivalent circuits, starting torque and maximum torque, Speed-torque relations, Losses and efficiency, Circle diagram, Starters, Methods of speed control, Methods of braking and plugging, Induction generator.	Lecture Animation Exercise Open discussion
5,6	**Single Phase Induction Motor:** Principle, Construction and types, Performance, Double revolving field theory, Cross field theory, Equivalent circuits.	Lecture Animation Exercise Discussion

Suggested Reading Lists/Essential Readings

1. Stephen J. Chapman : Electric Machinery and Power System Fundamentals
2. A Fitzgerald : Electric Machinery
3. A. Puchstein, T E Loyd and AG Conard : Alternating Current Machines
4. J. Rosenblatt & M. H. Friedman : Direct and Alternating Current Machinery
5. Charles I Hubert : Electric Machines: Theory, Operating Applications, and Controls
6. B.L. Thereja, A.K. Thereja : A Textbook of Electrical Technology, Volume II
7. Er. R.K. Rajput : Electrical Machines in S.I. UNITS
8. J.B. Gupta : Electrical Machines (AC and DC Machines)
9. M.A. Salam : Fundamentals of Electrical Machines

Course Code: EEE 2122
Course Title: Electrical Machine I Sessional
Course Credit: 1
Prerequisite: N/A

Course Description: This course provides the student a hand on experience of testing the transformer and motor and measure the efficiency.

Objectives:

1. Identify faults in transformer and induction motor
2. Test the transformer and induction motor to determine their efficiency

Course Learning Outcome (CLO):

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

1. Test and identify faults in single phase and three phase transformer
2. Conduct open circuit test and short circuit test of a transformer
3. Determine the line voltage & phase voltage and line current &phase current relation in primary and secondary winding of three phase transformer
4. Measure circuit parameter of single phase and three phase induction motor and determine the efficiency

CLO Mapping	Course Content	Teaching-Learning Strategy
1,2	To study of a single phase transformer	Demonstration

	To perform (a) open circuit tests (b) short circuit tests and (c) voltage regulation and efficiency	Discussion Lab practice
3	Construction of three-phase transformer using three single-phase transformer and observation of line voltage & phase voltage and line current &phase current relation in primary and secondary winding with balance and unbalanced loading.	Open discussion Lab practice
4	Measurement of circuit parameters of single phase induction motor and determination of efficiency.	Open discussion Lab practice

Suggested Text/Learning Materials:

1. Lab guide/Manuals

Course Code: EEE 2131
Course Title: Computational Methods for Engineers
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course introduces the mathematical modeling of physical systems and their numerical solutions. The goal of the course is to provide a broad background in numerical methods with theoretical discussion and appropriate software like MATLAB to be used for applying the discussed algorithms in solving practical problems in reference to electrical engineering.

Objectives:
1. To demonstrate understanding of computer algorithm, mathematical modeling of physical systems and basic MATLAB programming.
2. To apply numerical methods for various mathematical operations, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. To analyze and evaluate the accuracy of common numerical methods.
4. To implement numerical methods for various problems in MATLAB.

Course Learning Outcome (CLO): The students will be able to:
1. Understand computer algorithms to solve for various engineering and mathematical problems.
2. Define different types of errors introduced by numerical solutions.
3. Solve algebraic and transcendental equations numerically.
4. Understand and apply different methods used for polynomial approximation and curve fitting.
5. Solve integration, differentiation and differential equations using different numerical techniques.
6. Solve various linear and non-linear systems of equations numerically.
7. Use MATLAB programming skills to solve applied problems in electrical and electronic engineering.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1, 2	**Computational Methods:** Computer Algorithm, Mathematical modeling of physical systems. Approximations and Errors: Accuracy and precision, Error definitions, Round-off errors, Truncation errors. Introduction to MATLAB programming: control statements, looping, matrices and vector operations, functions.	Lecture, Discussion, Problem solving and Programming practice
3	**Solution of Algebraic and Transcendental Equations:**Bisection method, method of false position, fixed point iteration method, Newton-Raphson method, Ramanujan's method, Muller's Method, Bairstow's Method.	

4	**Curve Fitting:** Newton Gregory forward and backward interpolations, Gauss' central difference interpolation formula, Stirling's interpolation formula, Bessel's formula, Everett's formula, Lagrange interpolation formula, Lagrange inverse interpolation formula, Newton's general interpolation, cubic spline interpolation, Least square approximations.	
5	**Numerical Differentiation and Integration:** Numerical differentiations with different interpolations, Numerical integrations by Trapezoidal rule, Simpson's rules, Boole's and Weiddle rules, Romberg method.	
Section B		
5	**Numerical Solutions of Linear and Nonlinear Systems of Equations:** matrix inversion method, Gauss' elimination method, Gauss-Gordanmethod,tridiagonal system, Gauss-Seidel Method, Newton's Method.	Lecture, Discussion, Problem solving and Programming practice
6	**Numerical Solutions of Ordinary Differential Equations:** Taylor's series method, Picard method of successive approximations, Euler and modified Euler's method, Predictor-Corrector method, finite difference, shooting method, Runge-Kutta Methods.	
6	**Numerical Solutions of Partial Differential Equations:** Laplace equation by Jacobi's method, Gauss-Seidel method, SOR method, parabolic and hyperbolic equations by explicit and implicit finite difference technique.	

CLO Mapping	**List of experiments**	**Teaching-Learning strategy**
1, 7	Application of the above techniques in Electrical and Electronic Engineering through computer program.	Lecture, Discussion, Problem solving and Programming practice

Suggested Reading Lists/Essential Readings:

1. Steven Chapra and Raymond P. Canale : Numerical Methods for Engineers
2. S.S. Sastry : Introductory Methods of Numerical Analysis
3. E. Balagurusamy : Numerical Methods
4. Stephen J. Chapman : MATLAB Programming for Engineers
5. Brian R. Hunt : A Guide to MATLAB: For Beginners and Experienced Users
6. JaanKiusalaas : Numerical Methods in Engineering with MATLAB
7. Sergey E. Lyshevski : Engineering and Scientific Computations Using MATLAB

Course Code: EEE 2132
Course Title: Computational Methods for Engineers Sessional
Course Credit: 1
Prerequisite:N/A

Course Description:

In this course students will perform experiments to practically verify the theories learned in the theory course EEE 2131.

Course Learning Outcome (CLO):

1. To solve practical engineering problems using the software.

1,3	Determination of the roots using Bi-section, False Position , Newton-Raphson methods from i) Mathematical equation ii) Electrical circuit solution.	Discussion, Performing Experiment in the programming software., Report writing
1,3	Determination of the roots of algebraic equations by using Gauss Elimination/ Gauss Jordan Method i) Mathematical equation ii) Electrical circuit solution.	
1,3	Determination of the roots of first or second order differential equations by using Euler's and modified Euler's, Predictor-Corrector, R-K method i) Mathematical equation ii) Electrical circuit solution.	
1	Integrate a mathematical equation by using Simpson rule.	
2	Curve fitting – create an equation from the observed data.	

Course Code: EEE 2141
Course Title: Continuous Signals and Linear Systems
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course provides a basic introduction to continuous-time signals and systems. The course is intended to teach students mathematical techniques for the design and analysis of systems. Different types of transformation and modern filter design technique and its application will also be explained.

Objectives:
1. To introduce the students with different types of signals and systems, properties of systems.
2. To understand differential equation, the meaning and practical relevance of LTI system properties such as linearity, time invariance, stability, causality, impulse response, transfer function, and frequency function.
3. To introduce the students with Fourier series, Fourier transformation, Laplace transformation, Properties of Fourier and Laplace transformation.
4. To describe the student about the application of Fourier and Laplace transformation.
5. To introduce the student about analog filter, filter type, filter design, and application of filter.

Course Learning Outcome (CLO):
The students will be able to:
1. Define various properties of signals and systems.
2. Describe LTI systems and calculate their output signal, using impulse response, convolution, transfer function and frequency response
3. State the basic properties of the Fourier and Laplace transforms and use these properties in problem solving.
4. Use the Fourier transform and Laplace transform to design and analyse simple systems.
5. Understand analog filter and Application of Filter.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Signals and systems:** Basic definitions and types of signal; complex analysis, signal properties, system-classification, basic signal transformations, elementary signals, representation of signals using impulses.	Lecture, Discussion,
2	**Properties of LTI system:** Different properties of LTI systems properties of convolution, impulse response and convolution representation of LTI systems, System response to internal condition.	Lecture, Discussion, Problem Solving
2	**Time Domain Analysis of LTI Systems:** Time-domain interpretation of systems; Differential equations-system representation, solution technique, overall system response**.**	Lecture, Discussion, Problem Solving

3	**Laplace Transformation:** Definition, some properties of Laplace transformation, solution of differential equations using Laplace transformation, Circuit Analysis using Laplace transformation, Transfer function, System Stability.	Lecture, Discussion, Problem Solving
	Section B	
3	**Frequency Domain Analysis of LTI System:**Fourier series representation, Circuit analysis with Fourier Series, Fourier Series and LTI system, Aperiodic signal representation by Fourier integral, Fourier Transformation of some useful functions, Properties of Fourier Transformation, , power spectrum, system function, Energy spectrum.	Lecture, Discussion, Problem Solving, Demonstration
3,4	**Application of Time and Frequency Domain Analysis:** Solution of Analog Electrical and mechanical systems, amplitude modulation and Demodulation, time-division and frequency division multiplexing.	Lecture, Discussion, Problem Solving
5	**Filters and filter design:**Types of Filter, Time domain response, Filter realization, Application of filter.	Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:

1. B.P Lathi : Signal Processing and Linear Systems
2. Simon Haykin and Barry Van Veen : Signals and System
3. D.K CHeng : Analysis of Linear Systems
4. Charles K. Alexander and Mathew, N.O. Sadiku : Fundamental of Electric Circuits

Course Code: MATH 2131
Course Title: Fourier Analysis, Laplace Transform and Linear Algebra
Course Credit: 3
Pre-requisite: N/A

Course Description:

The course will introduce the fundamentals of Fourier analysis, Laplace transform and linear algebra for engineering and applied science streams.

Course Learning Outcome (CLO):

Upon completion of the course students will be able to:

1. Solve engineering problems with fundamental engineering transformation techniques like Fourier and Laplace transform
2. Apply Fourier analysis and Laplace transform in electrical circuits and communication system
3. Improve their ability to communicate via the language of mathematics with the abstract world
4. Apply the concepts linear algebra to real world phenomena such as electrical networks, traffic flow, archeological dating, economic interdependencies, population movement, communication networks, and weather prediction.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Fourier Analysis:** Real and complex form of Fourier series, Finite transform, Fourier Integral, Fourier transforms and their uses in solving boundary value problems of wave equations.	Lecture, Discussion,
2	**Laplace Transforms:** Definition, Laplace transforms of some elementary functions, Sufficient conditions for existence of Laplace Transforms, Inverse Laplace Transforms, Laplace Transforms of derivatives. The unit step function, Periodic function, Some special theorems on Laplace Transforms, Partial fractions, Solutions of differential equations by Laplace Transforms, Evaluation of improper	Lecture, Discussion, Problem Solving

	integrals.	
	Section B	
3	**Linear Algebra:** Introduction to systems of linear equations. Gaussian elimination. Definition of matrices. Algebra of matrices. Transpose of a matrix and inverse of matrix. Factorization. Determinants. Quadratic forms. Matrix polynomials.	Lecture, Discussion, Problem Solving
3	Euclidean n-space. Linear transformation from IRn to IRm. Properties of linear transformation from IRn to IRm. Real vector spaces and subspaces. Basis and dimension. Rank and nullity. Inner product spaces. Eigenvalues and eigenvectors. Application of linear algebra to electric networks.	Lecture, Discussion, Problem Solving, Demonstration

Suggested Reading Lists/Essential Readings:

1. P. P. G. Dyke : An Introduction to Laplace Transforms and Fourier Series
2. Joel L. Schiff : The Laplace Transform: Theory and Applications
3. Murray R. Spiegel : Schaum's Outline of Laplace Transform
4. R. J. Beerends : Fourier and Laplace Transforms
5. Seymour Lipschutz, Mark Lipson : Linear Algebra, Schaum's Outline Series
6. David C. Lay : Linear Algebra and its Applications
7. Gilbert Strang : Introduction to Linear Algebra
8. Carl. D. Meyer : Matrix Analysis and Applied Linear Algebra

Course Code: ACCO 2111
Course Title: Management and Accountancy
Course Credit: 2
Pre-requisite: N/A

Course Description:

Management examines managerial policies and practices in the context of organizational growth and development whereas accounting is concerned with keeping the business deals and transactions in order

Objectives:

1. To provide an opportunity for students to understand management skill in industry.
2. To analyze the financial accounting data for the management.

Course Learning Outcome (CLO):

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

1. Understand different theories and their practices in the field of management and accountancy
2. Implement the knowledge to deal with practical cases when necessary

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Industry:** Types of Industry, Commerce – Hindrance removed by Commerce, Business Environment. **Sole Proprietorships:** Features, Advantages, Disadvantages of Sole Proprietorship, Sustainability of Sole proprietorships. **Partnership:** Features, Advantages, Disadvantages, the Partnership Contract.	Lecture Open discussion Debates Presentation Exercise
1	**Joint Stock Company:** Characteristics, Advantages, Disadvantages, Types, Comparison between Public and Private Ltd Company and Formation of company.	

1	**Organizing the Business:** Formal and Informal Organization, Centralization and Decentralization, Principles of Organizing, Functional Structure, Product Structure, Terrestrial Structure, Matrix Structure, Multiple Structure.	
1	**Fundamentals of Management:** What is management? Management Function, Levels of Management, Management roles, Core Management skills, Principles of Management.	
	Section B	
1	**Accounting:** History, Scope and Nature of Accounting, Information and Uses.	Lecture Open discussion Debates Presentation Exercise
1,2	**Transaction:** Meaning and Features, Double entry System, Characteristics, Account Meaning, Classification, Rules for Determining Debit and Credit, Accounting. Equation, Accounting cycle.	
1,2	**Journal:** Meaning, Features, Necessity, Types, Practical Problems. **Ledger:** Definition, Advantages, Classification, Rules, Practical Problems. **Cash book:**Features, Advantages, Double and Triple Column Cash Book, Discount. **Trial Balance:** Meaning, Characteristics, Objects, Practical problems, Preparation of Financial Statements.	

Suggested Reading Lists/Essential Readings:

1. M. C. Shukla : Business organization and management
2. Weygandt, Kimmel and Kieso : Accounting Principles
3. Basu and Das : Practice in Accountancy
4. Khan and Arif : Essential of Business Organization and Management
5. May and Baker : Introduction to Business
6. W. H. Newman : Administrative Action
7. Ricky W. Griffin : Management
8. Hermanson and Associates : Accounting Principles
9. Khan and Arif : Fundamental of Operations Management

B.Sc. Engg. Part-II, Even Semester, Examination 2022

Course Code: EEE 2211
Course Title: Electronic CircuitII
Course Credit: 3
Prerequisites: EEE 2211

Course Description: This course introduces the characteristics and applications of feedback, oscillator and multivibrators. Emphasis is on analysis, selection, design and troubleshooting.

Objectives:
1. To familiarize the students with construction and electrical characteristics of semiconductor diodes, transistors and FETs.
2. To explain their use and behavior in fundamental application like rectification and amplification.
3. To discuss how the circuit parameters are calculated in order to use them in particular circuit.

Course Learning Outcome (CLO): The students will be able to:
1. Understand the various types of amplifier.
2. Solve different problems associated with amplifier circuits.
3. Analyze the characteristics of feedback and oscillator circuits.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Frequency Response of Amplifiers:** Low frequency response of BJT	Lecture, Discussion,

	and FET amplifier, Bode plot, Miller's theorem, High frequency response of BJT and FET amplifier, Frequency effects of Multistage amplifiers	Problem Solving
1	**Power Amplifiers:** Power amplifiers, power transistors, classification, collector efficiency, classes of amplifiers, Class-A, class-B, class-C power amplifier, Class-AB push pull complimentary output stage.	Lecture, Discussion, Problem Solving
2	**FET Amplifiers:** MOSFET amplifier: basic transistor amplifier configurations-Common-Source, Common-Gate Stage, Source Follower (common drain); single stage integrated circuit MOSFET amplifiers, multistage amplifiers, basic JFET amplifiers.	Lecture, Discussion, Problem Solving
	Section B	
3	**Feedback and Stability:** Basic feedback concept, positive and negative feedback, feedback voltage amplifiers, Stability study of feedback amplifier using Bode Plots.	Lecture, Discussion, Problem Solving
3	**Oscillators:** The oscillation criterion, Analysis and classification of oscillator, basic principle of sinusoidal oscillators, Op-Amp RC oscillators, RC phase shift oscillator, Wein bridge oscillator, Resonant circuit oscillators, and Crystal oscillator;	Lecture, Discussion, Problem Solving
	Multivibrators: Introduction, Construction and working principle of Monostable, Bistable, and Astablemultivibrators.	

Suggested Reading Lists/Essential Readings:

1. Robert Boylestad and Louis Nashelsky : Electronic Devices and Circuits
2. A. Mottershead Electronic Devices and Circuits, An Introduction
3. Albert P. Malvino and David J. Bates : Electronic Principles
4. David A. Bell : Electronic Devices and Circuits
5. J. Millman and C.C. Halkias : Electronic Devices and Circuits

Course Code: EEE 2212
Course Title:Electronic CircuitII Sessional
Course Credit: 3
Prerequisites: EEE 2211

Course Description: In this course students will perform experiments to practically verify the theories learned in the theory course EEE 2211.

Objectives:
1. To give hands-on experience of electronic circuits studied in course EEE 2211.
2. To familiarize the students about the design principles of feedback amplifiers and oscillators.
3. To show them how the power amplifiers are designed.

Course Learning Outcome (CLO):
Upon completion of this course, students should be able to:
1. Identify MOS devices and use them in the amplifier circuits
2. Design feedback amplifiers using Op Amps
3. Design oscillator circuits using feedback principle.

Course Code: EEE 2221
Course Title: Electrical Machine II
Course Credit: 3
Prerequisites: EEE 2211

Course Description:
Different AC and DC machines are widely used in small and industrial purposes. This course intends to provide necessary conception to work with DC machines, Alternator and some Special machines. Both DC generator and motors will be discussed in detail with regard to their construction, classification, connections, testing, and performance characteristics. AC generator and motors will also be discussed in detail. Some special purpose machine will be studied. Applications of these concepts in solving engineering problems will also be covered.

Objectives:
5. To understand the basic concepts of DC and synchronous machines with particular focus on their fundamentals and operating characteristics.
6. To understand the construction and operating principles of special machines and their applications in special purposes.
7. To gain an understanding about the testing of DC and synchronous machines.
8. To learn many techniques to analyze the performance characteristics of DC and synchronous machines and solve related machinery problems.

Course Learning Outcome (CLO):
Upon completion of this course, students should be able to:
1. Understand elementary concepts of DC machines and apply concepts of DC machines to analyze the performance characteristics of DC generators and motors and solve DC machinery problems.
2. Understand elementary concepts of special machines and apply concepts of special machines to analyze and solve machinery problems.
3. Understand construction and principles of synchronous machines and apply concepts of these machines to analyze the performance characteristics of synchronous generators and motors and solve related machinery problems.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**D.C. Generator:** Principles, Construction, Classification, Armature windings, Voltage build up, Armature reactions and Commutation, Performance and testing, Compounding of d.c. generator, Generator characteristics, Voltage regulation, Losses and efficiency, Parallel operation.	Lecture, Discussion, Problem Solving
1	**D.C. Motor:** Operation, Types, Back e.m.f, Torque equations, Motor characteristics, Speed-Torque Characteristics, Speed regulation, Losses and efficiency, Methods of speed control, Methods of braking, Starters, Amplidyne and Metadyne.	Lecture, Discussion, Problem Solving
2	**Special Machines:** Welding machine, Brushless machines, universal motor, stepper motor, reluctance motor, repulsion motor, servomotor, Hysteresis motor, permanent magnet motor and electrostatic motor.	Lecture, Discussion, Problem Solving
	Section B	
3	**Synchronous Generator:** Alternator construction. Armature winding, air gap flux and voltage compensation. Determination of machine parameters. Vector diagram and alternator regulation by different methods. Parallel operation: necessary condition, synchronizing, circulating current. Transient condition of alternator, transient and sub-transient reactances, Blondel's two reaction analysis. Power balance, loss and efficiency.	Lecture, Discussion, Problem Solving
3	**Synchronous Motor:** Characteristics operation and vector diagram. Effect of	Lecture,

	excitation on power factor and motor performance. Application and testing of synchronous motor. Synchronous capacitor and power factor improvements.	Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:

1. Stephen J. Chapman : Electric Machinery and Power System Fundamentals
2. A. Fitzgerald : Electric Machinery
3. A. Puchstein, T E Loyd and A.G. Conard : Alternating Current Machines
4. B. L. Thereja, A. K. Thereja : A Textbook of Electrical Technology, Volume II
5. J. Rosenblatt & M. H. Friedman : Direct and Alternating Current Machinery

Course Code: EEE 2222
Course Title: Electrical Machine II Sessional
Course Credit: 1

Course Description:

Different AC and DC machines are widely used in small and industrial purposes. This course intends to provide the student a hand on experience of testing and controlling of both AC and DC machines they are taught in EEE 2221 course.

Objectives:

1. To demonstrate the details construction of AC and DC machines.
2. To provide hands on experience for analyzing the performance characteristics of AC and DC machines.
3. Students will gain practical experience about the testing of AC and DC machines.
4. Students will gain practical experience about the controlling of AC and DC machines.

Course Learning Outcome (CLO):

Upon completion of this course, students should be able to:

1. Understand elementary concepts and construction of AC and DC machines, and practically find out the efficiency of these machines.
2. Analyze and control the performance characteristics of DC machines.
3. Analyze and control the performance characteristics of AC machines

CLO Mapping	Contents	Teaching-Learning Strategy
1,2,3	Familiarization with the equipment's of the Electrical Machines Lab.	Demonstration Discussion Lab practice
2	Verification of the Torque Speed Characteristics curve of a DC Shunt Motor.	Open discussion Lab practice
2	Verification of the Torque Speed Characteristics curve of a DC Series Motor.	Open discussion Lab practice
2	Verification of the Torque Speed Characteristics curve of a DC Compound Motor.	Open discussion Lab practice
2	Verification of the No Load Magnetization Curve of a Separately Excited DC Shunt Generator.	Open discussion Lab practice
2	Observation of characteristics curve of a DC Generator a). Generation Voltage (E_g) Versus Field Current(I_F) Curve at Constant Speed. b). Generation Voltage (E_g) Versus Speed at Constant Field Current(I_F).	Open discussion Lab practice

2	Comparison of the Terminal Voltage(Vt) Vs Load Current(I_L) curve of a DC Shunt Generator using Varying Load at constant Speed.	Open discussion Lab practice
3	Observation of the characteristics curves of a synchronous motor (V-curve: Armature current versus Field current for constant load.)	Open discussion Lab practice
3	Study of Alternator by Changing (i) Loads (ii) Excitation Voltage (iii) Changing Terminal Voltage/Speed	Open discussion Lab practice
3	Synchronization of Three Phase Alternator with grid by using Lamps.	Open discussion Lab practice

Course Code:EEE 2231
Course Title: Digital Logic Design
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course introduces the concept of digital electronics. It discusses the design techniques, circuit implementation and operation of various digital logic devices and circuits and along with their practical applications.

Objectives:
1. To introduce the concept of digital and binary systems to the students
2. To enable the students to understand, differentiate and analyze combinational and sequential logic circuits
3. To build up students capability to design and construct various combinational and sequential logic circuits
4. To develop students idea about the application and utilization of digital systems

Course Learning Outcome (CLO): Upon successful completion of this course the students will be expected to:
1. Understand the binary logic system and evaluate the operation of digital devices and circuits
2. Minimize logic functions using K-map and other methods
3. Analyze the operation of combinational and sequential logic circuits
4. Design and construct various logic circuits such as adders, A/D or D/A converters, counters, memory devices and displays
5. Learn about the application of MOS technology in digital electronics

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Introduction to Number Systems and Logic Gates:** number systems, number base conversions, complements, binary codes, BCD numbers, Boolean algebra, postulates and theorems, basic logic functions, digital logic gates, logic families (DL, DTL, TTL, ECL, BiCMOS)	Lecture/Discussion, Problem solving
2	**Minimization and Implementation of Boolean Functions:** Forms of Boolean functions, canonical and standard forms, Shannon's theorem, Minimization of Boolean functions using Karnaugh map, QuineMclusky method, Iterative consensus method, Implementation of switching functions (Using various gates: NOR, NAND, AND - OR- INVERT).	Lecture/Discussion, Problem solving
3,4	M**odular Combinational Circuit Design**; pass transistor, pass gate, Half adder, Full adder, multiplexer, demultiplexer, decoder, encoder, binary arithmetic elements and ALU design.	Lecture/ Problem solving,
3,4	**Converters:** Digital to analog conversion, D/A converter circuitry, DAC specifications and applications, Analog to digital conversion, Digital ramp ADC. A/D resolution and accuracy.	Lecture, Problem solving
	Section B	

3,4	**Sequential Logic:** Difference between combinational circuits and sequential circuits, Types of sequential circuit, Flip-Flops (Basic flip-flop circuit, clocked RS flip-flop, D flip-flop, JK flip-flop, T flip-flop), Triggering of Flip-flop, Analysis of clocked sequential circuits (state table, state diagram, state equations), state reduction, state assignment.	Lecture/Discussion, Problem solving, Demonstration
3,4	**Counter Design:** Types of counters, Design of synchronous and asynchronous counter, MOD number, propagation delay in Ripple counter,Ring counter, The Johnson Counter,	Lecture/Discussion, Problem solving, Demonstration
3,4	**Register and Memory Unit:** Basic shift register, Serial In/Serial out shift registers, Serial In/Parallel out shift register, Parallel In/Serial out shift register, Bidirectional shift register, Memory: Integrated circuit memory, Classification and architecture, RAM memory cells, Read only memory, Magnetic core memory.	Lecture/Discussion, Problem solving, Demonstration
5	**MOSFET Digital Circuits:** NMOS inverter, CMOS inverter, CMOS logic circuits, Clocked CMOS logic circuits, transmission gates.	Lecture/Discussion, Problem solving

Suggested Reading Lists/Essential Readings:

1. Thomas L. Floyd : Digital Fundamentals
2. A.P.Godse, D.A.Godse : Digital Electronics And Logic Design
3. M. Morris Manno : Digital and Computer Design
4. Tocci and Widmer : Digital Systems
5. V.K. Jain : Switching Theory and Digital Electronics
6. S.C. Lee : Digital Circuit and Logic Design

Course Code:EEE 2232

Course Title:Digital Logic Design Sessional

Course Credit: 1

Pre-requisite: EEE 2231

Course Description:

In this course students will perform experiments to practically verify the theories, concepts, design techniques, circuit implementation and operation learned in the course EEE 2231.

Objectives:

4. To demonstrate the concept of digital and binary systems through practical experiments.
5. To enable the students to understand, differentiate and analyze combinational and sequential logic circuits
6. To develop students idea about the practical use and limitations of digital circuits

Course Learning Outcome (CLO):

Upon successful completion of this course the students will be expected to:

5. Learn the design techniques, implementation and operation of digital devices and circuits
6. Construct and explain the operation of various combinational and sequential logic circuits such as adders, A/D or D/A converters, counters, memory devices and displays
7. Design and construct digital circuits using MOS

CLO Mapping	List of experiments	Teaching-Learning strategy
1	To construct the following logic gates using DL and DTL and study their operation: i) AND gate ii) OR gate iii) NOT gate iv) NAND gate v) NOR gate	Discussion, Experiment, Report writing
1	To construct the following logic gates using NAND/NOR only and study their operation: i) AND gate ii) OR gate iii) NOT gate iv) NAND gate v) NOR gate	
1,2	To construct and study i) a Half adder and ii) a 2-bit full adder	
1,2	To construct and study the operation of a Master – Slave J-K flip-flop using NAND gate only.	
1,2	To construct and study i) an A/D and ii) a D/A converter	
1,3	To construct the following logic gates using NMOS and CMOS and study their	

	operation: i) AND gate ii) OR gate iii) NOT gate iv) NAND gate v) NOR gate	

Suggested Reading Lists/Essential Readings:

1. Thomas L. Floyd : Digital Fundamentals
2. A.P.Godse, D.A.Godse : Digital Electronics And Logic Design

Course Code: EEE 2242
Course Title: Circuit Simulation Sessional
Course Credit: 1
Pre-requisite: N/A

Course Description:
In this course students will verify theories and concepts learned in electrical and electronic circuit theory courses using simulation software(s). PSPICE, MATLAB, PROTEUS and other simulation software will be introduced.

Objectives:
1. To familiarize the students with software used for simulating electrical and electronic circuits.
2. To discuss how to verify a circuit after it is designed, and before implementing it in a circuit board.

Course Learning Outcome (CLO):
The students will be able to:
1. Use PSPICE, MATLAB and Proteus software for simulating electrical and electronic circuits.
2. Write codes in PSPISE and MATLAB for calculating parameters of a circuit consisting of resistors, capacitors, inductors, diodes and transistors.
3. Draw a circuit in Proteus software and simulate its operation.

Course Code: MATH 2251
Course Title: Complex Variables, Co-ordinate Geometry and Vector Analysis
Course Credit: 3
Pre-requisite: N/A

Course Description:
The course will introduce the fundamentals of complex variables, co-ordinate geometry and vector analysis for engineering and applied science streams.

Objectives:
1. To learn functions of complex variable and related theorems.
2. To get familiar with Complex differentiation, infinite series and convergence phenomena.
3. To get familiar with line integral, integral formula and related theorems of a complex function and apply the concept to real world phenomena.
4. To gain an understanding about co-ordinate geometry of three dimension-System of co-ordinates.
5. To learn different theorems of vector analysis and apply the concept in real world problems.

Course Learning Outcome (CLO): The students will be able to:
1. Apply the concepts of complex variable to real world phenomena such as electrical networks, communication networks and other engineering majors.
2. Get accustomed in applying the concepts of co-ordinate geometry and vector analysis in electromagnetic field calculation and antennas
3. Improve their ability to communicate via the language of mathematics with the abstract world.

CLO mapping	Course content	Teaching-learning strategy
	Section A	

1, 3	**Complex Variable:** Complex number system. General functions of a complex variable. Limits and continuity of a function of complex variable and related theorems. Complex differentiation and the Cauchy-Riemann equations. Infinite series. Convergence and uniform convergence. Line integral of a complex function. Cauchy's integral formula. Liouville's theorem. Taylor's and Laurent's theorem. Singular points. Residue. Cauchy's residue theorem.	Lecture, Discussion, Problem Solving
	Section B	
2, 3	**Co-ordinate Geometry:** Co-ordinate geometry of three dimension-System of co-ordinates, transformation of co-ordinates, distance between two points, section formula, projection, direction cosines, equations of planes and lines, sphere, cylinder and cone. The general equations of second degree and reduction to standard forms. Identification of conicoid.	Lecture, Discussion, Problem Solving
2, 3	**Vector Analysis:** Multiple product of vectors. Linear dependence and independence of vectors. Differentiation and integration of vectors together with elementary applications. Line, surface, and volume integrals. Gradient of a scalar function, divergence and curl of a vector function, various formulae. Integral forms of gradient, divergence and curl. Divergence theorem. Stoke's theorem, Green's theorem and Gauss's theorem.	Lecture, Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:

1. M. R. Spiegel : Vector Analysis
2. M. A. Sattar : Vector Analysis
3. J. B. Conway : Functions of one complex variable
4. L. V. Ahlfors : Complex Analysis
5. D. Sarason : Notes on complex function theory
6. S.L. Loney : Analytic Coordinate Geometry
7. J.T. Bell : A Treatise on Three Dimensional Geometry
8. C. Smith : An Elementary Treatise on Solid Geometry

Course Code: STAT2211
Course Title: Statistics for Engineers
Course Credit: 2

Course Description:

The purpose of this course is to provide students about concepts of basic statistics, statistical distributions and probability and their extensive use in real life situations, in particular, in the area of science and engineering. The goal is to familiarize students with powerful analytical and numerical tools in the areas of probability and statistics that can be used to solve real life problems.

Objectives:

The objectives of this course is to

1. Practice statistical methodology and tools in the engineering problem-solving process
2. Develop probabilistic and statistical models for some applications, and apply statistical methods to a range of problems in science and engineering
3. Perform the basic tests.

Course Learning Outcome (CLO):

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

1. Analyze the statistical data using numerical and graphical techniques
2. Evaluate various quantities for probability distributions and random variables
3. Compute and interpret the linear regression analysis
4. Validate basic tests for simple hypothesis.

CLO Mapping	Course content	Teaching-learning strategy
	Section A	
1	**Analysis of Statistical Data:** Location, Dispersion and their measures, Skewness, Kurtosis and their measures, Moment and Cumulants and Practical examples.	Lecture Exercise Open discussion Debates Attendance
2	**Probability:** Concept of probability, Sample Space, Events union and Intersection of Events. Probability of events, Loss of probability, Conditional probabilities. Bay's Theorem, Chebysec's Inequality and Practical examples.	
	Section B	
3	**Linear Regression:** Correlation, Rank correlation. Partial and Multiple Correlations Linear Regression for two Variables, Principle of Least Squares Method, Lines of best fit, Residual Analysis and examples.	Lecture Exercise Open discussion Debates Attendance
4	**Test of Significance:** Basic ideas of Null hypothesis, Alternative hypothesis, Type-I error Type-II error level of significance Degree of freedom, Rejection region and Acceptance region. Test of Single mean, Single variance, two sample means and Variances. Test for 2×2 contingency tables, Independence test and practical examples. Application in quality control, failure pattern, depreciation calculation.	

Suggested Reading Lists/Essential Readings

1. P.G. Hoel : Introductory Statistics
2. S.G. Gupta : Fundamentals of Statistics
3. A. J. B. Anderson : Interpreting Data
4. H. Cramer : The Elements of Probability Theory
5. D. V. Lindley : Introduction to Probability and Statistics
6. S. Lipschutz : Probability

Course Code: MGT 2211
Course Title: Law and Professional Ethics
Course Credit: 2

Course Description:
This course will familiarize students with the legal issues concerning business entities and labors. The second part of this course will teach the moral and ethical codes to be followed by an individual, especially by an engineer.

Objectives:
1. Introduce students about professional ethics and the laws concerned with business and labor.
2. Develop probabilistic and statistical models for some applications.
3. Apply statistical methods to a range of problems in science and engineering.

Course Learning Outcome (CLO): The students will be able to**:**
1. Learn about the legal side of a business entity and concerned parties.
2. Learn the ethical and moral duties and obligation of an engineer as part of the society.

CLO Mapping	Course content	Teaching-learning strategy
	Section A	
1	**Law:** Principle of law of contract	Lecture Exercise Open discussion Debates Attendance
2	**Company Law:** The companies act with special reference to the amendments and ordinances applicable to Bangladesh. Law regarding formation	
	Labor Law: The scope and sources of labor law. Law in relation to wages	
	Section B	
3	**History and Development of Engineering Ethics:** Study of Ethics in Engineering. Applied Ethics in engineering.Human qualities of an engineer.Obligation of an engineer to the clients and to other engineers.Measures to be taken in order to improve the quality of engineering profession.	Lecture Exercise Open discussion Debates Attendance
4	**Ethical Expectations:** Employers and Employees inter-professional relationship, maintaining a commitment of Ethical standards. Desired characteristics of a professional code. Institutionalization of Ethical conduct cyber law moral thoughts.	

Suggested Reading Lists/Essential Readings

1. A. K. Sen : A Hand Book of Commercial Law
2. A. B.Siddique : The Law of Contract
3. A. A. Khan : Labour and Industrial Law
4. Emile Durkheim : Professional Ethics and Civics Morals
5. J. D. Mabboth : An Introduction to Ethics
6. A. R. Khan Business Ethics.
7. M. Radar Ethics and the Human Community.

B.Sc. Engg. Part-III, Odd Semester, Examination 2023

Course Code: EEE 3111
Course Title: Power System I
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course introduces fundamental concepts of power transmission line parameters, applicability ofper-unit system in circuit calculations with proper understanding of equivalent circuits of power transmission lines. The course also emphasizes onvarious types of analysis (steady state analysis of power system network, fault and protection).

Objectives:

1. Describe how the inductance and capacitance of transmission line are calculated.
2. Perform load flow computations with the help of the Newton-Raphson method.
3. Analyze the load flow results.
4. Explain the occurrence of both symmetrical and unsymmetrical faults for power system collapse.
5. Perform fault level calculations with selection of relays and circuit breakers.

Course Learning Outcome (CLO):
Upon completion of the course the student will be able to
1. Calculate transmission line parameters
2. Represent equivalent circuits of various types of power transmission line
3. Analyze complex commercial power systems using various Iterative algorithms
4. Understand the considerable effect on electrical equipment due to faulting.
5. Be familiarize with various types of protectiondevices used for electrical power system

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Network Representation:** Inductance and Capacitance of overhead power transmission line Single line and reactance diagram of power system and per unit system.	Lecture/Discussion and Problem solving
2	**Line Representation:** Equivalent circuit of short, medium and long lines, reactive power compensation of lines, introduction to DC transmission.	Lecture/Discussion, Problem solving
3	**Load Flow Studies:** Gauss-Seidel and Newton Raphson methods, Power flow control: Tap changing transformer, phase shifting, booster and regulating transformer and shunt capacitor	Lecture/ Discussion and Problem Solving
	Section B	
1	**Fault Analysis:** Transient and sub-transient reactance and Short circuit current of a synchronous machine. Symmetrical fault calculation, symmetrical components, sequence impedance and sequence networks of generators, transformers and lines. Different types of unsymmetrical faults: solid faults and faults through impedance. Unsymmetrical fault calculation.	Lecture/ Discussion and Problem Solving
2	**Protection:** Fault level calculation, selection of circuit breakers, introduction to relays and circuit breakers. Typical layout of a substation.	Lecture/ Discussion and Problem Solving

Suggested Reading Lists/Essential Readings Recommended Books

1.William D. Stevenson — Elements of power system analysis Fourth Edition
2.V.K. Mehta and Rohit Mehta — Principles of Power System
3.D P Kothari and I J Nagrath — Power System Engineering Second Edition
4.Ashfaq Hussain — Electrical Power System Fourth Edition
5.Hadi Saadat — Power system analysis
6.M.N. Bandyopadhyay — Electrical Power Systems: Theory and Practice

Course Code: EEE 3112

Course Title: Power System I Sessional
Course Credit: 1
Pre-requisite: N/A

Course Description:
In this course students will get hands-on experience on performingexperimentsfor verifying the theories and concepts learned from the course **EEE 3111.**

Objectives:
1. To show how the inductance and capacitance of transmission line are calculated.
2. To perform power flow analysis effectively with Iterative Newton-Raphsonalgorithm
3. To provide hands on experience for both symmetrical and unsymmetrical fault analysis
4. To perform fault current analysis for determining ratings of relays and circuit breakers.

Course Learning Outcome (CLO):
Upon completion of the course the student will be able to:
1. Understand the concept of MATLAB programming in calculating the transmission line parameters.
2. Understand the concept of MATLAB programming for power flow analysis
3. Conduct Line to Ground (L-G) Fault analysis of a Single Phase Transmission Line
4. Single Line to Ground Fault (L-G) analysis of a Three Phase Transmission Line.
5. Understand the concept of MATLAB programming to determine ratings of relays and circuit breakers.

CLO Mapping	**Course Content** (List of experiments)	**Teaching-Learning Strategy**
1	Determination ofinductance and capacitance of transmission line usingMATLAB	Using MATLAB programming tool
2	Analysis of power flow with IterativeNewton-Raphsonmethod	Using MATLAB programming tool
3	Measurement of Line to Ground (L-G) Fault current of a Single Phase Transmission Line	Using Symmetrical and Unsymmetrical fault Demonstrating training system
4	Measurement of Single Line to Ground Fault (L-G) current of a Three Phase Transmission Line	Using Symmetrical and Unsymmetrical fault Demonstrating training system
5	Determination of ratings of relays and circuit breakersusingMATLAB	Using MATLAB programming tool

Course Code:EEE 3121
Course Title: Electronic Circuit III
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course introduces various types of wave shaping circuits as well as discusses the characteristics and applications of analog IC, OpAmp and Timing circuits.

Objectives:

1. To familiarize the students with operational amplifier applications
2. To introduce the concept of signal wave-shaping
3. To enable the students to understand and analyze timer circuits
4. To improve students skill of analysis, selection, design and troubleshooting of circuits
5. To enable the students to learn about the design, features and applications of various ICs

Course Learning Outcome (CLO):

Upon successful completion of this course the students will be expected to:

1. Analyze the operation of OPAMP and circuit made of OPAMPs
2. Learn about linear wave-shaping circuits
3. Design and construct and troubleshoot linear wave-shaping circuits
4. Understand the design, features and applications of various integrated circuits (ICs)
5. Learn about the noise in ICs

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Operational Amplifiers:** Ideal operational amplifier and OP-AMP circuits; Differential vs. common mode operations; applications of OP-AMP: inverting amplifier, non-inverting amplifier, summing amplifier, differential amplifier, logarithmic amplifier, operational transconductance amplifiers, exponential amplifier, differentiator, integrator, voltage to current converter, voltage follower; Non-ideality of op-amp; Frequency response, bandwidth and other practical limitation of op-amps, compensation techniques.	Lecture/Discussion, Problem solving
2	**Linear Wave Shaping:** The high-pass and low pass RC circuits (Sinusoidal, Step-voltage, Pulse, Square-wave, Exponential and ramp inputs), The high-pass RC circuit as a differentiator, The low-pass RC circuit as an integrator, Attenuator, RL circuits, RLC circuits, Ringing circuits.	Lecture/Discussion, Problem solving, Demonstration
3,4	**555 Timer:** 555 IC and its Applications, Astable, Monostable and Bistable operation in 555 IC.	Lecture/Discussion, Problem solving, Demonstration
	Section B	
3,4	**Integrated Circuit Biasing and Active Loads:** BJT current sources, FET current sources/sinks, small signal analysis of active loads, design applications: an NMOS current source; differential and multistage amplifiers: BJT differential amplifier, FET differential amplifier, differential amplifier with active load, small signal analysis and frequency response of differential amplifiers.	Lecture/Discussion, Problem solving, Demonstration
3,4	**Applications and Design of Integrated Circuits:** Active filter-types and design, realization of low-pass and high pass first order and second order Butterworth filter using Op-Amps, bandpass and band reject filters, all pass filters; Voltage comparators, Schmitt trigger circuits, sample and hold circuit, IC comparator.	Lecture/Discussion, Problem solving, Demonstration
3,4	**Analog IC Design:** Bipolar, MOS and BiCMOS IC technology and its impact, eggshell analogy, application areas and the future of analog IC design.	Lecture/Discussion
5	**Noise in IC:** Origin of internally developed noises in ICs. Representation of noises in circuits, noises in single stage and differential amplifiers, noise bandwidth.	Lecture/Discussion, Problem solving

Suggested Reading Lists/Essential Readings:

1. Robert Boylestad and Louis Nashelsky : Electronic Devices and Circuits
2. Ramakant A. Gayakward : Op-Amps and Linear Integrated Circuits
3. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer : Analysis and Design of Analog Integrated Circuits
4. J. Millman and C.C. Halkias : Integrated Electronics
5. Robert F. Coughlin : Operational Amplifier and Linear Integrated Circuits
6. Albert P. Malvino and David J. Bates : Electronic Principles
7. J. Milman and H.Taub : Pulse, Digital and Switching Waveforms

Course Code:EEE 3122
Course Title: Electronic Circuit III Sessional
Course Credit: 1
Pre-requisite: EEE 3121

Course Description:
In this course students will perform experiments to practically verify the theories, concepts, design techniques, circuit implementation and operation learned in the course EEE 3121.

Objectives:

1. To demonstrate the concept of signal wave-shaping through practical experiments.
2. To enable the students to construct, differentiate and analyze various OpAmp and Timing circuits
3. To develop students idea about the practical use and limitations of ICs

Course Learning Outcome (CLO):

Upon successful completion of this course the students will be expected to:
1. Able to analyze the operation of OPAMP and construct various circuits using OPAMPs
2. Construct and explain the operation of wave-shaping circuits such as filters, attenuators etc.
3. Design and construct electronic circuits using 555 Timer IC and demonstrate their operation.
4. Construct and study active filter circuits.
5. Calculate the noise in ICs.

CLO Mapping	Course Content	Teaching-Learning strategy
1	To construct the following circuits using OP-AMP and study their operation: i) Inverting Amplifier ii) Non-inverting amplifier iii) Summing amplifier vi) Integrator v) Differentiator vi) Schimitt Trigger	Discussion, Lab experiment, Report writing
2	To construct i) an RC low pass and ii) an RC high pass filter and find the following: a) Cut-off Frequency ii) Characteristic impedance iii)Attenuation constant iv) Phase constant	Discussion, Lab experiment, Report writing
3	To design the following using 555 Timer and study their operation:i)Astablemultivibrator ii) Monostablemultivibrator iii) Bi-stable multivibrator	
4	To design and study the following active filter circuits i) Low pass ii) High pass ii) Band Pass and iv) Band elimination	
2,5	To design and study an NMOS current source	

Suggested Reading Lists/Essential Readings:

1. Robert Boylestad and Louis Nashelsky : Electronic Devices and Circuits
2. Ramakant A. Gayakward : Op-Amps and Linear Integrated Circuits
3. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer : Analysis and Design of Analog Integrated Circuits
4. J. Millman and C.C. Halkias : Integrated Electronics
5. Robert F. Coughlin : Operational Amplifier and Linear Integrated Circuits
6. Albert P. Malvino and David J. Bates : Electronic Principles
7. K. Milman and H.Taub : Pulse, Digital and Switching Waveforms

Course Code: EEE 3131
Course Title: Electromagnetic Fields and Waves
Course Credit: 3

Course Description:
Engineering electromagnetics plays most fundamental role over the modern wireless communications. This course brings the basics and application of electromagnetic theory in electrical and electronic engineering. Areas include: field equations: electrostatics, Gauss's law, magnetostatics, Ampere's law, Biot-Savart law, electric and magnetic fields in materials, E-H symmetry, Faraday's law of electromagnetic induction, capacitance and inductance in circuit models, differential and integral forms of Maxwell's equations, boundary field conditions, electromagnetic waves, propagation of plane waves from media boundaries, radiation, antenna fundamentals, propagation of electromagnetic waves, transmission line theory, wave guide etc.

Objectives:

After successful completion of this course students would learn:

1. Basic concepts and application of electromagnetics (EM) through the understanding of various laws of E-fields and H-fields along with relationship with each other and various distributions.
2. How to employ basic and advanced mathematics to materialize the EM.
3. Importance, understanding and application of Maxwell's equations to study the EM wave.
4. EM wave propagation: reflection and refraction.
5. To be introduced with antenna fundamentals and how EM work with antenna.
6. Different type antennas: applications and limitations.
7. Principle of EM transmission and reception.
8. Concepts and applications of waveguides.
9. EM transmission mechanism through transmission line concepts.

CLO Mapping	Course content	Teaching-learning strategy
1	**Basics laws and applications of EM: f**ield equations based on laws of Coulomb, Gauss, Ampere, Biot-Savart, and Faraday; displacement current	Lecture
1, 2	**Understanding of various law of E and H fields:** E-H symmetry, Lorenz's lemma, scalar and vector potentials, retarded potentials, Laplace's and Poisson's equations and their solutions	Lecture Exercise Open discussion
2	**Role of math and its uses over EM:** Vector analysis	Lecture Exercise
3	**Understanding of Maxwell's equations:** Maxwell's equations, differential and integral forms, units and dimensions of field vectors	Lecture Exercise Open discussion
4	**EM wave propagation mechanism:** Plane wave concept, Doppler effect, transverse electromagnetic wave, polarization of plane wave; phase and group velocities, Poynting vector, Joule heating in good conductors. Ground wave, Sky wave and Space wave propagation;Boundary conditions, laws of reflection and Snell's law of refraction, reflection from dielectrics and conductors, Fresnel's equations, The Brewster angle, Total reflection, skin effect, Reflection and refraction in the ionosphere.	Lecture Exercise Open discussion
5,6	**Introduction, classification and application of antenna:** antenna, applications, linear antenna, dipole antenna, Hertz and Marconi antenna, broadcast tower antenna, Yagi antenna, horn antenna, parabolic, periodic, parasitic, lens antenna. micro-strip patch antenna, and their uses. antenna array, array factor and directivity	Lecture
6,7,8	**Introduction to transmission lines and wave guides**	Lecture Exercise Open discussion

Suggested Reading Lists/Essential Readings:

1. Matthew N.O. Sadiku : Elements of Electromagnetics

2. D. K. Cheng : Fields and Wave Electromagnetics
3. W. H. Hayt& J. A. Buck : Engineering Electromagnetics
4. A.B. Brownell and R.E. Beam : Theory and Application of Microwave.
5. J.D. Kraus : Antenna
6. Louis E. Frenzel : Communication Electronics
7. Dale Corson, Paul Lorrain : Introduction to Electromagnetic Fields and Waves
8. S.Ramo, J. R. Whinnery, T. V. Duzer: Fields and Waves in Communication Electronics

Course Code: EEE 3141
Course Title: Electrical Properties of materials
Course Credit: 3
Pre-requisite: N/A

Course Description:
The fundamentals of construction of materials and their properties will be introduced.The effect of temperature on materials conductivity and Hall Effect will be presented. Both classical and quantum theory will be explained. Band theory of solids will be covered. Dielectric properties of solid will be presented. The course will cover ferroelectricity, pizoelectricity and pyroelectricity. The magnetic properties of solids and the basic theory of superconductivity will be explained.

Objectives:
1. To understand the basic building blocks of solid and band theory of solids.
2. Materials properties like electrical and thermal conductivity will be explained in the light of classical theory.
3. To introduce quantum theory for better understanding of properties of solid.
4. Dielectric properties and dielectric parameters of materials will be taught.
5. To know various magnetic materials and their properties.
6. Superconductivity property of solid and their models will be explained.

Course Learning Outcome (CLO):
Upon completion of this course the students will be able to:
1. Illustrate the construction of various crystal and construct structure of crystal.
2. Explain various properties of crystals using classical, quantum and band theory.
3. Interpret dielectric properties of materials and identify dielectric materials for various applications.
4. Classify magnetic materials and explain the origin of magnetism.
5. Explain the origin of zero resistivity in superconductor.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1, 2	**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, Electron in a 3D box. Hydrogen Atom.	Lecture/ Problem solving / Demos/ Presentation
1, 2	**Band Theory of Solids:** Band theory from molecular orbital, Bloch theorem, Kronig-Penny model, Brillouin zone, 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.	

	Section B	
3	**Dielectric Properties of Materials:** Dielectric constant, polarization-electronic, ionic, orientational and interfacial; internal field, Clausius-Mosotti equation, spontaneous polarization, frequency dependence of dielectric constant, dielectric loss, piezoelectricity, ferroelectricity, pyroelectricity.	Lecture/Discussion/ Presentation
4	**Magnetic Properties of Materials:** Magnetic moment, magnetization and relative permittivity, different types of magnetic materials, origin of ferromagnetism and magnetic domains.	
5	**Introduction to Superconductivity:** Zero resistance and Meissner effect, Type I and Type II superconductors and critical current density. BCS theory. Magnetic recording materials, Josephson theory. Introduction to meta-materials.	

Suggested Reading Lists/Essential Readings:

1. Safa O. Kasap : Principles of Electronic Materials and Devices
2. J. Dekker : Solid State Physics
3. C. Kittel : Introduction to Solid State Physics
4. J. Mckelvy : Solid State and Semiconductor Physics
5. L.J. Azaroff and J.J. Brophy : Electronic Process in Materials
6. C.A. Wert and R.M. Thomson : Physics of Solids
7. Rogers, Pennathur, Adams : Nanotechnology: Understanding Small Systems

Course Code: EEE 3151
Course Title: Measurement and Instrumentation
Course Credit: 3
Prerequisite: N/A

Course Description:
This course will provide concepts to the student for the generation of information and knowledge on measurement of physical variables as encountered in our everyday life and during scientific experimentation along with their significance of measurements.

Objectives:

1. To understand the necessities of physical variables as encountered in everyday life and during scientific experimentation along with their significance of measurements.
2. To understand and use statistical methods to perform calibrations, quantify measurement uncertainties, and propagate uncertainties through systems.
3. To understand the properties (e.g. mechanical, hydraulic, electrical, magnetic, optical, pneumatic and so on) of the physical variables of interests.
4. To understand how to convert physical variables into measurable forms through proper selection of devices along with their properties and selection criteria.
5. To understand how to choose the physical variable sensing devices, write and solve governing equations to control, design and implement circuits of interests for measurements.

Course Learning Outcome (CLO):

Upon completion of this course the students will be able to:
1. Understand the significance and use of instruments.
2. Understand and use statistical methods to perform calibrations, quantify measurement uncertainties, and propagate uncertainties through systems.
3. Understand the properties (e.g. mechanical, hydraulic, electrical, magnetic, optical, pneumatic and so on) of the physical variables to be measured.
4. Understand the conversion of physical variables into measurable forms.
5. Understand sensing devices, writing and solving governing equations for system control, designing and implementing circuits for measurements as instrument.

CLO Mapping	Course Content	Teaching-Learning Strategy
	Section-A	
1,2	**Introduction:** Methods of measurement, Statistical method applied to field of measurement and error analysis and calibration.	Instruction & problem solving
3,4	**Resistance, Inductance and Capacitance Measurement:** Different Methods of measuring high, medium and low resistances. Methods of measuring self and mutual inductance and capacitance measurement. A.C and D.C bridge methods, Measurement of insulation and earth resistances, Localization of cable fault.	Instructional, problem solving & Experimental
3,4	**Magnetic Measurement:** Ballistic galvanometer, Tangent galvanometer, D-Arsonval galvanometer, Flux meter, Flux and Flux density measurement, Determination of iron losses and their separation. Speed, frequency and phase difference measurement. Illumination measurement.	Instructional, problem solving & Experimental
3,4	**Measuring Instruments:** Classification of measuring instruments, Ammeter, Voltmeter, wattmeter, AVO meter, Energy meter, Ampere-hour meter and Maximum demand meter for measuring AC and DC quantities.	Instruction, problem solving & usage in experiment
4,5	**Electronic Measuring instruments:** Digital instruments, VTVM, Q-meter and CRO.	Instruction & usage in experiment

4,5	**Instrumentation:** Extension of instrument range, Use of C.T and P.T and calculation of their burden, Instrumentation of substation. Transducer-mechanical, electrical and optical.	Instruction, problem solving & usage in experiment
4,5	**Measurement of Non-Electrical Quantities:** Measurement of temperature, pressure, displacement, velocity acceleration. Strain gauge and their applications.	Instruction, problem solving & experiment

Suggested Reading Lists/Essential Readings:

1. A.K. Sawhney : Electrical and Electronic Measurement and Instrumentation
2. U.A. Bakshi and A.V. Bakshi : Electrical Measurements and Instrumentation
3. Alan S. Morris : Measurement and Instrumentation Principles
4. Robert B. Northrop : Introduction to Instrumentation and Measurements

Course Code:EEE 3152
Course Title: Measurement and Instrumentation Sessional
Course Credit: 1
Prerequisite: N/A

Course Description:
This course will make familiar to students with the measurement of physical variables as encountered in our everyday life and during scientific experimentation along with their significance of measurements.

Objectives:
1. Students will be familiar how to measure physical variables and analyze measured data statistically.
2. Students will be familiar with instruments for measuring resistance, inductance and capacitance under different situations.
3. Students will be familiar with instruments for measuring magnetic flux and magnetic flux density.
4. Students will be familiar with analog instruments for measuring current, voltage, electrical power and energy.
5. Students will be familiar with digital instruments for measuring and visualizing electrical quantities.
6. Students will be familiar with instruments for measuring non-electrical quantities.

Course Learning Outcomes: The students will be able to:

1. Students will be able to measure physical variables and how to analyze measured data statistically.
2. Students will be able to measure resistance, inductance and capacitance under different situations.
3. Students will be able to measure magnetic flux and magnetic flux density.
4. Students will be able to use analog instruments for the measurements of current, voltage, electrical power and energy.
5. Students will be able to use digital instruments for measuring and visualizing electrical quantities.
6. Students will be able to use instruments for measuring non-electrical quantities.

Course Code: EEE 3162
Course Title: Electrical Services Design
Course Credit: 1
Prerequisite: N/A

Course Description:

This course provides the student a practical experience about the electrical layout, wiring, protections and wattage ratting of wire in a building. Students will also know about the electrical wiring, symbols and regulations used in a building. Building securities like fire alarm, smoke alarm and CCTV systems implementation will be taught in the courses. Implementation of various utility services like water supply and gas supply will be covered in the course. Execution of communication services like intercom, internet and telephone systems in a building.

Objectives:

1. Understand domestic wiring procedures practically.
2. To implement the electrical wiring and to select the wattage rating of wires in a building.
3. To provide hands on experience of three phase connection and electrical protections.
4. To show how the demand of security systems in a building is fulfilled.
5. To execute various utility systems need in a building design.
6. To know how to install air conditioning, lift and heating systems.

Course Learning Outcome (CLO): The students will be able to:

1. Choose the proper electrical wires, its ratings, fuses, bas-bars, circuit breakers, switches and rating of a power transformer for a building.
2. Inspect the electrical faults and problems in a buildings.
3. Solve the security and alarm systems in a building.
4. Examine the power requirement for a building.

CLO Mapping	Course Content	Teaching-Learning Strategy
1, 2	To design and implement a stair case wiring	1. Online video demonstration for high voltage safety requirements 2. Practical implementation of electrical wiring using wires and light, Fans and switch
1, 2	To design and implement electrical wiring of a multi-storied building	
1, 2	To assemble a residential house wiring using fuse, switch, indicator, lamp and energy meter	
1, 2, 3	To implement and test of Fire and Smoke alarm systems in an office building	
1, 2, 4	To calculate and measure the maximum power requirements in a building	
1, 2, 3	To install and test a security system in an office	

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Course Code: EEE 3211
Course Title: Power System II
Course Credit: 3
Pre-requisite: N/A

Course Description:

This course introduces fundamental concepts of the dynamics of the power system, operation of AC and DC distribution system, modification the natural electrical characteristics of electric power system, voltage sags and swells causing damage to electronic/industrial equipment, sag and tension calculation ,various types of insulatorsusedintransmission lines andinsulated cables,

Objectives:

1. Describe how some synchronous machines are operated in synchronism for Power System Stability.
2. Describe various aspects of AC and DC distribution system.
4. Analyzemost common power disturbance using voltage sags and swells.
5. Explain the suitability of various types of insulatorsused in transmission lines

Course Learning Outcome (CLO):

Upon completion of the course the student will be able to

1. Develop comprehensive idea on Power System Stability.
2. Perform mathematical calculation for different AC and DC network configuration
3. Assess most common power disturbance in power transmission line
4. Select properly insulators for transmission lines

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Power System Stability:** Definition and classification of stability, two axis model of synchronous machine, loading capability, rotor angle stability – swing equation, power-angle equation, synchronizing power coefficients, equal area criterion, multi-machine stability studies, step-by-step solution of the swing curve, factors affecting transient stability. Frequency and voltage stability.	Lecture/Discussion and Problem solving
2	**Power Distribution:** D.C and A. C distribution, calculation for different network configuration	Lecture/Discussion, Problem solving
3	**Flexible AC Transmission System (FACTS):** Introduction, shunt compensation (SVC, STATCOM), series compensation (SSSC, TCSC, TCSR, TCPST), series-shunt compensation (UPFC).	Lecture/ Discussion
	Section B	
1	**Power Quality:** Voltage sag and swell, surges, harmonics, flicker, grounding problems; IEEE/IEC standards, mitigation techniques	Lecture/ Discussion and Problem Solving
2	**Insulators and Transmission Lines:** Design and constructional features of overhead power transmission lines and underground cables. Types of insulators and their coordination. Electric stress calculations and string efficiency. Insulator testing..	Lecture/ Discussion
3	**Mechanical Characteristics of Transmission Lines:** Sag calculations and stress analysis	Lecture/ Discussion and Problem Solving
4	**Insulated Cable:** Insulating materials, Electric stress grading of single phase and three phase cable. Dielectric losses and heating. Modern development, testing of insulated cables. Corona power loss. Kelvin's law. Economic conductor section, limitation and selection of ideal voltage.	Lecture/ Discussion and Problem Solving

Suggested Reading Lists/Essential Readings Recommended Books

1. William D. Stevenson Jr. : Elements of Power System Analysis
2. HadiSaadat : Power System Analysis
3. V.K. Mehta and Rohit Mehta : Principles of the Power System
4. Kothari and Nagrath : Power System Engineering
5. Ashfaq Husain : Electrical Power Systems
6. M. N. Bandyopadhyay : Electrical Power Systems: Theory and Practice
7. Arthur R. Bergen and Vijay Vittal : Power Systems Analysis

Course Code: EEE 3221
Course Title: Communication System I
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course has been designed to familiarize students with the fundamental communication principles and the application of these principles to analogue and digital communication system. This course will help them understand information, coding, modulation and signal processing and finally to apply these knowledge in radio and TV system.

Objectives:

1. To introduce the students with different transmission types and transmission media.
2. To present the details of modulation and demodulation of analogue communication system.
3. To explain the knowledge of basic analogue modulation in radio system.
4. To introduce different coding schemes digital system and the modern TV system.

Course Learning Outcome (CLO):

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

1. Understand different transmission types and transmission media.
2. Understand various noise sources and their characteristics.
3. Analyze both modulation and demodulation techniques of analogue communication system.
4. Apply the acquired knowledge in radio system.
5. Analyze the transmission channel mathematically with different coding schemes for digital transmission.
6. Understand the modern TV system.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Overview of Communication Systems:** Basic principles,fundamental elements, system limitations, message source, bandwidth requirements, Transmission types- base-band transmission, carrier transmission; transmission media types, bandwidth and transmission capacity.	Lecture/Discussion
1,2	**Noise:** Sources of noise, characteristics of various types of noise and signal to noise ratio.	Lecture/Discussion
3	**Analog Modulation and Demodulation:** Amplitude modulation (AM)-introduction, DSB, SSB, VSB, 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.	Lecture/Discussion, Problem solving
1,2,3,4	**Radio System:** Radio Transmitter- classification, elements of AM, FM and SSB transmitter, master oscillator, mixer, RF power amplifier, pre-emphasis circuits, Radio Receiver- classification, elements of AM, FM and SSB receiver, AGC, AFC, de-emphasis circuits, noise limiter, cross modulation, Design of radio transmitter and receiver circuits.	Lecture/Discussion, Problem solving
	Section B	
5	**Introduction to digital Communication:** Baseband digital transmission, Limitations, Channels for digital communication, AWGN channel model, bit error rate of a baseband transmission system, channel capacity theorem, channel coding theorem.	Lecture/Discussion, Problem solving

5	**Waveform Coding Techniques:** Sampling- sampling theorem, Nyquist criterion, aliasing, instantaneous and natural sampling, flattopped sampling; message reconstruction rom its samples, PAM,PCM, quantization noise, channel noise, SNR, robust quantization, differential PCM, delta modulation (DM) principle, adaptive DM; line coding- formats and bandwidths.	Lecture/Discussion, Problem solving
6	**TV System:** Elements of TV system, principle of operation, TV signals generation, composite video signal, TV transmitter and receiver, transmitting and receiving antenna, picture tube; Introduction to color TV-compatibility, three color theory, Grassman's law, color display tube; VCR, CCTV, CATV, MATV, TV Booster.	Lecture/Discussion, Problem solving

Suggested Reading Lists/Essential Readings:

1. B. P. Lathi : Modern Digital and Analog CommunicationSystem
2. Simon Haykin : Digital Communication Systems
3. Kennedy and Davis : Electronic Communication Systems
4. Roddy and Coolen : Electronic Communications
5. G. K. Mathur : Radio Engineering
6. B. Grob : Basic TV
7. Gulati : Monochrome and Color TV

Course Code: EEE 3222
Course Title: Communication Systems I Sessional
Course Credit: 1
Pre-requisite: N/A

Course Description:

In this course students will perform experiments to practically verify the theories learned in the theory course EEE 3221.

Objectives:

1. To show how AM works- SSB and DSB.
2. To provide hands on experience of demodulating AM, FM and PM using practical circuits.
3. To show the process of designing and constructing radio transmitter and receiver circuits.
4. To provide knowledge about pulse code modulation (PCM).

Course Learning Outcome (CLO):

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

1. Understand the operation of practical modulation circuit for AM, FM and PM.
2. Design practical radio transmitter and receiver circuits.
3. Design and construct a simple PCM circuits.
5. Understand the basic elements of TV system.

Course Code: EEE 3231
Course Title: Microprocessors and Embedded Systems
Course Credit: 3
Pre-requisite: N/A

Course Description:

This is the introductory course on Microprocessor and Embedded Systems. In this course student will learn about Generic architecture of a Microprocessor and its working principle. Detail of 8086 Microprocessor, assembly language programming and operation will be taught. Students will also learn about basic embedded system based on microcontrollers.

Objectives:

1. Grow concept of how a microprocessor operates.
2. Explain memory interfacing technique with microprocessor.
3. Explain the I/O operation and I/O interfacing
4. Discuss how a Microprocessor based system is designed.
5. Explain basic architecture of Micro-controllers.

Course Learning Outcome (CLO):

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

1. Understand the working principle of a microprocessor
2. Explain the operation of 8086 Microprocessor's ALU, Memory interfacing, DMA, Interrupts etc.
3. Design the I/O ports and interfacing circuits for microprocessor
4. Design memory organization for 8086 and 8085 microprocessors

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	Microcomputer Architecture: Basic microcomputer blocks, bus architecture	Lecture/Discussion
1	Microprocessor Architecture: Generalized microprocessor architecture, basic concepts of 8085 processor. Detail study of Intel 8086 processor architecture and pin diagram. Familiarization of Z80, MC 68000, 80286 and Pentium series.	Lecture/Discussion
3	Memory Interfacing: Address decoding techniques, Interfacing memory with 8086 Microprocessor. Bus control signals. Organizing memory chips for different word size and address size.	Lecture/Discussion, Problem solving
	8086 Assembly Language Programming: Basic instructions, logic, shift and rotate instructions, addressing modes, stack management and procedures, advanced arithmetic instructions for multiplication and division, instructions for BCD and double precision numbers, introduction to 8086 programming with C language.	Lecture/Discussion, Problem solving
	Section B	
4	**Embedded System Organization:** Introduction to embedded system, categories and applications, Major components in a typical embedded system, operating requirement, modes of operation, hardware/software co-designs, hardware-software trade-offs.	Lecture/Discussion, Problem solving
3	**I/O Hardware Interfacing with Intel 8086 Microprocessor:** Input devices, output devices, memory mapping, bus structures, programmable peripheral interface, programmable interrupt controller, programmable timer, serial communication interface, keyboard and display interface (LED, 7 segments, dot matrix and LCD), Direct memory access (DMA). Operating System: Design and organization of embedded and real-time operating systems, scheduling, power management, communication, debugging.	Lecture/Discussion, Problem solving
	Microcontrollers: Basic structures of microcontrollers, basic features, types of microcontrollers, PIC, CISC and RISC microcontrollers, basic features and architecture, memory interfacing, digital I/O, timers, analog interfaces, interrupt services, programming in high-level languages and assembly languages, basic data types, operators, constructs, data structures, compiler directives, power management.	Lecture/Discussion, Problem solving

Suggested Reading Lists/Essential Readings:

1. Douglas V. Hall : Microprocessors and Interfacing

2.	M. Rafiquzzaman	:	Microprocessor and Microprocessor-based System Design
3.	Barry B. Brey	:	Microprocessor Hardware Interfacing and Application
4.	Morris Manno	:	Digital Logic and Computer Design
5.	M. Morris Manno		Computer System and Architecture
6.	R. Gaonkar	:	Microprocessor Architecture, Programming and Applications
7.	John P. Hayes	:	Computer Architecture and Organization
8.	Ajay V. Deshmukh	:	Microcontrollers: Theory and Applications
	S.K. Bose	:	Digital Systems from Gate to Microprocessors

Course Code: EEE 3232
Course Title: Microprocessors and Embedded Systems Sessional
Course Credit: 1
Pre-requisite:

Course Description:
In this course students will perform experiments to practically verify the theories learned in the theory course EEE 3231.

Objectives:
1. To show how assembly language programming is done in 8085 microprocessor
2. To show how assembly language programming is done in 8086 microprocessor
3. To show how a microcontroller is programmed for using it in a particular application

Course Learning Outcome (CLO):
Upon completion of the course the students will be able to:
1. Identify 8085 and 8086 ICs
2. Program 8085 using assembly language program
3. Program 8086 using assembly language or C language
4. Design an input output system using microcontroller

Course Code: EEE 3241
Course Title: Solid State Devices
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course intends to provide necessary conception and physics behind the devices used in electronics. Concept of semiconductor and carrier transport properties is discussed in details. Structure and operation of diode, transistor, and FET are discussed elaborately.

Objectives:
1. Students will be able to understand the basic principle of semiconductor physics.
2. Students will understand the construction and operating principles of different semiconductor devices, like junction diodes and transistors.
3. Students will gain an understanding about the characteristics of junction diodes and transistors.
4. Students will understand the physical phenomena that run behind the devices.

Course Learning Outcome (CLO):
Upon completion of this course, students should be able to:
1. Understand basics of semiconductor physics and its transport characteristics.

2. Understand elementary concept of different junctions and apply this concept to analyze the characteristics of junctions.
3. Understand construction and principles of bipolar junction transistor and apply this concept to analyze and derive junction parameters.
4. Understand construction and principles of FETs and apply this concept to analyze device performances.
5. Calculate different parameters of solid state devices.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Semiconductors in Equilibrium:** Energy bands, intrinsic and extrinsic semiconductors, Fermi levels, electron and hole concentrations, temperature dependence of carrier concentrations and invariance of Fermi level.	Lecture, Discussion
1	**Carrier Transport Processes and Excess Carriers:** Drift and diffusion, generation and recombination of excess carriers, built-in-field, recombination-generation SRH formula, surface recombination, Einstein relations, continuity and diffusion equations for holes and electrons and quasi-Fermi level.	Lecture, Discussion, Problem Solving
2, 5	**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.	Lecture, Discussion, Problem Solving
	Section B	
2, 3, 5	**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 model and circuit synthesis. BJT non-ideal effects; Hetero-junction transistors.	Lecture, Discussion, Problem Solving
2, 5	**Metal-semiconductor Junction:** Energy band diagram of metal semiconductor junctions, rectifying and ohmic contacts.	Lecture, Discussion, Problem Solving
4, 5	**MOS Structure:** MOS capacitor, energy band diagrams and flat band voltage, threshold voltage and control of threshold voltage, static CV characteristics, qualitative theory of MOSFET operation, body effect and current-voltage relationship of a MOSFET. Non-ideal characteristics of MOSFET: channel-length modulation and short channel effects in MOSFETs. MOS scaling.	Lecture, Discussion, Problem Solving
4, 5	**Introduction to Multigate FET Architecture:** Double gate MOSFET, FinFET, Surrounding gate FET, high-K dielectric FETs.	Lecture, Discussion

Suggested Reading Lists/Essential Readings:

1. Donald Neamen : Semiconductor Physics and Devices
2. Benjamin G. Streetman : Solid State Electronic Devices
3. S.M. Sze and Kwok K. Ng : Physics of Semiconductor Devices
4. Jasprit Singh : Semiconductor Devices: Basic Principles
5. K. Hess : Advanced Theory of Semiconductor Devices
6. Chih-Tang Sah Fundamentals of Solid State Electronics

Course Code: EEE 3251
Course Title: Digital Signal Processing
Course Credit: 3

Pre-requisite: N/A

Course Description:
This course presents the concept of signals and systems in the time and frequency domain and their processing. Students will learn about Digital Signal Processing in regards to the common mathematical tools such as- impulse response, solution of difference equation, z-transform, discrete time harmonic analysis, discrete Fourier transform. Techniques for processing signals are introduced including FIR and IIR filters.

Objectives:

1. To classify signals and systems and their mathematical representation.
2. To realize the impulse response of different discrete time systems.
3. To apply different transformation techniques, such as z- and Fourier transforms and their computations.
4. To study about filters and their design for digital implementation.

Course Learning Outcome (CLO):

On successful completion of this course, students will be able to:

1. Understand different signals and systems and their processing.
2. Find impulse response of discrete-time systems.
3. Convert signals and systems from time domain to z or frequency domain and vice-versa.
4. Implement digital filters for filtering and prediction of signals.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Introduction to Digital Signal Processing (DSP):** Signal, System and processing, Advantages and limitations of DSP, Components of DSP, Classification of Signals, Concept of Frequency, Sampling Theorem, Nyquist Rate, Aliasing, Quantization. Coding, Classifications of discrete time signal and systems, Implementation of discrete time systems, analog to digital conversion.	Lecture, Discussion and Problem solving
1, 2	**Impulse Response:** Finite impulse response (FIR) and infinite impulse response (IIR) of discrete time systems Natural Response and Forced Response.	Lecture/Discussion, Problem solving
1, 2	**Solution of Difference Equation:** Convolution, transient and steady state response.	Lecture, Discussion, Problem Solving
3	**Z-transform:** Properties, transfer function, poles and zeros and inverse Z transform.	Lecture, Discussion, Problem solving
1	**Correlation:** circular convolution, autocorrelation and cross correlation.	
	Section B	
1, 3	**Discrete Time Harmonic Analysis:** Discrete-time Fourier series, discrete-time Fourier transform & their Properties.	Lecture, Discussion
3	**Discrete Fourier Transform:** DFT definition and properties, Fast Fourier transform (FFT), inverse fast Fourier transform.	Lecture, Discussion, Demonstration
4	**FIR Filters**: Linear phase filters, specifications, design using window, optimal and frequency sampling methods.	Lecture, Discussion, Problem Solving
4	**IIR Filters:** specifications, design using impulse invariant, bi-linear Z-Transformation, Least-square methods and finite precision effects.	Lecture, Discussion

Suggested Reading Lists/Essential Readings:

1. J. G. Proakis and D.G. Manolakis : Digital Signal Processing: Principles, Algorithms and Applications
2. A.V. Oppenheim, R. W. Schafer and J.R. Buck : Discrete-Time Signal Processing

3. Dag Stranneby and William Walker : Digital Signal Processing and Applications

Course Code: EEE 3252
Course Title: Digital Signal Processing Sessional
Course Credit: 1
Pre-requisite:

Course Description:
This course intended to verify different methods to analyze digital signals in time and frequency domain using computer programming and simulation software.

Objectives:
1. Introduce basic concepts in MATLAB programming and use of built-in and user-defined functions for DSP.
2. Develop mathematical and analytical skills necessary to analyze digital signals by computer.
3. Introduce application of DSP including spectral analysis, digital filters etc.

Course Learning Outcome (CLO):

On successful completion of this course, students will be able to:
1. Use MATLAB programming for digital signal processing.
2. Represent/plot different types of continuous and discrete time signals using MATLAB.
3. Understand ADC process.
4. Calculate Fourier transform of digital sequences.
5. Design, implement and simulate various applications of DSP using MATLAB tools.

CLO mapping	Course content	Teaching-learning strategy
1	Exp-1: Getting started with MATLAB for digital signal processing	Lecture, Discussion and Program writing
1, 2	Exp-2: Represent/plot continuous and discrete time signals	Discussion and Program writing
1	Exp-3: Calculate correlation and convolution between two DT sequences	Discussion and Program writing
1, 3	Exp-4: Convert analog signal to digital signal and analyze the effect of sampling rate	Discussion and Program writing
1, 4	Exp-5: Calculate Fourier transform of different DT sequences and functions and plot spectrum	Discussion and Program writing
1, 5	Exp-6: Design and simulate FIR and IIR filters using MATLAB tools	Discussion and Program writing

Course Code: EEE 3261
Course Title: Project Planning and Management
Course Credit: 2
Prerequisite: X

Course Description:
This is an introductory course on the key concepts of planning and executing projects. It would identify factors that lead to project success, and learn how to plan, analyze, and manage projects. Learners will be exposed to the methodologies and the challenges in various types of projects.

Objectives:
Upon successful completion of this course students would learn:
1. Basic understanding and importance of formal projects.
2. Investment and outcome in projects.
3. Project organizational structures along with work break down structure, life cycle, analysis, milestones, risk etc.
4. Project management and role as project manager.

CLO Mapping	Course content	Teaching-learning strategy
1	**Understanding of formal projects:** definitions of project and project management in the engineering point of view	Lecture
1, 2	**Importance and applications along with budget and cost:** project initiation, project selection, project manager, project organization and project planning, project feasibility study	Lecture Exercise discussion
3	**Functional organizational and structure:** project management, budgeting and cost estimation	
3	**WBS, analysis, milestones, life cycle:** project control and human aspects of project management	Lecture Exercise discussion
2,3	**Risk in projects**	
4	**Project control and monitoring:** network techniques of project management; PERT, CPM, and Gantt Charts	
4	**Project management and familiar with practical methodologies**	

Suggested Reading Lists/Essential Readings:

1. Albert Lester : Project Management, Planning and Control
2. Garold D Oberlender : Project Management for Engineering and Construction
3. Nigel J. Smith : Engineering Project Management
4. M. Kemal Atesmen : Global Engineering Project Management

Course Code: EEE 3272
Course Title: Electronic Shop Practice
Course Credit: 1
Prerequisite: N/A

Course Description:
This course intends to develop the skills to assemble and troubleshoot the electronic system.

Objectives:

The objectives of this course is to
1. Acquire knowledge about electronic components, measuring instruments, bread board assembling, etc.
2. Acquire knowledge and practice soldering, de-soldering and PCB design .
3. Able to analyze the circuit and troubleshoot

Course Learning Outcome (CLO):
Upon completion of this course the students will be able to:
1. Identify and test the various active and passive components.
2. Solder and de-solder of electronic component in electronic circuits
3. Design the PCB Layout and fabricate PCB.
4. Troubleshoot and repair the common electronic system.

CLO Mapping	Course Content	Teaching-Learning Strategy

1	Familiarization, identification and testing of active and passive components –Resistor, Capacitor, Inductor, diodes, transistors, IC, Relays.	Visualization Component Test
2	Introduction to formal procedures of preventive maintenance, Circuit tracing, trouble shooting, fault finding and repairing, soldering and de-soldering of electronic circuits	Hands on Tutorial of Fault finding Lab Practice
3	Design and fabrication of PCBs: Full wave bridge rectifier, dc power supply	Software Lab practice
4	Troubleshoot of electronic systems- PC, Radio Receiver, TV, Multimeter, Oscilloscope etc.	Hands on tutorial on troubleshooting

Suggested Reading Lists/Essential Readings

1. Keith Mobley, Lindley Higgins and Darrin Wikoff : Maintenance Engineering Handbook
2. Tim Williams : The Circuit Designer's Companion
3. Marcus and Lavy : Elements of Radio Servicing
4. Mark I. Monstrose : A Handbook for Designers

Course Code:EEE 4111Course Title: Power Plant Engineering and Economy
Course Credit: 3
Pre-requisite: N/A

Course Description:
Power Plant Engineering basically focuses on power generation principles for real world applications. More specifically this course is focused on application of energy principles and power generation cycles. The main purpose of implementing this course in curriculum is to learn about how the power is generated in a power plant and its applications.

Objectives:
1. To introduce students to different aspects of power plant engineering
2. To familiarize the students to the working of power plants based on different fuels
3. Define the performance characteristics and components of thermal power plant
4. Understanding of terms and factors associated with Power Plant Economics.

Course Learning Outcome (CLO): The students will be able to:

1. Identify elements and their functions of steam, hydro, diesel, nuclear power plants.
2. Determine performance of power plants based on load variations.
3. Analyze economics of power plants and list factors affecting the power plants

CLO Mapping	Course content	Teaching-learning strategy
	Section A	
1	Power Plants: Types, Thermal power station- general layout of a thermal power plant, heat rate, incremental heat rate, efficiency, capacity scheduling, load division principles and construction of gas turbine, steam turbine, diesel, combined cycle, hydro and nuclear, and magneto-hydrodynamic power plants.	Lecture, Discussion, Problem Solving
2	Variable load problems, plotting and analysis ofload curves, chronological load curves and loadduration curve. Energy load curve and its use. Load factor, capacity factor, demand factor, utilization factor, diversity factor etc. and theirimpactover the cost analysis of powergeneration and utilization. Load forecasting, selections of units and plant location.	Lecture, Discussion, Problem Solving
2	Load Sharing: Base load and peak load plants.Use of chronological load curves to distributeload among units.	Lecture, Discussion, Problem solving
	Section B	
2,3	Power Plant Economics: Economic operation ofpower plants. Input output curve, heat rate curve,and incremental rate curve. Use of incremental rate curve for optimum load scheduling.	Lecture, Discussion, Demonstration
2, 3	Transmission line loss, determination of loss co-efficient.Economic conductor selection,Kelvin's law. Graphical method forlocationofdistribution systems. Tariff and tariff design.Bus system.	Lecture, Discussion, Demonstration
2,3	Importance of power control. Current limitingreactors. Different types of bus system layout.Forces on bus section in case of short circuit.	Lecture, Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:

1. William A. Vopat : Power Station Engineering and Economy
2. P. K. Nag : Power Plant Engineering
3. Bernhardt G.A. Skrotzki, W.A. Vopat : Power Station Engineering and Economy

Course Code: EEE 4121
Course Title: Communication System II
Course Credit: 3
Pre-requisite: N/A

Course Description:
In this course student will learn about the digital communication system and Telecommunication networks. Students will also be briefly introduced with the radar and optical fiber communications.

Objectives:
1. To introduce the students with different digital modulation and demodulation techniques.
2. To present the details of error correction techniques.
3. To differentiate and compare different multiplexing and multiple access techniques.
4. To explain the mechanism of different analog and digital switching system used in telecommunication networks.
5. To explain traffic engineering
6. To present basics of fiber optic and satellite communication.

Course Learning Outcome (CLO):
The students will be able to:
1. Understand different digital modulation and demodulation techniques.
2. Be able to detect and estimate error using different error correction and coding scheme.
3. Understand various multiplexing and multiple access techniques.
4. Understand telecommunication switching system: analog and digital.
5. Understand traffic in telecommunication network and different network topology.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Digital Modulation Techniques:** Binary modulation techniques:ASK, PSK, and FSK, Detection of ASK, PSK, and FSK, Quadrature modulation techniques, M-ary modulation techniques, power spectra,effect of inter-symbol interference.	Lecture/Discussion, Problem Solving
2	**Detection and Estimation:** Model of digital communication system,detection of signals in noise, probability of error, correlation receiver, matched filter receiver. Estimation: MLE, Weiner filters, Adaptive filters, linear prediction. Bit error rate calculation of a digital link, digital link design.	Lecture/Discussion, Problem Solving
2	**Error Correction Coding:** Block codes, cyclic codes, systematic and nonsystematic cyclic codes, convolutional codes, Trellis codes, decoding techniques.	Lecture/Discussion, Problem solving
3	**Multiplexing Techniques:** FDM, TDM, SDH, PDH, SONET, WDM, SONET over WDM. **Multiple Access Techniques:** FDMA, TDMA, CDMA and SDMA.Introduction to 2G, 3G and 4G mobile communication systems.	Lecture/Discussion, Problem solving
	Section B	

4	**Introduction to Telecommunication Engineering:** Simpletelephone communication, Basic switching system,Transmissionbridge, Subscriber line circuit, CB cord circuit, Junction working.	Lecture/Discussion,
4	**Introduction to Analog Switching System:** Strowgerand Crossbarswitching systems, Telephone Networks: Subscriber loop systems,79 switching hierarchy and routing, Transmission plan, Transmissionsystems, numbering plan, charging plan, signaling techniques, Inchannel signaling, Common channel signaling.	Lecture/Discussion, Problem solving
4	**Introduction to Digital Switching System:** Stored programcontrol, Software architecture, Application software, Enhancedservices. Space division switching, time division switching, blockingprobability andmultistage switching, and digital memory switch.	Lecture/Discussion, Problem solving
5,6	**Traffic Engineering:** Traffic characterization, Grade of services andblocking probability, Modeling switching systems, Blocking modelsand loss estimates, delay system and queuing. **Access Network Technology:** DSL, VDSL, HDSL, Fiber AccessNetwork, FTTX. **Introduction to optical fiber and Satellite communications**.	Lecture/Discussion, Problem solving

Suggested Reading Lists/Essential Readings:

1. B. P. Lathi : Modern Digital and Analog CommunicationSystem
2. Simon Haykin : Digital Communication Systems
3. Roddy and Coolen : Electronic Communications
4. T. Viswanathan : Telecommunication Switching Systems andNetworks
5. J. Martin : Communication Satellite System
6. John Bellamy : Digital Telephony
7. S.E. Miller and A.G.Chynoweth : Optical Fiber Communication
8. Tri T Ha : Satellite Communications
9. J.M. Senior : Optical Fiber Communication

Course Code: EEE 4122
Course Title: Communication Systems II Sessional
Course Credit: 1
Pre-requisite:

Course Description:
In this course students will perform experiments to practically verify the theories learned in the theory course EEE 4121.

Objectives:
1. To show how ASK, FSK and PSK.
2. To provide practical experience of detecting ASK, FSK and PSK using practical circuits.
3. To show the process of designing and constructing multiplexing techniques.
4. To provide knowledge about telecommunication switching networks.

Course Learning Outcome (CLO):
Upon completion of the course students will be able to:
1. Understand the operation of practical modulation circuit for ASK, FSK and PSK.
2. To be able to design practical circuits for ASK, FSK and PSK detection.
3. Design and construct a simple FDM and TDM systems.
5. Understand the basic elements of telecommunication switching system.

Course Code: EEE 4131
Course Title: Control System
Course Credit: 3
Pre-requisite: N/A

Course Description:
Recognition of what a control system is, and the distinction between simple and feedback control systems. Analysis and design of simple control systems with Differential equations, Laplace transforms, transfer functions, state space models. Stability analysis of closed loop system with Routh-Hurwitz , root locus, simple frequency response Bode and Nyquist plots technique. PI, PD, PID and Lead-lag Controller design. Introduction and applications of PLC controllers, basic concepts of PLC ladder logic programming

Objectives:
1. The students should be able to learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective.
2. The students should learn how to represent system by transfer function and block diagram and state space model.
3. Students can be able to learn stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot.
4. Students can design PI, PD and PID controlled and use of PLC controller.

Course Learning Outcome (CLO):
Upon completion of the course students will be able to:
1. Demonstrate an understanding of the fundamentals of open and closed loop control systems.
2. Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.
3. Determine the stability of a closed-loop control system using Routh Hurwitz criteria and relative stability by bode plot, polar plot, Nyquist plot and root-locus technique. .
4. Understand and implement PI, PD, PID and PLC controllers

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Introduction:** to control system, classification and application of control systems. Review of Laplace transform, Initial and Final value theorems.	Lecture Discussion, Problem solving
1, 2	**Transfer Functions:** Open-loop stability, Poles, Zeros, Time response, Transients, Steady-state, Block diagrams and signal flow diagram. Feedback Principles: Open versus Closed-loop control, High gain control, Inversion.	Lecture Discussion, Problem solving
1, 2	**State Variables:**State variable characterization of systems, transition matrix, canonical forms. Signal flow diagram to state variables, transfer function to state variable and state variable to transfer function. Controllability and observability.	Lecture, Discussion, Problem Solving
3	**Stability of Closed-loop Systems:** Bounded-input bounded-output (BIBO) stability, Routh-Hurwitz stability criterion, Stability in State Space, Root locus.	Lecture, Discussion, Problem solving
	Section B	
1,2	**Pole Assignment:** Sylvester's theorem, PI and PID synthesis using pole assignment.	Lecture Discussion, Problem solving
2, 3	**Frequency Response:**Nyquistplot, bode diagram, Nyquist stability theorem, Stability margins, Closed-loop sensitivity functions, Model Errors: System Type, sensitivity, and Steady-state Error, Robust stability.	Lecture, Discussion, Demonstration
4	**PID Control:** Structure, Design using root locus, Proportional control, Lead-lag control, PID control, Digital control systems: introduction, sampled data systems, stability analysis in Z-domain.	Lecture, Discussion, Problem Solving
4	**Programmable Logic Controllers:** Introduction, purpose, functions, and operations of the PLC in industrial applications, Introduction to PLC ladder logic and basic programming concepts.	Lecture, Discussion

Suggested Reading Lists/Essential Readings:

1. Norman S. Nise : Control Systems Engineering
2. Katsuhiko Ogata : Modern control engineering
3. FaridGolnaraghi, Benjamin C. Kuo : Automatic Control Systems
4. I.J. Nagrath : Control Systems Engineering
5. R. C. Dorf and R. H. Bishop : Modern Control Systems
6. Bernard Friedland : Control System Design: An Introduction to State-Space Method
7. Kelvin T. Erickson : Programmable Logic Controllers: An Emphasis on Design and Application

Course Code: EEE 4132
Course Title: Control System Sessional
Course Credit: 1
Pre-requisite: N/A

Course Description:

This lab course provides strong understanding of control system analysis and design with software simulation and PLC trainer board.

Objectives:

1. Have a strong knowledge on MATLAB software.
2. Get the basic knowledge on practical control system and PLC applications.
3. Get the knowledge on applications of machines & electronic devices with control systems.

Course Learning Outcome (CLO): The students will be able to:

1. Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.
2. Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.
3. Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.
4. Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.
5. Formulate different types of analysis in frequency domain to explain the nature of stability of the system

CLO mapping	Course content	Teaching-learning strategy
1	Determine the partial fraction expansion using MATLAB software from the transfer function	Lecture, Discussion, Problem solving, Design via software
1,2	Represent the following transfer function in state space	
1,2	Convert state space equation into transfer function	
3	Simulink Model of DC Motor transfer function	
4	Time Response of Open Loop and Closed Loop System and find its characteristics	
4	Observation of unit step response for 2nd order system damping case	
5	Sketch the root locus of open loop and closed loop system and find the limit of the gain(K) for remaining stable	

Suggested Reading Lists/Essential Readings:

1. Norman S. Nise : Control Systems Engineering
2. Katsuhiko Ogata : Modern control engineering

Course Code: EEE 4141
Course Title: Power Electronics
Course Credit: 3
Pre-requisite: N/A

Course Description:
This course intends to give idea about power electronic devices like, thyristor, DIAC, TRIAC, UJT, Rectifiers, Controllers, Inverters etc. The operation, performance measurement and design of schemes with regard to power electronic devices will be taught

Objectives:
To learn the design and operation of high power electronic drives and devices.

Course Learning Outcome (CLO):

1. Understand the characteristics and usage of power electronic switches and devices
2. Analyze the performance of uncontrolled and controlled rectifiers for both single phase and three phase system.
3. Analyze the operation and performance of different voltage controllers and converters
4. Analyze the performance of different inverters.

CLO mapping	**Course content**	**Teaching-learning strategy**
	Section A	
	Power Semiconductor Switches and Triggering Devices: BJT, MOSFET, SCR, IGBT, GTO, TRIAC, UJT and DIAC.	Lecture Discussion, Problem solving

	Uncontrolled Rectifiers: Single-Phase Half-Wave rectifier, Performance parameters, Single-Phase Full-Wave Rectifiers with R load and RL load, Three-Phase Full-Wave Rectifiers with R load and RL load.	Lecture Discussion, Problem solving
	Single-Phase Controlled Rectifiers: Thyristor Characteristics and Applications, Two Transistor model of Thyristor, Thyristor Turn-On and Turn-Off, Thyristor types. Phase Controlled Converter operation, Single-Phase Full Converters with R Load and RL load, Single-Phase Dual Converters and Semiconverters.	Lecture, Discussion, Problem Solving
	Three-Phase Controlled Rectifiers: Three-Phase Half-Wave Converters, Three-Phase Full Converters with R load and RL load, Three-Phase Dual Converters and Semiconverters, Power Factor Improvements, Twelve-Pulse Converters.	Lecture, Discussion, Problem solving
	Section B	
	DC-DC Converters: Generation of Duty Cycle, Step-Down Converter, Step-Up Converter, Converter Classification, Switching-Mode Regulators: Buck regulators, Boost Regulators. Buck-Boost Regulators, Cuk Regulators.	Lecture Discussion, Problem solving
	Pulse-Width-Modulated Inverters: Principle of Operation, Single-Phase Bridge Inverters, Three-Phase Inverters: 180-Degree Conduction, 120-Degree Conduction.	Lecture, Discussion, Demonstration
	Resonant Pulse Inverters: Series and Parallel Resonant Inverters, Zero-Current Switching and Zero- Voltage-Switching Resonant Converters, Comparisons between ZCS and ZVS Resonant Converters.	Lecture, Discussion, Problem Solving
	AC voltage Controllers: Principle of On-Off Control, Principle of Phase Control, Single Phase Controllers with Resistive and Inductive load, Three-Phase Full-Wave Controllers, Three Phase Full-Wave Controllers, Three Phase Bidirectional Delta-Connected Controllers, Single-Phase and Three-Phase Cycloconverters.	Lecture, Discussion

Suggested Learning/ Text:

Course Code: EEE 4142
Course Title: Power Electronics Sessional
Course Credit: 1
Pre-requisite: N/A

Course Description:
This lab course provides strong understanding of power electronics course with experimental verification of switching device characteristics, experimental study of power converter and controller circuits

Objectives:
1. Experimental verification of power semiconductor devices.
2. Experimental study of power converters and controllers

Course Learning Outcome (CLO):
At the conclusion of the course, the student is expected to:
1. Understand the behavior of power semiconductor devices
2. Able to design and construct power converters and controllers.

CLO	List of experiments	Teaching-Learning

Mapping		strategy
1	Introduction and Familiarization of the Components of Power Electronics Laboratory.	Discussion
1,2	To study of the half wave and full wave controlled rectifier with unity, lagging and leading power factor loads.	Discussion, Performing Experiment in hardware and Simulation.
1,2	To study of the DC-DC converters – **i.** Boost converter ii. Buck Converter iii. Buck-Boost Converter	Discussion, Performing Experiment in hardware and Simulation.
1,2	To study of the DC-AC converter. **i.** Half bridge converter ii. Full bridge Converter iii. SPWM Topology for switching gates.	Discussion, Performing Experiment in hardware and Simulation.
1,2	To study of the AC voltage controller. **.i** Single phase full wave converter ii. Three phase full wave converter. iii. Single phase cyloconverter	Discussion, Performing Experiment in hardware and Simulation.
1,2	Project design for individual group of student.	Designing an open ended experiment.

Course Code: EEE 4182
Course Title: Industrial Training
Course Credit: 1
Pre-requisite: N/A

Course Description:
Students will be attached with the Electrical and Electronic Engineering related industries/service agencies for two weeks to take Professional/Industrial/In-Plant training. This training is to be organized after completion of their third year odd semester or during any vacation in Third year even semester to gain practical knowledge.

Objectives:
1. To give students learn from practical environment and impromptu problems in the industries or companies.
2. To learn from the working engineers about the common problems and solutions in the attached industries.
3. To give them an opportunity to get along with staff of the industries and learn how to develop cordial relationship among the co-workers

Course Learning Outcome (CLO):
Upon completion of the course students will be able to:
1. See some electrical and electronic devices/equipment/machine which are not available currently in the laboratory.
2. Learn from the working engineers how to operate these equipment.

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Course Code: EEE 4211
Course Title: Power System Protection and Switchgear
Course Credit: 3
Prerequisite: N/A

Course Description: In this course student will be taught about 'Power System Protection' in regards to switchgear, fuse & relay, circuit breakers and breaker ratings; transformer, generator, motor, bus and transmission line protection; static, digital and numerical relay.

Objectives:
1. To familiarize the students with different protective measures taken again power faults.
2. To explain the operation of different protective devices, such as connectors, relays, circuit breakers, etc.
3. To explain the performance metrics and ratings of switchgear so that students can appropriately select necessary devices in order to use them in a protective scheme.
4. Familiarize the students about basic protective measures for generator, transmission line and motor.

Course Learning Outcome (CLO):
Upon completion of the course students will be able to:
1. Understand the fundamentals of protective devices
2. Distinguish between different type of relays and circuit breakers according to their construction and use
3. Design protective scheme for transformer, generator, motor and transmission line.
4. Use modern relays in protective schemes.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Introduction to Switchgear:** Purpose of power system protection, Introduction to Switchgear, circuit interruption and protection. Criteria for detecting faults and requirements of protective devices, Terminologies and general characteristics of relays and circuit breaker.	Lecture/Discussion
1, 2	**Fuse & Relay:** Fuse and it's types, Relays: over-current, differential, directional, distance. Electromechanical relay.	Lecture/Discussion
1, 2,3	**Circuit Breakers:** control systems, Trip circuit, arc extinction methods, Types of circuit breaker, Different types of protective devices used in Switchgear.	Lecture, Discussion, Problem Solving
1,2,3	**Circuit Breaker Ratings:** circuit breaker ratings, recovery voltage, TRV, Switching in a capacitive circuit, Current chapping. Air, Oil, air blast, SF_6, vacuum and high voltage DC circuit breaker, Selection criteria, testing of circuit breakers.	Lecture, Discussion, Problem solving
	Section B	
1,2	**Transformer Protection:** Different types of faults in Transformer, different types of protection scheme in transformer, Buocholz Relay etc. Integrated HV transmission line protection, Combined Transformer and Bus bar protection.	Lecture, Discussion

1, 2, 3	**Generator and Motor protection:** Introduction, Different types of faults in Generator and motor, different types of protection scheme.	Lecture, Discussion, Demonstration
1, 2,3	**Bus and Transmission Line Protection:** Bus bar arrangement, Pilot-wire and carrier current protection, different types of Bus and Transmission line protection scheme, Over voltage protection, lightning and lightning arresters, Grounding	Lecture, Discussion, Problem Solving
4	**Static and Digital/Numerical Relay:** Definition, features, Operation, application, Block diagram and types, Microcontroller and Microprocessor based protection.	Lecture, Discussion

Suggested Reading Lists/Essential Readings:

1. Sunil S. Rao : Switchgear protection and power systems
2. T. S. MadhavaRao : Power System Protection Static Relays
3. Badri Ram and D. Vishwakarma : Power System Protection and Switchgear
4. Paul M. Anderson : Power System Protection

Course Code: EEE 4212
Course Title: Power System Protection and Switchgear Sessional
Course Credit: 1
Prerequisite: N/A

Course Description:
In this course student will learn practically how the devices of power protection system works. They will have working experience with relays, circuit breakers, switches, fuses etc in the laboratory.

Objectives:
1. To familiarize the students with different protective measures taken again power faults.
2. To introduce the students with switches, protective relays, circuit breakers, fuses, bus bar etc.
3. To introduce students with LT and HT switchgear.
4. To introduce students with Generator protection system.

Course Learning Outcome (CLO):
Upon completion of the course students will be able to:
1. Identify the circuit breakers, switches, fuses, protective relays, CT and PT etc.
2. Explain and figure out common faults occur in the transmission line, generator and substation.
3. Operate the circuit breakers during faults and unbalance conditions.
4. Design protective system via hardware and software.

CLO Mapping	List of experiments	Teaching-Learning strategy
1	Introduction and Familiarization of the Components of Power System Protection Laboratory.	Discussion
1,2	To study of the three phase current transformer.	Discussion and Performing Experiment in hardware.
1,2,3	To study of the operation of Under and Overvoltage Time	Discussion and Performing

	Relay.	Experiment in hardware
1,2,3	To study of the operation of Definite Time Overcurrent Relay.	Discussion and Performing Experiment in hardware
1,2,3,4	To study of the operation of Combined Overcurrent and Earth Fault Relay.	Discussion and Performing Experiment in hardware and software (MSCom2 and MATLAB - command and Simulation)
1,2,3,4	To study of the operation of Differential Protection Relay during Transformer / Alternator winding fault.	Discussion and Performing Experiment in hardware and software (MSCom2 and MATLAB - Command and Simulation)

Course Code: EEE 4221
Course Title: High Voltage Engineering
Course Credit: 3
Pre-requisite: EEE 3111 (Power System I)

Course Description:
This course intends to develop and apply the theory of high voltage generation and measurements to the appropriate places. Students will also be taught of the breakdown of matters and how to test electrical equipment which are supposed to be exposed to high voltages.

Objectives:
1. To learn the principles of theory of high voltage generation and measurements.
2. To understand the operation of high voltage power supplies for dc, ac, and impulse voltages.
3. To get familiar with high voltage testing and various applications where high voltage field is used.
4. To improve their ability to bring clarity to high voltage breakdown in gas liquid, and solid dielectric materials.
5. To gain an understanding about overvoltage phenomenon and insulation coordination in electric power systems.

Course Learning Outcome (CLO): The students will be able to:
1. Understand the theory of high voltage dc, ac and impulse voltage generation.
2. Comprehend breakdown phenomena in insulating materials and overvoltage phenomena in power transmission systems and insulation coordination.

3. Analyze different methods for high voltage measurements to measure the voltages accurately, ensuring perfect safety to the personnel and equipment.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**High Voltage DC Generation:** Rectifier circuits, ripple minimization, voltage multipliers, Van-de-Graaf and electrostatic generators; applications.	Lecture, Discussion, Problem Solving
1	**High Voltage AC Generation:** Tesla coils, cascaded transformers and resonance transformers.	Lecture, Discussion, Problem solving
1	**Impulse Voltage Generation:** Shapes, mathematical analysis, codes and standards, single and multi-stage impulse generators, tripping and control of impulse generators.	Lecture, Discussion, Problem Solving
	Section B	
2	**Breakdown** in gas, liquid and solid dielectric materials, applications of gas and solid dielectrics in transformer. Corona.	Lecture, Discussion
3	**High Voltage Measurements and Testing:** IEC and IEEE standards, sphere gap, electrostatic voltmeter, potential divider, Schering bridge, Megaohm meter, HV current and voltage transducers: contact and noncontact.	Lecture, Discussion, Demonstration
2	**Overvoltage Phenomenon** and insulation coordination. Lightning and switching surges, basic insulation level (EV, EHV and UHV systems), surge diverters and arresters.	Lecture, Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:

1. C. L. Wadhwa : High Voltage Engineering
2. M. S. Naiduand V Kamaraju : High Voltage Engineering
3. RavindraArora : High Voltage and Electrical Insulation Engineering
4. Farouk A.M. Rizk, Giao N. Trinh : High Voltage Engineering

Course Code: EEE 4222
Course Title: High Voltage Engineering Sessional
Course Credit: 1
Prerequisite: N/A

Course Description:
This course provides the student a hands on experience of verifying the theorems, measurement and testing phenomena they are taught in EEE 4221 course.

Objectives:

1. To study the filtration and treatment techniques of transformer oils and determine their dielectric strength.
2. To study solid dielectrics used in power apparatus and capable to measure the capacitance and dielectric loss of insulating materials.
3. To provide knowledge about applications of insulating materials and analysis of breakdown phenomena in these materials.
4. To provide hands on experience of measuring and testing high voltage accurately.

Course Learning Outcome (CLO): Upon completion of the course, students will be able to:

1. Understand the filtration and treatment techniques of transformer oils and capable to determine their dielectric strength.
2. Recognize applications of insulating materials and analyze breakdown phenomena in these materials.
3. Examine different methods for high voltage measurements and testing to measure the voltages accurately.
4. Understand overvoltage phenomena in power transmission system.

CLO Mapping	Course Content	Teaching-Learning Strategy
1	Study filtration and Treatment of transformer oil.	Discussion,

1	Determine dielectric strength of transformer oil.	Experiment, Report-writing
1	Study solid dielectrics used in power apparatus.	
2	Study applications of insulating materials.	
3	Study high voltage testing of electrical equipment: (i) Different line insulator (iii) cable (ii) bushing (iv) power capacitor (v) power transformer.	
2	Breakdown studies of uniform field and non-uniform field gaps under A.C. excitation:(i)Sphere to sphere (ii) Sphere to plane (iii) Sphere to point (iv) Plane to plane (v) Plane to Point (vi) Point to Point	
3	To study of high voltage ac measurement.	
2	Study the capacitance and dielectric loss measurement of an insulating material using Schering Bridge.	
4	Design an EHV transmission line.	

Course Code: EEE 4292
Course Title: Project/Thesis
Course Credit: 4
Prerequisite: N/A

Course Description:
The undergraduate thesis project should provide the student with knowledge of how to seek scientific facts and how to plan, carry out and present scientific work as well as theoretical and practical specialization within the area of Electrical and Electronics Engineering.

Course Learning Outcome (CLO):
Upon completion of the course, student is expected to:
1. Show basic knowledge on how to pursue scientific fact.
2. Show basic knowledge on planning and performance of a scientific work.
3. Show basic knowledge on analysis of scientific data.
4. Show basic knowledge on how to present scientific work.
5. Have theoretical and practical professional specialization within the EEE discipline including understanding of the current research questions.
6. Be able to search scientific literature.
7. Be able to summaries scientific literature.
8. Be able to discuss scientific data related to the question at hand.
9. Be able to present scientific data and conclusions in written and oral form addressed to different groups.
10. Complete a supervised research project and submit a dissertation as the requirement of partial fulfillment of BSc Engineering Degree to the department.

Course Content:
The undergraduate thesis project within the field of Electrical and Electronics research is an individual study that should include hypothesis testing that will substantiate new data.
The undergraduate thesis project includes search, studies and summary of scientific literature, practical work in close relation to ongoing research of the corresponding project, compilation and critical analysis of the results, and oral and written presentation.
The undergraduate thesis project is mastered under individual supervision. The supervision includes how to perform a scientific study and how to orally and in writing present gathered data in good scientific manner. The supervisor must have documented scientific experience.
The studies take place under individual supervision and include literature studies, seminar exercises and practical work.
Project Dissertation/Report must be submitted by the end of the Even semester and make an oral defense of the project. Project Evaluation will be made in the Even semester.

Suggested Reading Lists/Essential Readings:
1. As per the guide line of the corresponding supervisor

Course Code: EEE 4200
Course Title: Board Viva Voce
Course Credit: 2
Prerequisite: N/A

Course Description:
The objective of this course is to verify the students how well they can express their knowledge orally. A student has to face a board of members and answer the questions from the board members.

Course Learning Outcome (CLO):
The students will be able to:
1. Convince the audience orally about their knowledge on the courses in Part-4.

Suggested Reading Lists/Essential Readings:

1. All course of part-4

Elective Courses

Elective I

Course Code: EEE 4113
Course Title: Computer Networks
Course Credit: 3
Pre-requisite: N/A

Course Description:
The subject is concerned with the working principles of local area network and internet. It describes in detail about the OSI and TCP/IP network reference model. IPv4 has been explained rigorously. Also gives an introduction to application services, such as, Web, DNS, Email, FTP etc.

Objectives:
1. To describe the internet using layered approach.
2. To master the terminology and concepts of the OSI reference model and the TCP /IP reference model.
3. To master the concepts of protocols, network interfaces, and design/performance issues in different layers of TCP/IP reference model.
4. To master the underlying working principle of Internetwork.
5. To master the usage of IP address version 4.
6. To Familiarize the student with wireless networking concepts,
7. To familiarize the student with the Web, DNS, Email and FTP Services.
8. To give brief introduction to ATM networking.

Course Learning Outcome (CLO): At the conclusion of the course, the student is expected to:
1. Describe the internet structure using standard OSI and TCP/IP reference model using proper terminology.
2. Explain functions of different layers of the Internet working principle.
3. Identify the different types of network topologies and protocols
4. Design local area network, create subnetwork, assign IPs (IPv4), configure routers for routing the traffic in a expected way.
5. Identify the different types of network devices and their functions within a network
6. Explain the working principle of DNS, DHCP, WWW, Email and FTP services.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Introduction:** Computer networks, Types of computer networks, Network topology, Circuit switching and packet switching, Protocol and protocol hierarchies, The OSI reference model, TCP/IP protocol suit.	Lecture/ Discussion
1,2	**Physical Layer:** The theoretical basis for data communication, Transmission media: Wired and wireless, Narrowband ISDN, Broadband ISDN and ATM.	Lecture Discussion, Problem solving
2,3	**Data link Layer:** Data link layer design issues, Error detection and correction, Elementary data link protocols, Sliding window protocols, Protocol specification and verification, HDLC.	Lecture, Discussion, Problem Solving
4	**Medium Access Sublayer:** Channel allocation problem, Multiple access protocols, IEEE standards for LANs and MANs, Bridges, and high-speed LANs, ATM and frame relay.	Lecture, Discussion, Problem solving
	Section B	
1,2	**Network Layer:** Network layer design issues, Routing algorithms, Congestion control algorithms, Internetworking, IP, IP addresses, Network layer protocols; ARP, IPv4, ICMP, IPv6, Routing protocols; OSPF and BGP.	Lecture, Discussion, Problem solving
3	**Transport Layer:** Process-to-process delivery, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion control and quality of service, Performance issues.	Lecture, Discussion, Demonstration
4,5,6	**Application Layer:** Client-server model, Domain Name System (DNS), Electronic mail (SMTP) and File Transfer Protocol (FTP), HTTP and WWW.	Lecture, Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:

1. A. S. Tanenbaum : Computer Networks
2. Behrouz A. Forouzan : Data Communication and Networking
3. J.F. Kurose and K.W. Ross : Computer Networking
4. W. Stallings : Data and Computer Communication

Course Code: EEE 4114
Course Title: Computer Networks Sessional
Course Credit: 3
Pre-requisite: N/A

Course Description: The subject is concerned with the working principles of local area network and internet. It gives the student a hands on experience of configuring switches and routers and designing customized network using simulation software as well as real devices. All exercises will use IPv4. Also students will have experience on DHCP and WWW servers.

Objectives:

1. To give students hands on experience of using real life switches and routers.
2. To master the usage of IP address version 4.
3. To master the student about creating and configuring subnetworks

4. To familiarize the student with the Web and DHCP servers.

Course Learning Outcome (CLO): At the conclusion of the course, the student is expected to:
1. Configure network cards, switches and routers as per requirements
2. Design local area network, create subnetwork, assign IPs (IPv4), configure routers for routing the traffic in a expected way.
3. Use access control list for controlling access of the users in their designed network.
4. Use Packet Tracer Simulation software for simulating their designed networks
5. To use and configure WWW and DHCP servers using Linux machine.

Suggested Textbook:

1.	A. S. Tanenbaum	:	Computer Networks
2.	Behrouz A. Forouzan	:	Data Communication and Networking
3.	J.F. Kurose and K.W. Ross	:	Computer Networking
4.	W. Stallings	:	Data and Computer Communication

Course Code: EEE 4123
Course Title: VLSI Circuits and Design
Course Credit:3
Pre-requisite (If any): EEE 2231

Course Description: This course is offered for the senior students that provide a clear understanding of digital system operation and techniques of designing very large scale integrated circuit (VLSI) systematically. Starting with the history of VLSI development this course will cover the system level design of CMOS VLSI chips.

Objectives:
1. To familiar with CMOS based digital Very Large Scale Integrated (VLSI) Circuit
2. To learn the CMOS process technology
3. To learn the CMOS combinational and sequential logic gates and network design, synthesis and analysis based on design constraints
4. To learn hardware description language (VHDL) for digital system synthesis

Course Learning Outcome (CLO): Upon completion of the course students will be able to:
1. Explain VLSI and its design and fabrication process
2. Calculate MOS parameters
3. Design and synthesize CMOS combinational gates, sequential machine and networks
4. Design, synthesize and analyze digital system using VHDL

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	Design integrated circuits. Integrated circuit Manufacturing. CMOS technology. Integrated circuit Design techniques. A look into the future.	Lecture/Discussion
1, 2	Fabrication processes. Transistors. Wires and Vias. Design rules. Layout design and tools.	Lecture/Discussion, Problem solving
2, 3	Combinational logic functions, Static complementary gates, Wires and delay, Switch logic, Alternative gate circuits.	Lecture/Discussion, project-based learning
3	Layout design methods. Simulation. Combinational network delay. Crosstalk, Power optimization. Switch logic networks. Combinational logic testing.	Lecture/Discussion, Problem solving
3	Latches and Flip-Flops. Sequential systems and clocking disciplines. Sequential system design. Power optimization. Design validation.	Lecture/Discussion, Problem solving

	Sequential testing.	
3	Subsystem design principles. Combinational shifters. Adders. ALUs. Multipliers. High-density memory. Field-Programmable Gate Arrays: Internal architecture, Design implementation using HD; Programmable Logic Arrays.	Lecture/Discussion, project-based learning
3	Floor planning methods. Floor planning large chips. Off-chip connections.	Lecture/Discussion
4	Hardware Description Language, Verilog and VHDL: History, Code structure; Design flow, Introduction to VHDL: Data types, Operators, Signal, Concurrency, Circuit simulation, Test Bench; Introduction to Xilinx ISE software suit.	Lecture/Discussion, project-based learning

Text Book/ Suggested Reading:

1. Wayne Wolf, Modern VLSI design, Pearson Education, 2003.
2. D.A Pucknell&K.Eshraghian Basic VLSI Design, Third edition, PHI, 2003.
3. Weste and Harris: CMOS VLSI DESIGN (Third edition) Pearson Education, 2005.
4. M.J.S.Smith: Application specific integrated circuits, Pearson Education, 1997.
5. J.Bhasker: Verilog HDL primer, BS publication, 2001.
6. Ciletti Advanced Digital Design with the Verilog HDL, Prentice Hall of India, 2003.

Course Code: EEE 4124
Course Title: VLSI Circuits and Design Sessional
Course Credit: 1
Pre-requisite (If any**):**N/A

Course Description:
The course explores the design aspects of various combinational circuits, counters, shift registers, multipliers, and finite state machine (FSM). The experiments are related with the design of digital circuits and simulation using Xilinx ISE software tool and verify the waveforms. The students will get a wide knowledge to use various VLSI simulation tools.

Objectives:
1. To become familiar with VHDL language and describe the hardware of combinational and FSM.
2. To learn the test-bench design for design problems.
3. To verify the functionality of designed hardware using test bench.

Course Learning Outcome (CLO): Upon completion of the course students will be able to :
1. Simulate a test bench using VHDL.
2. Design and simulate list of combinational and sequestional digital circuits using Xilinx –VHDL language

CLO mapping	Lab Experiments	Teaching-learning strategy
	Section A	
1	Design a test bench for 2-input NAND gate	Computer with VHDL simulator
2	Design of 4 bit Adders and Subtractors	Computer with VHDL simulator
2	Design of 4x1 Multiplexer	Computer with VHDL simulator
2	Design a 4-bit counter	Computer with VHDL simulator

Software:
1. Vivado® Xilinx Design Suite HLx editions

Text Book/ Suggested Reading:
2. Circuit Design and Simulation with VHDL by Volnei A. Pedroni
3. The Designer's Guide to VHDL / Edition-3 by Peter J. Ashenden

Course Code:EEE 4133
Course Title: Microwave Engineering
Course Credit: 3
Pre-requisite (If any**):** N/A

Course Description: With the increasingly application of microwave technologies in applications like radio astronomy, long-distance communications, space navigation, radar systems, medical equipment students need to understand the theoretical and experimental design and analysis of microwave devices and circuits. This course provides a through coverage of fundamental principles of microwave engineering on microwave production, amplification, analysis and applications.

Objectives:
1. To be familiar with microwave tubes solid-State devices.
2. To understand characteristics of microwave generated by tube and solid state devices.
3. To design microwave components such as Directional Couplers, Microwave Wave-guides and Components.
4. To analyze and study rectangular and circular wave guides using field theory.
5. To design impedance matching and tuning using lumped and distributed elements for network.

Course Learning Outcome (CLO): Upon completion of the course students will be able to:

1. Explain the basic theories, models and design methods applied in microwave engineering starting from the fundamental of microwave production by tube and solid state devices along with basic microwave components.
2. Analyze basic passive and active microwave circuits such as couplers, amplifiers, mixers, oscillators
3. Apply microwave engineering in specific area.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	**Transmission Lines:** Transmission line equations and parameters; Transmission line configuration and formulae, Transmission line at radio and audio frequency.	Lecture/Discussion
	Waveguides: Rectangular and cylindrical wave guides, Cavity resonators, Microstrip lines and their characteristics.	Lecture/Discussion, Problem solving
1	**Microwave Tubes:** Klystron, Magnetron, TWT.	Lecture/Discussion, Problem solving
1	**Solid State Microwave Devices:** Gunn diode, Tunnel diodes, IMPATT Diode, TRAPATI Diode.	Lecture/Discussion, Problem solving
2	**Microstrip Lines**: Characteristic Impedance, Losses ,Quality Factor Q, Parallel Strip Lines, Distributed Parameters, Attenuation Losses 487	Lecture/Discussion, project-based learning
	Section B	
2	**Microwave Components:** Microwave hybrid circuits, scattering parameters, Wave guide Tees, Directional couplers, Circulators and Isolators, Phase shifter and attenuator.	Lecture/Discussion, Problem solving
3	**Microwave Antenna:** Hertzian and half wave dipoles. Mono pole, horn, rhombic and parabolic reflector, array, and Yagi-Uda antenna.	Lecture/Discussion, Problem solving
3	**Microwave Systems:** Wireless Communications, Radar, Radiometer Systems, Microwave Propagation, Microwave Power Transfer, Biological Effects and Safety.	Lecture/Discussion, project-based learning

Text Book/ Suggested Reading:

1. Microwave Devices and Circuits by Samuel Y. Liao, Prentice Hall
1. Microwave Engineering by David M. Pozar, Wiley & Sons.
2. Microwave Principles by Herbert J. Reich, J. G. Skalnik, P. F. Ordung and H. L. Krauss, CBS Publishers and Distributors.
3. Microwave Engineering Passive Circuits by Peter A.Rizzi, PHI.
4. Electronic and Radio Engineering by F.E Terman, McGraw-Hill.

Course Code:EEE 4134
Course Title: Microwave Engineering Sessional
Course Credit: 1
Pre-requisite (If any**):** N/A

Course Description: The lab course will give a practical exposure to students to learn the characteristics of microwave components and gain practical hands on experience by exposing the students to various microwave components.

Objectives:
1. To be familiar with microwave generation.
2. To understand characteristics of microwave generated by solid state device.

Course Learning Outcome (CLO): Upon completion of the course students will be able to:
1. Explain probable impedance mismatch by measuring the voltage standing ration (VSWR).
2. Determine average microwave power at any position in waveguide.
3. Demonstrate microwave generation and control of generated power using Gunn Diodes.

CLO mapping	Course content	Teaching-learning strategy
	Section A	
1	Measurement of VSWR	Hands on experiment using microwave bench
2	**Measurement of microwave power**	Hands on experiment using microwave bench
3	Study of I-V Characteristics of Gunn Diodes	Hands on experiment using Gunn oscillator, Gunn power supply

Reference Book:

2. Operational manual of microwave bench

Elective II

Course Code: EEE 4215
Course Title: Renewable Energy
Course Credit: 3
Pre-requisite: N/A

Course Description: Energy demand increases day by day with increasing population worldwide. For saving natural resources like coal, gas, oil and for the development of the sustainable society this course will focus basic understanding with the sources of renewable energy. The course will provide some concrete idea to student about the technologies for conversion and storing renewable energy into useful energy source. As a result the course will bring comprehensive theoretical study on solar energy, solar photovoltaic, solar to thermal energy, wind turbine and biomass to electricity.

Objectives:

1. To understand basic aspects of renewable energy sources;
2. To gather knowledge about renewable energy conversion technique to useful energy source.
3. To introduce about energy coupling between turbine and electric generator.

Course Learning Outcome (CLO): The students will be able to:

1. Identify and understand the renewable energy sources and their characteristics;
2. Differentiate between renewable energy sources and traditional sources;
3. Analyse energy conversion technique and coupling between turbine and electric generator.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1.2	**Renewable Energy Sources:** Solar, wind, mini-hydro, geothermal, biomass, wave and tides.	Lecture/discussions /demonstration
1,2	**Solar Photovoltaic:** Characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, sun tracking systems, Maximum	Lecture/Discussions/Analysis
3	**Power Point Tracking (MPPT):** Chopper, inverter. Sizing the PV panel and battery pack in stand-alone PV applications. Modern solar energy applications (residential, electric vehicle, naval, and space). Solar power plants connected to grid	Lecture/Discussions/Demonstration/design and problem solving.
1, 2	**Solar Thermal:** Principles of concentration, solar tower, parabolic dish, receiver, storage, steam turbine and generator.	Lecture/Discussions

	Section B	
3	**Wind Turbines:** Wind turbine types and their comparison, power limitation, Betz's law; Control mechanism: pitch, yaw, speed. Couplings between the turbine and the electric generator, Wind turbine generator - DC, synchronous, self-excited induction generator and doubly fed induction generator. Grid interconnection: active and reactive power control. Biomass and biogas electricity generation.	Lecture/Discussions/Design/problem solving

Suggested Reading Lists/Essential Readings:

1. D. Rapp : Solar Energy
2. M.J. Fish and H.C.W. Anderson : Introduction to solar technology
3. M.A. Green : Solar Cells
4. B.S. Magal : Solar Power Engineering
5. G.D. Rai : Solar Energy Utilization
6. G.D. Rai : Nonconventional Source of Energy

Course Code: EEE 4225
Course Title: Power System Operation and Control
Course Credit: 3
Prerequisite:

Course Description:
This course deals with modern power system operational and control problems and solution techniques.

Objectives:
1. Understand Economic operation of power system.
2. Discuss about thermal and hydro power plants operation in meeting the load demand optimally.
3. Improve student's ability in solving problems by posing different problem models related to Economic Load Dispatch, Load Frequency Control and reactive power control.

Course Learning Outcome (CLO): The students should be able to:
1. Explain the functional content of SCADA, EMS and related systems.
2. Optimize techniques used in the power system and frequency control.
3. Understand the importance of the power system security.
4. Understand the concept of power systems and operation and control to solve real time world applications.
5. Solve economic load dispatch problems.

Learning Outcomes	Course content	Teaching-learning strategy
Section A		
1, 2, 3	**Overview:** Vertically integrated vs. deregulated power system. Realtime operation: SCADA; EMS (energy management system); various data acquisition devices – RTU	Lecture Exercise Open discussion Attendance
2,3,4	**Application Functions:** State estimation; short term load forecasting; unit commitment (UC); economic dispatch (ED); optimal power flow (OPF). Frequency control: generation and turbine governors	
Section B		
3	**Power system security:** Static and dynamic; security constrained OPF.	Lecture Exercise Open discussion Attendance
4, 5	**Electricity Market Operation:** GenCos, ISO, DisCos, bidding, spot market, social welfare, market clearing price (MCP), locational marginal price (LMP), bilateral contracts and forward market, hedging.	
5	**Demand Side Control:** DMS (distribution management system), DSM (demand side management), smart grid concept.	

Suggested Reading Lists/Essential Readings

1. P.S.R. Murty : Operation and Control in Power Systems
2. Dr. K. Uma Rao : Power System: Operation and Control
3. Robert Miller, James Malinowski : Power System Operation
4. Allen J. Wood and Bruce F. Wollenberg : Power Generation, Operation and Control

Course Code: EEE 4235
Course Title: Biomedical Engineering
Course Credit: 3
Prerequisite: N/A

Course Description:
The course includes a revision of DC and AC circuit theory, hands-on practice in the use and testing of medical transducers and electromedical equipment in common use in hospitals and research laboratories to make measurements of biomedical variables of clinical significance. This course serves as an introduction to physiological measurement of bioelectric phenomena and neuro-stimulation.

Objectives:

1. To understand the physical principles which govern the measurement of a biological variable or system as an electrical quantity
2. To get familiar with the basic medical instrumentation used clinically to perform these functions
3. To get insight of bioelectric phenomena, bioelectrodes, medical electronics and neuro-stimulation.

Course Learning Outcome (CLO): The students will be able to:

1. Understand the physical principles which govern the measurement of biological variables or systems as an electrical quantity
2. Get familiar with the basic medical instrumentation used clinically to perform these functions
3. Get insight of bioelectric phenomena, bioelectrodes, medical electronics and neuro-stimulation.

CLO Mapping	Course Content	Teaching-Learning Strategy
1	**Physics of Human Body:** The cell, Body fluid, Musculo-skeletal system, Respiratory system, Nervous system, the circulatory system, the body as a control system, the heart, Bioelectricity, Work done by heart, blood pressure and its measurements, Membrane potentials, Electrical activity of excitable cells, Molecular basis of muscle contraction, Basic electrical signals from the muscles.	Instruction
1,2	**Interaction of Wave and Radiation with Human Body:** Body's detector and matter wave, speech noise, physiological effects of intense matter waves, Interaction of electromagnetic radiation on living mater, penetration of rays into tissue. Biological effects of ionizing radiation: Dosimetry, primary effects, Biophysical effects of whole body irradiation, radiation measurement and protection.	Instructional
1,3	**BiopotentialsElectrodes and Amplifiers:**Biopotential electrode, Sensors, Transducers and bioelectric amplifiers, Electromagnetic interference of medical electronic equipment, ENG, EMG, ECG, ERG, EEG, MEG.	Instructional
1,3	**Ultrasonography:** Physics of ultrasonic wave, Ultrasonic transducers, Absorption and attenuation of ultrasound, Scan modes, scan pattern and scanning systems, Doppler imaging, Echocardiography, Ultrasonic flow meter, Ultrasonic blood pressure measurement.	Instruction

1,3	**X-ray:** X-ray production, X-ray image formation and contrast, Contrast types, Effects of photon energy, Area contrast, Fluoroscopic imaging system, computed tomography.	Instruction
1,3	**Magnetic Resonance Imaging:** Nuclear magnetic resonance, Image characteristics, Gamma camera.	Instruction
1,3	**Analytical and Medical Laboratory Instruments:** Blood components, Colorimeter, spectrophotometer, Blood cell counter, pH/Blood gas analyzer, chromatograph, Auto analyzer, Atomic absorption and atomic emission spectroscopy.	Instruction
1,3	**Therapeutic and Prosthetic Devices:** Cardiac pacemaker, Hemodilysis, Defibrillator, Surgical diathermy.	Instruction

Course Code: EEE 4245
Course Title: Optoelectronics
Course Credit: 3
Pre-requisite: N/A

Course Description:
The course is based on the quantum mechanical effects of light on electronic materials, especially semiconductors. Thus, a communication between optics and electronics is build up. Beginning with the interaction and nature of light with semiconductor materials, the concern flows in the theory, design, manufacture and operation of devices that converts electrical signal to visible or infrared radiation energy or vice versa. Finally, integrated optics is introduced to the students.

Objectives:
1. Students will understand the laws and phenomena in the area of optical properties of semiconductors.
2. Students will acquire in depth understanding in emission and amplification of light.
3. Students will get up to date with the design, fabrication and interfacing of LED, LASER, Photodetectors and Solar Cells.
4. Students will develop concept about available devices, current trends and future developments in the application of light into electronics.

Course Learning Outcome (CLO):
Upon completion of the course, students should be able to:
1. explain fundamental and technical base of optoelectronic system
2. use principles of optics to analyze and design LED, LASER, Photodiodes and Photovoltaics.
3. incorporate above devices into systems for optimal performance.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Optical Properties in Semiconductor:** Direct and indirect band-gap materials, basic transitions in semiconductors, radiative and nonradiative recombination, optical absorption, photo-generated excess carriers, minority carrier life time, luminescence and quantum efficiency in radiation.	Lecture Assignment
1	**Properties of Light:** Particle and wave nature of light, polarization, interference, diffraction and blackbody radiation.	Open discussion
2	**Light Emitting Diode (LED):** Principles, materials for visible and infrared LED, internal and external efficiency, loss mechanism, structure and coupling to optical fibers. Double-Hetero-structure (DH) LEDs, Characteristics, Surface and Edge emitting LEDs.	Lecture Class Test

1	**Stimulated Emission and Light Amplification:** Spontaneous and stimulated emission, Einstein relations, population inversion, absorption of radiation, optical feedback and threshold conditions.	Lecture Open discussion
	Section B	
2	**Semiconductor Lasers:** Population inversion in degenerate semiconductors, laser cavity, operating wavelength, threshold current density, power output, elementary laser diode characteristics, heterojunction lasers, optical and electrical confinement. single frequency solid state lasers-distributed Bragg reflector (DBR), distributed feedback (DFB) laser.	Lecture Assignment
1,2	**Introduction to Quantum Well Lasers**. Introduction to quantum well lasers, Vertical Cavity Surface Emitting Lasers (VCSELs), optical laser amplifiers.	Lecture Open discussion
2	**Photo-detectors:** Photoconductors, junction photo-detectors, PIN detectors, avalanche photodiodes, hetero-junction photodiodes, Schottky photo-diodes and phototransistors. Noise in photodetectors. PIN and APD. Photo-detector design issues.	Lecture Class Test
2,3	**Solar Cells:** Solar energy and spectrum, silicon and Schottkey solar cells.	Lecture Assignment
1,3	**Modulation of Light:** Phase and amplitude modulation, electro-optic effect, acousto-optic effect and magneto-optic devices. Introduction to integrated optics.	Lecture Open discussion

Suggested Reading Lists/Essential Readings:

1. Wilson and Hawkes : Optoelectronics: An Introduction
2. J. Wilson, J.F.B. Hawkes : Optoelectronics
3. Michael A. Parker : Physics of Optoelectronics
4. Pallab Bhattacharya : Semiconductor Optoelectronic Devices
5. S.C. Gupta Optoelectronic Devices and Systems
6. Joachim Piprek Optoelectronic Devices

Course Code: EEE 4255
Course Title: Compound Semiconductor Devices
Course Credit: 3
Pre-requisite: N/A

Course Description:

Compound Semiconductor Devices form the foundation of solid state microwave and optoelectronic technologies. This course outlines the physics, modeling, technology and application of compound semiconductors, primarily III-Vs. Topics include properties, preparation, and processing of compound semiconductors as well as theories and practices of heterojunctions. After explanation of physical properties, heterojunction diodes, HBTs and resonant tunnelling diodes are described.

Objectives:

1. Students will comprehend relevant properties of compound semiconductors and their facilities to form heterostructures for fabricating devices.
2. Students will gain an ability to analyze models, structures and band diagrams of various heterojunction diodes and transistors.
3. Students will enhance their reasoning ability in the basic principles of coherent tunnelling and relative applications.

Course Learning Outcome (CLO):

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

1. use various functional properties of compound semiconductors for fabricating high performance electrical and optical component structures.
2. demonstrate the usefulness of doping and exploitation of compound semiconductor heterostructures.
3. comply with operational principles and modeling approaches of resonant tunneling diodes.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Reviews of Compound Semiconductor:** Zinc-blend crystal structures, growth techniques, alloys, band gap, basic opto-electronic properties, density of carriers in intrinsic and doped compound semiconductors.	Lecture Open Discussion
1, 2	**Introduction to Physics of Hetero-Junctions:** Band alignment, band offset, Anderson's rule, single and double sided hetero-junctions, quantum wells and quantization effects, lattice mismatch and strain and common hetero-structure material systems.	Lecture Class Test
1, 2	**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. Nonideal effects, frequency response, high electron mobility transistor.	Lecture Assignments
	Section B	

2	**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.	Lecture Oral Presentation
3	**Resonant Tunneling Diodes:** Physics and operation. Resonant Tunneling Transistors: device physics, operation and characteristics.	Lecture Class Test

Suggested Reading Lists/Essential Readings:

1. Kenneth A. Jackson : Compound Semiconductor Devices: Structures and Processing
2. SandipTiwari : Compound Semiconductor Device Physics
3. Michael Shur : Physics of Semiconductor Devices
4. H. Craig Casey : Devices for Integrated Circuits: Silicon and III-V Compound Semiconductors
5. S. M. Sze Semiconductor Devices: Physics and Technology

Course Code: EEE 4265
Course Title:Cellular Mobile Communication
Course Credit: 3
Pre-requisite: N/A

Course Description:

This course discusses how cellular and mobile communication works. It describes various engineering techniques to establish an efficient mobile communication system. It also discuss about different types of mobile communication systems and their characteristics and applications.

Objectives:

1. To familiarise the students about the evolution of various generation of mobile communication system
2. To enable the students to understand how cellular mobile communication system works
3. To introduce different techniques and mathematical analysis used in communication system
4. To introduce various coding system
5. To develop students idea about the application and utilization of mobile communication

Course Learning Outcome (CLO):

Upon successful completion of this course the students will be expected to:

1. Identify various generation of mobile communication system
2. Describe how cellular mobile communication system works
3. Understand the characteristics and management of radio wave propagation
4. Learn about frequency management and channel assignment techniques
5. Analyze the operation of different multiple access techniques
6. Explain diversity and equalization techniques

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Introduction:** Evolution of mobile radio communication, Introduction to 2G, 2.5G and 3G wireless networks, Paging, Cordless telephony, Cellular telephony, Cellular Concept-Noncellular and cellular communication, evolution and fundamentals, analog and digital cellular systems.	Lecture/Discussion
2	**Cellular Radio System:** Frequency reuse techniques, co-channel interference, cell splitting and components.	Lecture/Discussion
2,3	**Mobile Radio Propagation:** Propagation characteristics, models of radio propagation, antenna at cell site and mobile antenna.	Lecture/Discussion
2,4	**Frequency Management and Channel Assignment:** Fundamentals, spectrum utilization, fundamentals of channel assignment, traffic and channel	Lecture/Discussion , Problem solving

	assignment.	
2,4	**Handoffs and Dropped Calls:** Reasons and types, forced handoffs, mobile assisted handoffs and dropped call rate.	Lecture/Discussion , Problem solving
	Section B	
2,5	**Multiuser Systems:** Multiuser channels: the uplink and downlink, Multiple-access techniques: TDMA, FDMA, CDMA - spread spectrum multiplexing, coding techniques and constraints of CDMA.	Lecture/Discussion
2,6	**Diversity and Equalization Techniques:** Concept of diversity branch and signal paths, Diversity techniques: Time diversity - repetition coding, beyond repetition coding. Antenna diversity - SC, MRC, EGC, spacetime coding. Frequency diversity - fundamentals, single-carrier with ISI equalization, DSSS, OFDM, Alamouti space-time block coding, carrier to noise and carrier to interference ration performance, Equalizer noise enhancement, Equalizer types.	Lecture/Discussion , Problem solving, Demonstration
2	**Space-time Communications:** Multi-antenna techniques, MIMO channel capacity and diversity gain, STBC, OSTBC, QOSTBC, SM, BLAST, smart antennas, frequency selective MIMO channels.	Lecture/Discussion
2,6	**Broadband Communications:** DSSS, FHSS, spreading codes, RAKE receivers, MC-CDMA, OFDM, OFDMA, multiuser detection, LTE, WiMAX.	Lecture/Discussion , Problem solving

Suggested Reading Lists/Essential Readings:

1. Jon W. Mark, WeihuaZhuang : Wireless Communications and Networking
2. T.S. Rappaport : Principles of Wireless Communication
3. Pahlavan and Krishnamurty : Principles of Wireless Network
4. VK Garg and J E Wilkis : Principles and Application of GSM
5. Y. Lee : Mobile Cellular Communication
6. A J Goldsmith : Wireless Communication

Elective III

Course Code: EEE4217
Course Title: Nuclear Power Engineering
Course Credit: 3
Pre-requisite: N/A

Course Description:
The course will provide some comprehensive idea to student about basic concept of nuclear energy as well as how that energy can be utilized as useful power through grid interconnection. As a result the course will bring theoretical study on nuclear power reactor, safety issues, instrumentation and control and grid interconnection issues.

Objectives:
1. To understand basic concepts of nuclear energy and nuclear processes.
2. To gather knowledge about different types of nuclear power reactor, instrumentation and control.
3. To introduce and highlights safety issues and grid interconnections issues.

Course Learning Outcome (CLO):
The students will be able to:
1. Understand the basics of nuclear energy and processes;
2. Describe and explain different types of nuclear power reactor;
3. Address safety, security and grid interconnection issues.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1	**Basic Concepts:** Nuclear energy, atoms and nuclei, radioactivity, nuclear processes, fission, fusion.	Lecture/discussions /demonstration
2, 3	**Nuclear Systems:** Particle accelerator, isotope separators, neutron chain reaction, reactor types, power generation. Layout of nuclear power plant (NPP). **Nuclear Power Plant Reactors:** Pressurized water reactor, boiling water reactor, CANDU reactor, gas cooled reactor, liquid metal cooled reactor, and breeder reactor. Auxiliaries, instrumentation and control.	Lecture/Discussions/Descriptions/demonstrations/ problem solving
	Section B	
3	**Grid Interconnection Issues:** Effects of frequency and voltage changes on NPP operation. Advanced and next generation nuclear plants; very high temperature reactors. Biological effects, reactor safety and security; Three Mile island case; Chernobyl case; Fukushima case. Fuel cycle; radioactive waste disposal	Lecture/Discussions

Suggested Reading Lists/Essential Readings:

1. M M El-Wakil : Nuclear Power Engineering
2. Julian Meyer, Jürgen Schnell, and RüdigerMeiswinkel : Design and Construction of Nuclear Power Plants
3. Janet Wood : Nuclear Power
4. John R. Lamarsh and Anthony J. Baratta : Introduction to Nuclear Engineering

Course Code: EEE 4227

Course Title: Processing and Fabrication Technology
Course Credit: 3
Pre-requisite:

Course Description:
This course introduces manufacturing practices used in silicon integrated circuit fabrication and the underlying scientific basis of processing technologies. Physical models are developed to explain basic fabrication steps, such as substrate growth, thermal oxidation, dopant diffusion, ion implantation, etching etc. The course also presents different measurement techniques like spectroscopy, X-ray diffraction, SEM etc. for characterization of semiconductor materials. The overall discrete and integrated circuit process flows are described within the context of these physical models.

Objectives:
1. Students will understand the basic principles underlying integrated circuit fabrication and analyze the popular laboratory methods and equipment used throughout the process.
2. Students will be able to explain typical silicon wafer manufacturing processes.
3. Student will understand the mechanical, chemical, optical and electrical measurements and develop the ability to characterize the semiconductor wafer at crucial stages in the fabrication process.
4. Student will gain knowledge on integrated circuit fabrication fundamentals.

Course Learning Outcome (CLO):
Upon completion of the course, students should be able to:
1. relate semiconductor material properties to the underlying physical concepts.
2. apply the knowledge of semiconductor fabrication processes to work in industry/ institute in the research and development of semiconductor devices.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1, 2	**Substrate Materials:** Crystal growth and wafer preparation, epitaxial growth technique, molecular beam epitaxy, chemical vapor phase epitaxy and chemical vapor deposition (CVD).	Lecture Assignment
1, 2	**Doping Techniques:** Diffusion and ion implantation. Growth and deposition of dielectric layers: Thermal oxidation, CVD, plasma CVD, sputtering and silicon-nitride growth.	Lecture Class Test
1, 2	**Introduction to Semiconductor Characterization Tools:** Structural characterization- X-ray diffraction, electron microscopy (SEM and TEM), Auger electron microscopy (AES), Secondary ion mass spectroscopy (SIMS), Rutherford backscattering (RBS), Scanning probe microscopy (SPM), Optical characterization- Photoluminescence spectroscopy (PL), Cathodoluminescence (CL), reflectance and absorbance measurements, Ellipsometry, Raman Spectroscopy, Fourier transform spectroscopy, Electrical characterization- Resistivity measurement, Hall effect measurement, Capacitance techniques, electrochemical capacitance-voltage (ECV) profiling.	Lecture Lab Visit
	Section B	
2	**Etching:** Wet chemical etching, silicon and GaAs etching, anisotropic etching, selective etching, dry physical etching, ion beam etching, sputtering etching and reactive ion etching.	Lecture Oral Presentation
2	**Cleaning:** Surface cleaning, organic cleaning and RCA cleaning.	Lecture Oral Presentation

2	**Discrete Device Fabrication:** Diode, transistor, resistor and capacitor.	Lecture Assignment
2	**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.	Lecture Class Test

Suggested Reading Lists/Essential Readings:

1. Michael E. Levinshtein and Michael S. Shur : Semiconductor Technology: Processing and Novel Fabrication Techniques
2. Yoshio Nishi, Robert Doering : Handbook of Semiconductor Manufacturing Technology
3. Peter Van Zant : Microchip Fabrication: A Practical Guide to Semiconductor Processing
4. Simon M. Sze and Ming-Kwei Lee : Semiconductor Devices: Physics and Technology
5. Stephen A. Campbell : The Science and Engineering of Microelectronic Fabrication
6. Gary S. May and Simon M. Sze : Fundamentals of Semiconductor Fabrication
7. R. Castellano : Semiconductor Device Processing: Technology Trends in the VLSI Era

Course Code: EEE 4237
Course Title: Plasma Science and Technology-I
Course Credit: 3
Prerequisite: N/A

Course Description:

Plasma Science and Technology-I course is introduced to gain basic concepts on plasmas and properties of plasmas, collision processes in plasmas, plasma kinetics, plasma productions and their diagnostics in laboratory. This course will provide basic ideas on plasma-surface interactions and applications of plasmas in food processing, agriculture, medicine, environment, surface modifications and materials processing.

Objectives:

1. To understand the kinetic theory of gases as a prerequisite for the production of plasma.
2. To understand the plasma production mechanisms through different collisional mechanisms.
3. To understand the plasma production mechanisms of different electrode configurations.
4. To understand the plasma production mechanisms using different types of power supply.
5. To understand the production mechanisms of ROS and RNS as used in different surface modifications.
6. To understand the diagnostic techniques of plasmas.
7. To understand the plasma-surface interaction mechanisms and their applications.

Course Learning Outcome (CLO):

The students will be able to:

1. Understand the kinetic theory of gases as a prerequisite for the production of plasma.
2. Understand the plasma production mechanisms through different collisional mechanisms.
3. Understand the plasma production mechanisms of different electrode configurations.
4. Understand the plasma production mechanisms using different types of power supply.
5. Understand the production mechanisms of ROS and RNS as used in different surface modifications.
6. Understand the diagnostic techniques of plasmas.
7. Understand the plasma-surface interaction mechanisms and their applications.

CLO Mapping	Course Content	Teaching-Learning Strategy

1	**Gases:** Kinetic energy and temperature, mean speed, Maxwell-Boltzmann distribution, Pressure, Avogadro's Laws, Mean free path, Probability of collision, Collision frequency, Energy transfer in collisions, Gas flow, Types of gas flow, Pumping speed and throughput, Gas flow rate and its measurements.	Instruction
1,2	**Plasmas and Collision Processes:** Collision Processes and their cross sections, Electron and ion temperatures, Plasma potential, Sheath formation and Bohm criterion, Debye shielding, Sheath formation, Plasma oscillations, Ambipolar diffusion.	Instructional, problem solving & Experimental
2,3	**High Voltage Plasma Source Design:** Electric breakdown in gases, Townsend's criterion for spark breakdown, Sparking potential, Penning effect, Corona discharge, AC voltage, Series resonant circuit, Impulse voltage generator: design consideration & mathematical analysis.	Instructional, problem solving & Experimental
3,4	**Plasma Production:** Types of plasma discharges: DC glow, Pulsed DC, RF and microwave discharges, Matching networks, Plasma discharge equivalent circuit, Electrode design, Plasma production dependency on pressure, voltage, gas composition & flow rate, dielectric material and electrode spacing. Plasma sources as function of operating frequency, pulse type and duty cycle.	Instruction, problem solving & usage in experiment
4,5	**Chemical Reactions and kinetics:** Introduction, Elementary Reactions, Gas Phase Kinetics, Rate Balance Equation and their solution using software, Reduced electric field (E/N), changes of EEDF with gas mixture and temperature, Formation of Reactive Oxygen Species (ROS), Reactive nitrogen species (RNS).	Instruction & usage in experiment
6	**Plasma Diagnostics:** Introduction, Langmuir probe, Single and Double Probe constructions, circuits and characteristics, Determination of electron density (n_e), & Temperature (T_e) by probe techniques, Optical Emission Spectroscopy (OES), Species identification, Spectral broadening mechanisms, Plasma Volt-Ampere characteristics.	Instruction, problem solving & usage in experiment
5,6,7	**Plasmas Applications to Surface Modifications & Material Processing:** Surface properties of textile Materials, Plasma Systems for Surface Treatment, Plasma Surface Interaction, Thin Film Deposition, Plasma-Enhanced Chemical Vapor Deposition (PECVD).	Instruction, problem solving & experiment
5,6,7	**Plasmas Applications to Food, Agriculture, Medicine & Environment:** Anti-wear coatings for food processing, Coating requirements & applications in food sector, Treatment of seeds, Decontamination of seeds, Fundamental and applied aspects of plasma medicine, Surface sterilization, Direct &bubble discharges in liquid, polluted air and wastewater cleaning.	Instruction, problem solving & experiment

Suggested Reading Lists/Essential Readings:

1. Brian Chapman : Glow Discharge Processes
2. M. A. Lieberman and A. J. Lichtenberg : Principles of Plasma Discharges and Materials Processing
3. H. Rauscher, M. Perucca, G. Buyle : Plasma Technology for Hyperfunctional Surfaces
4. R Shishoo : Plasma Technologies for Textiles
5. N.N. Misra, Oliver K. Schluter, P. J. Cullen : Cold Plasma in Food and Agriculture
6. A. Friedman, G. Fridman : Plasma Medicine
7. Y. Yang, Y. I. Cho, A. Friedman : Plasma Discharge in Liquid

Course Code: EEE 4247
Course Title: Optical Fiber Communication
Course Credit: 3

Course Description:
This is a basic course on optical fiber communication systems.

Objectives:
Students will try:
1. To understand the basics of optical fiber communications
2. To understand the physics of optical fiber and its characteristics
3. To describe the principle of operation of optical sources and detectors
4. To describe different type dispersions and limitations which are inherent to the system
5. To learn the coherent optical communication and multi-channel optical systems.

Course Learning Outcome (CLO):
Upon completion of the course, students should be able to:
1. Demonstrate an understanding of the principles of optical communication systems: fiber optic communication, coherent optical communication, and multi-channel optical communication systems.
2. Understand the functionality of each of the components that comprise optical communication systems.
3. Apply this knowledge to modern fiber optic systems.

CLO mapping	Course content	Teaching-learning strategy
1	Principle of light transmission in a fiber, propagation of light in an optical fiber, ray model and wave model.	Lecture Exercise
1,2	Types and characteristics of optical fiber, transmission characteristics, fiber joints and fiber couplers.	Lecture Exercise Open discussion
1,2	Transmission impairments: Losses in fibers, Dispersion, Power and rise time budget, SNR and BER calculations	Lecture Exercise Open discussion
2	Light Sources and Detectors: Light emitting diodes and laser diodes. PIN photo-detector and avalanche photo-detectors, Photo detector connector and splices	Lecture Exercise Open discussion
2	Optical Amplifier: Laser and fiber amplifiers, applications and limitations. Introduction to high speed long distance fiber optic links.	Lecture Exercise Open discussion
1	Coherent Optical Communication: Introduction, WDM systems, Devices for coherent optical communication, Chromatic dispersion, nonlinear refraction, four wave mixing and laser phase noises.	Lecture Exercise Open discussion
3	Receiver Analysis: Direct detection and coherent detection, noise and limitations.	Lecture Exercise Open discussion
1,3	Multi-channel Optical System: Frequency division multiplexing, wavelength division multiplexing and co-channel interference.	Lecture Exercise Open discussion

Suggested Reading Lists/Essential Readings:

1. John Senior : Optical Fiber Communications
2. G. P. Agrawal : Optical Fiber Communication System
3. Chrin : An Introduction to Optical Fiber
4. Barnoski : Fundamentals of Optical Fiber Communication

Course Code: EEE 4257
Course Title: Radar and Satellite Communications
Course Credit: 3
Pre-requisite: N/A

Course Description:
Describe the working principle of different RADAR systems and their applications. This course provides a basic introduction Satellite Communications in regards to their design, operation, types and application.

Objectives:
1. To get the basic concepts, operation, and applications of modern radar systems
2. How to design modern radar system with associated digital processing.
3. To provide an in-depth understanding of different concepts used in a satellite communication system.
4. To get knowledge of every aspects of satellite communication like orbital mechanics, launching techniques, satellite link design, earth station technology and different access system towards a satellite.
5. Application of satellites in different areas.

Course Learning Outcome (CLO):
The students will be able to:
1. Describe the working principle of different RADAR systems and their applications.
2. Understand the principles of Synthetic Aperture Radar, its use in geophysical remote sensing and surveillance applications, and the digital processing used to form SAR images.
3. Design simple radar systems and the associated signal processing, at block diagram level.
4. Understand the Satellite fundamentals and types of satellite
5. Explain the working of a Satellite communication system and its other subsystems.
6. Know the applications of Satellites in different areas.

CLO Mapping	Course Content	Teaching-Learning strategy
	Section A	
1,2,3	The simple form of Radar Equation, Radar block diagram and operation, minimum detectable signal, Antenna parameters, CW and frequency modulated radar, MTI and pulse Doppler radar, Tracking Radar, radar Transmitter, Receivers, displays and duplexers, Detection of Radar signal in noise, Extraction of information, Antenna Array in radar.	Lecture, Discussion, Problem Solving
	Section B	
4,5,6	Fundamentals of satellite systems, Microwave link engineering, Antennas, Modulation multiple access and impairments, Spacecrafts and repeater, Spacecrafts mission and subsystem, Earth station and network technology, Launch vehicles and Services, Satellite operations and organisation, Satellite Television Broadcasting network, Applications.	Lecture, Discussion, Problem Solving

Suggested Reading Lists/Essential Readings:
1. D. Roddey and Cooleen : Electronic Communication
2. M.I Skolnik : Introduction to Radar System
3. J. Martin : Communication Satellite System
4. Bruce R. Elbert : Introduction to Satellite communication
5. Timothy Pratt, Charles Bostain and Jeremy Allnutt Satellite Communications

Course Code: EEE 4267
Course Title: Telecommunication Engineering

Course Credit: 3

Course Description:
This is a basic course on Telecommunication engineering.

Objectives:
1. To describe and relate fundamentals of telecommunication networks and associated technologies.
2. To apply the principles of queuing theory in evaluating the performance of telecommunication networks.
3. To solve problems and design simple systems related to telecommunications networks.
4. To appreciate the reasons for switching, and the relative merits of the possible switching modes, e.g. packet and circuit switching.
5. To understand the principles of the internal design and operation of communication switches, and the essence of the key protocols that are used with switched networks.

Course Learning Outcome (CLO):
Upon completion of the course, students should be able to:
1. Analyze the characteristics of the telecommunication systems and networks.
2. Solve problems and design simple systems related to tele-traffic and trunking efficiency.
3. Learn new technological development in related field.

CLO mapping	Course content	Teaching-learning strategy
1	**Introduction:** Principle, evolution and telecommunication networks. National and International regulatory bodies, Telephone apparatus, telephone Exchanges, subscriber loop, supervisory tones, PSTN.	Lecture Exercise
1,2	**Introduction to Analog Switching Systems:** Strowger and Crossbar switching systems, Telephone Networks: Subscriber loop systems, switching hierarchy and routing, Transmission plan, Transmission systems, numbering plan, charging plan, signaling techniques, Inchannel signaling, Common channel signaling.	Lecture Exercise Open discussion
1,2	**Introduction to Digital Switching Systems:** Stored program control, Software architecture, Application software, Enhanced services. Space division switching, time division switching, blocking probability and multistage switching, and digital memory switch.Trunking Efficiency.	Lecture Exercise Open discussion
2	**Traffic Analysis:** Traffic characterization, Grade of services, Trunking Efficiency, and network blocking probabilities, Modeling switching systems, Blocking models and loss estimates, delay system and queuing.	Lecture Exercise Open discussion
1, 2	**Telephone Networks:** Analog termination requirements, BORSCHT configuration, digital termination requirements, signaling tones, touch tone dial generation, design consideration, touch tone detection, switching hierarchy and routing, transmission plan, numbering plan-CCITT No. 7 Signaling systems.	Lecture Exercise Open discussion
3	**Network Hierarchy:** Network hierarchy in the telephone network, Network hierarchy in other networks; Network Intelligence.	Lecture Exercise Open discussion
1,3	**Access Network Technology:** Digital subscriber loop (DSL), Wireless local loop (WLL), FTTx, SONET/SDH, WDM Network, IP telephony and VoIP, ATM network and Next Generation Network (NGN).	Lecture Exercise Open discussion

Suggested Reading Lists/Essential Readings:

1. John Dunlop and D. Geoffrey Smith : Telecommunication Engineering
2. Roger L. Freeman : Telecommunication System Engineering
3. T. Viswanathan : Telecommunication Switching Systems and Networks
4. John Bellamy : Digital Telephony