Ordinance for Semester System for Bachelor's Degree

(This ordinance will replace other ordinances/resolutions etc. on the issues described here; however, it will not affect ordinances/resolutions on issues not mentioned here.)

1. Student Admission

1.1 Undergraduate Admission:
The admission committee of the university will conduct the admission process for Bachelor's degree as per the rules. The student will be admitted in the first semester of an academic year in the individual discipline of different schools. However, the admission of foreign students will be subjected to the verification of academic records as per the university rule.

1.2 Student Status and Student Level:
Every student has to maintain his/her student status by getting admission paying necessary fees and register for required credits every semester. Unless a student graduate early by taking courses in advance, every student has to get admission in every semester successively. For book keeping purpose, a student's level will be expressed by his/her year and semester. A student will be transferred to next level if he/she completes or appears in 80% of his designated courses at his/her present level. Once a student reaches 4th year 2nd (5th year 2nd for Architecture) semester he/she will be kept at this level until he/she graduates.

1.3 Re-Admission:
A student has to take re-admission if his/her student status is not maintained or one or more semesters were cancelled because of disciplinary action against him/her. In case of semester cancellation, the student has to get re-admission in the same semester. The level (Year and Semester) of re-admission will be determined by his completed/appeared credits. A student will be eligible for re-admission in the first year first semester of the subsequent session if he/she was present in at least 25% of the classes of his/her major courses or appeared at the semester final examination and his/her admission/semester fees was clear in the past semester/session. Re-admitted students will always be assigned the original Registration Number.

1.4 Student's Advisor:
After admission every batch of student will be assigned to a student's Advisor from the teacher of his/her discipline to guide him/her through the semester system. Advisors will always be accessible to the students and will be ready to mentor them in their academic activities, career planning and if necessary, personal issues. There will be a prescribed guideline for the Advisors to follow.

2. Academic Calendar

2.1 Number of Semesters:
There will be two semesters in an academic year. The first semester will start on 1st January and end on 30th June, the Second semester will start on 1st July and end on 31st December. The routine of the final examination dates along with other academic deadlines will be announced in the academic calendar at the beginning of each semester.

2.2 Duration of Semesters:
The duration of each semester will be as follows:

Classes and Preparatory weeks	15 weeks
Final Examination	04 weeks
Total	19 weeks

These 19 weeks may not be contiguous to accommodate various holidays and the Recess before the final examination may coincide with holidays. The final grading will be completed before the beginning of the next semester.

3. Course Pattern

The entire Bachelor's degree program is covered through a set of theoretical, practical, project, viva and seminar courses. At the beginning of every academic session a short description of every available course will be published by the syllabus committee of each discipline.

3.1 Course Development:

3.1.1 Major and Non-Major Courses:

Syllabus committee of every discipline will develop all the courses that will be offered by that particular discipline and has to be approved by the respective school and the Academic Council. These include major courses for the respective discipline as well as non-major courses that will be offered to other disciplines. Non-major courses will be developed with COse cooperation of the disciplines concerned keeping into consideration of the need of that discipline.

3.1.2 Syllabus:

(a) Major and Non-Major Courses: Syllabus committee will select and approve the courses from major courses of the discipline as well as non-major courses offered by other disciplines to complete the syllabus. The syllabus committee will also select a group of courses as core-courses and without these courses a student will not be allowed to graduate even if he completes the credit requirement. The committee may assign pre-requisite for any course if deemed necessary.

(b) Second Major Courses: The syllabus committee will select a set of courses of 28-36 credits from the major courses for a second major degree.

3.1.3 Course Instruction:

At the beginning of every semester the course instructor has to make a detailed plan of the course instruction in the prescribed form and supply it to the head of the discipline to make it available to the students. The course plan should have the information about the suggested text books, number of lectures per topic, number and type of assignments, number and approximate dates of mid-semester examinations and mandatory office hours reserved for the students of the course offered. If not otherwise mentioned the medium of instruction is always English.

3.2 Course Identification System:

Each course is designated by a three-letter symbol for discipline abbreviation followed by a three-digit number to characterize the course. To avoid confusion new or modified courses should never be identified by reusing a discontinued course number

3.2.1 Course Number:

The three-digit number will be used as follows:

(a) First Digit: The first digit of the three digit number will correspond to the year intended for the course recipient.

(b) Second Digit: A discipline should use the number 0 and 1 for the second digit to identify non-major courses. The digits 2-9 are reserved for major courses to identify the different areas within a discipline.

(c) Third Digit: The third digit will be used to identify a course within a particular discipline. This digit can be used sequentially to indicate follow up courses. If possible even numbers will be used to identify laboratory courses.

3.2.2 Course Title and Credit:

Every course will have a short representative course title, declaration if it is core course, a number indicating the total credits as well as reference to prerequisite courses if any.

3.2.3 Theory and Lab Course:

If a single course has both Theory and Laboratory/Sessional part, then the course must be split into separate Theory and Lab courses and both should have separate course number. A student may not register for a lab course without registering or completing the corresponding theory course.

3.3 Assignment of Credits:

3.3.1 Theoretical:
One lecture per week (or 13 lectures in total) of 1 hour duration per semester will be considered as one credit. (There will be 10 minutes recess between theory classes). A theory course will have only integer number of credits.

3.3.2 Laboratory Classes:
Minimum two contact hours of a laboratory class per week (or 26 contact hours in total) per semester will be considered as one credit. A laboratory course may have half integer credits with a minimum of 1 credit.

3.3.3 Seminar, Thesis, Projects, Monographs, Fieldwork, Viva etc.:
Will be assigned by the respective discipline.

3.4 Classification of the Courses:
The Bachelor's degree courses will be classified into several groups and the syllabus committee will finalize the curricula selecting courses from the groups shown below.

3.4.1 Major Courses:
A student has to take at least 70% courses from his/her own discipline. Out of these courses a section will be identified as core courses and every student of a particular discipline will be required to take those courses.

3.4.2 Non-Major Courses:
Every student is required to take at least 20% (including mandatory) courses from related disciplines. If any Non-Major course is declared as Core course a student is required to take that course to graduate. The Non-Major courses will be designed, offered and graded by the offering disciplines.

3.4.3 Other Courses:
After completion of the required mandatory, major and non-major courses a student may take few other courses of his/her choice not directly related to his/her discipline to fulfill the total credit requirement.

3.4.4 Credit-Only Courses:
The credit of these Credit-Only courses will be added to the total credits if passed but will not affect the CGPA as there will be no grades for these courses.

4. Course Registration

4.1 Registration:
A student has to register for his/her courses and pay necessary dues within the first two weeks of every semester. Departmental student advisor will advise every student about his/her courses and monitor his/her performances. A student at any level is expected to register the courses at his level provided he/she does not have any incomplete courses from previous levels. A student will not be allowed to appear in the examination if his/her semester and examination fee is not cleared.

4.2 Minimum and Maximum Credits:
A student, if s/he is not a clearing graduate, has to register for at least 12 credits minimum and 30 credits maximum every semester.

4.3 Incomplete Courses:
(i) If a student has incomplete courses, he/she has to register his/her available incomplete courses from preceding levels before s/he can register courses from current or successive levels. If an incomplete course is not offered in a given semester the student has to take the courses when it is offered next time. A student with incomplete courses will not be eligible for Distinction.

(ii) A student to register his/her incomplete courses, if offered, from proceeding semesters before s/he can register courses from current or successive semester, otherwise s/he takes the courses when the desired course is offered next time. A student will not be allowed to take 100 and 300 level and 200 and 400 level courses simultaneously. 100 level courses mean courses of 1st and 2nd semesters, 200 level courses mean courses of 3rd and 4th semesters and so on.

4.4 Course Withdrawal:
A student can withdraw a course by a written application to the Controller of Examinations through the Head of the discipline on or before the last day of instruction. The Controller of Examinations will send the revised registration list to the disciplines before the examination. There will be no record of the course in transcript if the course is withdrawn.

4.5 Course Repetition:
If a student has to repeat a failed or incomplete course and that course is not offered any more, the discipline may allow him/her to take an equivalent course from the current syllabus. For clearing graduates if any incomplete course is not offered in the running semester, the discipline may suggest a suitable course to complete the credit requirement.

5. Graduation Criteria

5.1 Major Degree:

5.1.1 Total Credits:
School of Physical Sciences, School of Social Sciences and School of Management and Business Administration have a requirement of 140 credits to graduate from its disciplines. School of Applied Sciences and Technology, School of Life Sciences and School of Agriculture and Mineral Science have requirement of 160 (200 for Architecture) credits for graduation.

5.1.2 Total Years:
A regular student is expected to graduate in 8 semesters (4 years) or in 10 semesters (5 years) for the discipline of Architecture. A student may graduate in shorter time period if s/he is willing to take extra courses in a systematic way. A student will be given 4 (2 years) extra semesters in addition to 8/10 semesters to complete his/her degree. The regular examination year will be identified by the session and the end-month (June or December) of the semester the student graduates.

5.1.3 Early Graduation:
A student may graduate early by completing courses in advance, in that case he does not need to pay tuition or get admission in subsequent semesters. However, a student will not be able to start master's degree one session earlier unless he graduates two semesters early.

5.1.4 Minimum Credit for a Clearing Graduate:
For a clearing graduate (8th and subsequent semesters) condition for maximum and minimum credit requirements is relaxed.

5.1.5 Break in study:
Those students who have not been able to achieve their degrees by participating in the ascertained 12th (for ARC department 14th) semester final exams will have the opportunity to do so by enrolling into 2 (two) running semesters back to back if after the publications of their results of the 12th (for ARC department 14th) semester final exam, it becomes evident that they have completed at least 80% of their total credits. In case of such students, on the tabulation sheet, result sheet, certificate, transcript, grade sheet, etc., number of total semesters shall be stated instead of the word “Irregular.” As for irregular students, studentship shall be annulled after the aforesaid 2 (two) semesters have come to an end.

5.2 Second Major Degree:

5.2.1 Total Credits:
A student may apply for a second major degree if he/she completes an extra 28-36 credit requirement designated by the offering discipline.

5.2.2 Total Semesters:
A student has to complete the credit requirement of second major degree within 8 regular and 4 extra semesters.

5.2.3 Requirement of Major Degree:
A student will not be given a second major degree if he/she fails to complete his regular major degree. A student will not be allowed to enroll in Masters program before completion of his/her second major degree even if he/she complete his/her major degree requirement.

5.2.4 Registration Criteria:
An offering discipline will decide on the number of seats for second major, enrollment criteria and get it approved from the academic council. Students willing to get a second major have to apply to the offering discipline for enrollment and the discipline will enroll them as per the admission criteria. During registration enrolled students have to get their courses approved from the offering department completing a separate registration form.

5.2.5 Class Routine:
After enrollment a regular student may start taking the second major courses starting 3rd semester. The class routine may be arranged to accommodate the student need.

5.2.6 Certificate and Mark sheet:
A student completing the requirement will be given an additional certificate and grade sheet for his second major degree.

6. Examination System

A student will be evaluated continuously in the courses system, for theoretical classes s/he will be assessed by class participation, assignments, quizzes, mid-semester examinations and final examination. For laboratory work s/he will be assessed by observation of the student at work, viva-voce during laboratory works, from his/her written reports and grades of examinations designed by the respective course teacher and the examination committee.

6.1 Distribution of Marks:
The marks of a given course will be as follows:

Class Attendance	10%
Class performance	10%
Assignments and Mid-Semester Examinations	20%
Final Examination	60%

6.1.1 Class Participation:
The marks for class participation will be as follows:

Attendance (Percentage)	Mark s	Attendance (Percentage)	Mark s	Attendance (Percentage)	Mark s
95 and above	10	80 to 84	7	65 to 69	4
90 to 94	9	75 to 79	6	60 to 64	3
85 to 89	8	70 to 74	5	Less than 60	0

A student will not be allowed to appear at the examination of a course if his/her class attendance in that course is less than 50%.

6.1.2 Assignments and Mid-Semester Examinations:
There should be at least two mid-semester examinations for every course. The course teacher may decide the relative marks distribution between the assignments, tutorial and mid-semester examinations, however at least 50% contribution should come from the mid-semester examinations. The answer script should be returned to the students as it is valuable to their learning process.

6.1.3 Final Examination:
The final examination will be conducted as per the Semester Examination Ordinance.
(a) Duration of the Final Examination: There will be a 3-hour final examination for every course of 3 credits or more after the 13th week from the beginning of the semester. Courses less than 3 credits will have final examination of duration 2 hours.
(b) Evaluation of Answer Script: The students of the School of Applied Science and Technology and the School of Agriculture and Mineral Sciences will have two answer scripts to answer separate questions during final examination. Two separate examiner will grade the two scripts separately and the marks will be added together to get the final mark. For the students of the other schools there will be a single answer script which will be evaluated by two examiners. The two marks will be averaged and if the marks by the two examiners differ by 20% or more the concerned answer scripts will be examined by a third examiner and the two COsest marks among the three will be averaged to get the final mark.

7. Grading System

7.1 Letter Grade and Grade Point:
Letter Grade and corresponding Grade-Point for a course will be awarded from the roundup marks of individual courses as follows:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	C-	2.00
Less than 40%	F	0.00

7.2 Calculation of Grades

7.2.1 GPA:
Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses completed by a student in a semester.

7.2.2 CGPA:
Cumulative Grade Point Average (CGPA) of only major and both major and second major degree will be calculated by the weighted average of every course of previous semesters along with the present semester. For clearing graduates if the roundup value of the third digit after decimal is nonzero the second digit will be incremented by one. A student will also receive a separate CGPA for his second major courses.

7.2.3 F Grades:
A student is given an ‘F’ grade if he fails or is absent in the final examination of a course. If a student obtains an ‘F’ grade his grade will not be counted for GPA and s/he has to repeat the course. An ‘F’ grade will be in his/her record and s/he will not be eligible for Distinction.

8. Distinction

8.1 Distinction:
Candidates for four-year Bachelor degree will be awarded the degree with Distinction if his/her overall CGPA is 3.75 or above. However, a student will not be considered for Distinction if (a) s/he is not a regular student (has semester drop, incomplete courses in any semester or break of study) (b) has ‘F’ grade in one or more courses.

Ref.: This Ordinance was approved in the 126th Academic Council (26 June 2013). Clause 3.4.1 was cancelled in 127th Academic Council (27 August 2013). 128th Academic Council (21 November 2013) decided to make it effective from 01 January 2014.

Department of Electrical and Electronic Engineering
Sylhet Engineering College
Shahjalal University of Science & Technology
Sylhet-3100, Bangladesh

Curriculum for B. Sc. (Engg.) Program
Session: 2022-23

Vision Statement

The Department of Electrical and Electronic Engineering, Sylhet Engineering College is responsible for imparting knowledge and excellence in Electrical and Electronic Engineering with global perspectives and hence add value to the knowledge-based economy and society consistently.

Mission

M1 To provide quality education and knowledge in Electrical and Electronic Engineering to build competent engineers and capable of addressing real-world problems to meet the needs of industry and society.

M2 To enable students to develop skills to solve complex technological problems and provide a framework for promoting collaborative and multidisciplinary activities.

M3 To contribute towards the creation of new knowledge through progressive research and innovation in EEE and related fields in order to face emerging national and global concerns for the sustainable development of the society.

M4 To alleviate students in gaining required ethics with an attitude of technopreneurial skills, moral values and consciences.

M5 To create a bridge between industry and academia by framing curriculum based on industrial and societal needs.

Program Name: B.Sc. (Engg.) in Electrical and Electronic Engineering
Program Educational Objectives (PEO)

The EEE department has established a set of goals that turn its mission into specific, measurable actions. The following dimensions are used to group the curriculum's goals:

a) *Inquisitiveness*
b) *Career planning*
c) *Professionalism and leadership*
d) *Ethics and moral principles*

In order to attain these goals, the following are the program educational objectives (PEO)-

PEO1. Prepare graduates for a variety of abilities, including those in communications, electric power, electronics, and digital systems by providing them with a strong foundation in engineering, mathematics, physics, and soft skills.

PEO2. Aid students in acquiring the fundamental competencies to perform proficiently in laboratories.

PEO3. Make the students capable of displaying advanced analytical and critical thinking abilities to address conceptual and mathematical issues that arise in a range of fields, including power systems, communication technologies, and the invention of energy-efficient electronic devices.

PEO4. To enhance the skill for communicating scientific results effectively in written, oral and in interactive presentation.

PEO5. To motivate graduates to act ethically, professionally, and punctually in both their personal and professional aspects.

PEO to Mission Statement Mapping

Mission /PEO	PEO1	PEO2	PEO3	PEO4	PEO5
M1	**X**	**X**			
M2	**X**		**X**		
M3			**X**	**X**	
M4	**X**		**X**		**X**
M5		**X**	**X**		**X**

Program Learning Outcome (PO)
After graduation from our program in EEE, the graduates will be able to:

PO1. Apply engineering, mathematical, and scientific principles theoretically to present electrical and electronic engineering problems.

PO2. Apply learned skills and knowledge to the issues of sustainable development while taking societal, economic, and environmental restrictions into consideration;

PO3. Operate and calibrate lab apparatus by planning and carrying out tests, evaluating the data obtained, and drawing appropriate conclusions;

PO4. Enhance the ability to organize your research findings and data for correct documentation, as well as to locate, formulate, and study through a relevant literature review;

PO5. Demonstrate the capacity to work together as a team member to attain specified and measurable results;

PO6. Develop flexibility, adaptability, and time management abilities in line with the productivity requirements of related sector;

PO7. Recognize the value of lifelong learning and advancement in professional career;

PO8. Demonstrate an understanding of professional, ethical, and moral responsibilities as well as the capacity to uphold the conditions of the contract defined by their emPOyment.

PO9. Apply acquired knowledge and expertise to serve the society and nation at large.

Program Objectives (PEO/PO) to Program Learning Outcome (PO) Mapping

PO/PEO	PEO1	PEO2	PEO3	PEO4	PEO5
PO 1	**X**		**X**		
PO 2		**X**	**X**		
PO 3		**X**	**X**	**X**	
PO 4			**X**	**X**	
PO 5				**X**	**X**
PO 6	**X**				**X**
PO 7				**X**	**X**
PO 8					**X**
PO 9	**X**		**X**		**X**

Graduate Profile:
Graduates of the department of EEE are expected to have the following attributes:

a. Deep knowledge in Electrical and Electronic Engineering
b. Numeracy and analytical skills
c. Complex problem-solving and design skills
d. Technopreneurship and innovation skills
e. Communication and Signal Processing skills
f. Interpersonal and teamwork skill
g. Professionalism and commitment to society
h. Life-long learning.

Semester wise Curriculum Breakdown:

One-semester credit hour represents one class hour or two laboratory hours per week. An academic semester represents 13 weeks of classes exclusive of final exams. Semester wise breakdown of the curriculum structure for 2020-21 session are shown.

Department of Electrical and Electronic Engineering
Undergraduate Program
Session: 2021-22

Semester – I

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/Sessional	
1	EEE 121	Electrical Circuits I	3.00	-	3.00
2	EEE 122	Electrical Circuits I Sessional	-	3.00	1.50
3	CSE 101E	Introduction to Computer Language	2.00	-	2.00
4	CSE 102E	Introduction to Computer Language Sessional	-	3.00	1.50
5	PHY 101E	Physics I (Waves & Oscillations, Optics, Thermal Physics)	3.00	-	3.00
6	MATH 101E	Differential and Integral Calculus	3.00	-	3.00
7	MATH 103E	Complex Variables and Vector Analysis	3.00	-	3.00
8	SSS 100	History of the Emergence of Independent Bangladesh	3.00	-	3.00
		Total =	**17.00**	**6.00**	**20.00**

***N.B.:** **SSS 100 Course is mandatory to fulfill the requirement of completing Bachelor's degree in Engineering**.

Semester – II

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/Sessional	
1	EEE 131	Electrical Circuits II	3.00	-	3.00
2	EEE 132	Electrical Circuits Lab II	-	3.00	1.50
3	EEE 131	Energy Economics	2.00	-	2.00
4	PHY 103E	Physics II (Electricity and Magnetism, Modern Physics and Mechanics)	3.00	-	3.00
5	PHY 104E	Physics II Sessional	-	3.00	1.50
6	CHEM 201E	Chemistry (Inorganic and Quantitative Analysis)	3.00	-	3.00
7	CHEM 202E	Chemistry Lab	-	3.00	1.50
8	MATH 105E	Differential Equations, Laplace & Fourier Transform	3.00	-	3.00
9	CEE 101E	Engineering Drawing	-	3.00	1.50
10	EEE 199	Viva			1.00
		Total =	**14.00**	**12.00**	**21.00**

Semester – III

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/Sessional	
1	EEE 221	Electronics I	3.00	-	3.00
2	EEE 222	Electronics I Lab	-	3.00	1.50
3	EEE 223	Energy Conversion I	3.00	-	3.00
4	EEE 224	Energy Conversion I Lab.	-	3.00	1.50
5	EEE 226	Numerical Analysis Lab.	-	3.00	1.50
6	ACC 201E	Financial and Managerial Accounting	3.00	-	3.00
7	MATH 207E	Co-ordinate Geometry and Linear Algebra	3.00	-	3.00
8	ENG 201E	English	3.00	-	3.00
9	ENG 202E	Communication in English Practice		3.00	1.50
		Total =	**15.00**	**12.00**	**21.00**

Semester – IV

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/Sessional	
1	EEE 231	Electronics II	3.00	-	3.00
2	EEE 232	Electronics Lab II	-	3.00	1.50
3	EEE 233	Energy Conversion II	3.00	-	3.00
4	EEE 234	Energy Conversion II Lab	-	3.00	1.50
5	EEE 235	Electromagnetic Fields and Waves	3.00	-	3.00
6	EEE 236	Circuit Simulation Lab	-	3.00	1.50
6	ME 201E	Mechanical Engineering Fundamentals	3.00	-	3.00
7	ME 202E	Mechanical Engineering Fundamentals Lab	-	3.00	1.50
8	MATH 209E	Probability and Statistics	3.00	-	3.00
9	EEE 299	Viva			1.00
		Total =	**15.00**	**12.00**	**22.00**

Semester – V

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/Sessional	
1	EEE 321	Communication I	3.00	-	3.00
2	EEE 322	Communication I lab	-	3.00	1.50
3	EEE 323	Digital Electronics	3.00	-	3.00
4	EEE 324	Digital Electronics Lab	-	3.00	1.50
5	EEE 325	Power System I	3.00	-	3.00
6	EEE 326	Power System I Lab	-	3.00	1.50
7	EEE 327	Electrical Properties of Materials	3.00	-	3.00
8	EEE 329	Continuous Signals and Linear System	3.00	-	3.00
		Total =	**15.00**	**9.00**	**19.50**

Semester – VI

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/Sessional	
1	EEE 331	Digital Signal Processing	3.00	-	3.00
2	EEE 332	Digital Signal Processing Lab	-	3.00	1.50
3	EEE 333	Control System I	3.00	-	3.00
4	EEE 334	Control System I Lab	-	3.00	1.50
5	EEE 335	Measurement and Instrumentation	3.00	-	3.00
6	EEE 336	Measurement and Instrumentation Lab	-	3.00	1.50
7	EEE 337	Power System II	3.00	-	3.00
8	IPE 301E	Management for Engineers	3.00	-	3.00
9	EEE 399	Viva			1.00
		Total =	**15.00**	**9.00**	**20.50**

Semester – VII

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/ Sessional	
1	EEE 420	Project I/Thesis I	-	6.00	3.00
2	EEE 421	Solid State Devices	3.00	-	3.00
3	EEE 423	Microprocessor and Embedded Systems	3.00	-	3.00
4	EEE 424	Microprocessor and Embedded Systems Lab	-	3.00	1.50
5	EEE 4*	Elective I	3.00	-	3.00
6	EEE 4*	Elective II	3.00	-	3.00
7	EEE 4*	Elective II lab	-	3.00	1.50
8	EEE 4*	Elective III	3.00	-	3.00
		Subtotal =	**15.00**	**12.00**	**21.00**

Semester – VIII

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/ Sessional	
1	EEE 430	Project II/Thesis II	-	6.00	3.00
2	EEE 432	Electrical Service Design		3.00	1.50
3	EEE 499	Viva Voce	-	-	1.50
4	EEE 4*	Elective IV	3.00	-	3.00
5	EEE 4*	Elective IV Lab	-	3.00	1.50
6	EEE 4*	Elective V	3.00	-	3.00
7	EEE 4*	Elective VI	3.00	-	3.00
8	EEE 4*	Elective VI Lab			1.50
		Subtotal =	**09.00**	**12.00**	**18.00**

Elective I

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/ Sessional	
1	EEE 425	Power Plant Engineering	3	-	3.00
2	EEE 427	Processing & Fabrication Technology	3	-	3.00
3	EEE 429	Digital Signal Processing II	3	-	3.00
4	EEE 441	Random Signals and Process	3	-	3.00
5	EEE 443	Fundamentals of Nano electronics & Quantum Transport	3	-	3.00

Elective II

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/ Sessional	
1	EEE 445	Power Electronics	3	-	3.00
2	EEE 446	Power Electronics Lab	-	3.00	1.50
3	EEE 447	Microwave Engineering	3	-	3.00
4	EEE 448	Microwave Engineering Lab	-	3.00	1.50
5	EEE 461	Microcontroller System design	3	-	3.00
6	EEE 462	Microcontroller System design Lab	-	3.00	1.50

Elective III

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/ Sessional	
1	EEE 463	Renewable Energy Systems	3	-	3.00
2	EEE 465	Energy Conversion III	3	-	3.00
3	EEE 467	Compound Semiconductor & Hetero-Junction Devices	3	-	3.00
4	EEE 469	Geographical Communication	3	-	3.00
5	EEE 481	Real Time Computer System	3	-	3.00

Elective IV

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/ Sessional	
1	EEE 433	Power System Protection	3	-	3.00
2	EEE 434	Power System Protection Lab	-	3.00	1.50
3	EEE 435	High Voltage Engineering	3	-	3.00
4	EEE 436	High Voltage Engineering Lab	-	3.00	1.50
5	EEE 437	Computer Networking	3	-	3.00
6	EEE 438	Computer Networking Lab	-	3.00	1.50

Elective V

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/ Sessional	
1	EEE 451	Power System Reliability	3	-	3.00
2	EEE 453	Optoelectronics	3	-	3.00
3	EEE 455	Telecommunication Engineering	3	-	3.00
4	EEE 457	Power System Operation & Control	3	-	3.00
5	EEE 459	Semiconductor Device Theory	3	-	3.00
6	EEE 471	Fundamentals of Biomedical Engineering	3	-	3.00

Elective VI

Sl. No	Course Number	Course Name	Hours/Week		Credit
			Theory	Practical/ Sessional	
1	EEE 473	Control System II	3	-	3.00
2	EEE 474	Control System II Lab	-	3.00	1.50
3	EEE 475	Optical Fiber Communication	3	-	3.00
4	EEE 476	Optical Fiber Communication Lab	-	3.00	1.50
5	EEE 477	Cellular Mobile & Satellite Communication	3	-	3.00
6	EEE 478	Cellular Mobile & Satellite Communication Lab	-	3.00	1.50
7	EEE 491	VLSI	3	-	3.00
8	EEE 492	VLSI Lab	-	3.00	1.50

Summary

Semester	Subject		Total Credit
	Theory (Credit)	Sessional (Credit)	
Semester- 1	**17.00**	**3.00**	**20.00**
Semester- 2	**14.00**	**7.00**	**21.00**
Semester- 3	**15.00**	**6.00**	**21.00**
Semester- 4	**15.00**	**7.00**	**22.00**
Semester- 5	**15.00**	**4.50**	**19.50**
Semester- 6	**15.00**	**5.50**	**20.50**
Semester- 7	**15.00**	**6.00**	**21.00**
Semester- 8	**9.00**	**9.00**	**18.00**
Total =	**115.00**	**48.00**	**163.00**

N.B. Students must complete all Theory, Sessional and Viva Courses.

Sylhet Engineering College, Sylhet
(Shahjalal University of Science and Technology)
School of Applied Sciences and Technology
Department of Electrical and Electronic Engineering

COURSE PROFILE
First Year

First Year First Semester

Course Title: Electrical Circuits I	Year/Semester:1/1	Course Status: Theory (Compulsory, Major)
Course Code: EEE 121	Credits: 3.0	Contact hours: 3 hours lecture per week

Rationale

This is an introductory course in Electrical and Electronic Engineering, introducing simple electrical DC circuits as well as the technical skills to facilitate necessary knowledge to analyze such simple and complex circuits. It is a course suitable for students pursuing further studies in electrical, electronic or telecommunications engineering as well as some other related engineering disciplines including computer engineering. In the practical section, it provides hands-on experience in building and testing circuits. It is packaged in such a way that students, having taken this course, can go away and build and analyze some practical, useful devices afterwards. It is a pre-requisite for the subsequent course on Circuits and Signals.

Course Objectives are

- To disseminate knowledge about electrical charge, voltage, current and power
- To give the idea of basic concepts of DC circuit behavior.
- To develop mathematical representations for simple RLC DC circuits.
- To teach the students methods to solve mathematical representations for simple RLC DC circuits of dependent and independent sources.
- To make the students understand the use of circuit analysis theorems and methods.
- To give idea about magnetic circuits

Course Contents:

Circuit variables and elements: Voltage, current, power, energy, independent and dependent sources, and resistance.
Basic laws: Ohm's law, Kirchhoff's current and voltage laws.
Simple resistive circuits: Series and parallel circuits, voltage and current division, wye-delta transformation.
Techniques of circuit analysis: Nodal and mesh analysis including super node and super mesh.
Network theorems: Source transformation, Thevenin's, Norton's and superposition theorems with applications in circuits having independent and dependent sources, maximum power transfer condition and reciprocity theorem.
Energy storage elements: Inductors and capacitors, series parallel combination of inductors and capacitors.
Responses of RL and RC circuits: Natural and step responses.
Magnetic quantities and variables: Flux, permeability and reluctance, magnetic field strength, magnetic potential, flux density, magnetization curve.
Laws in magnetic circuits: Ohm's law and Ampere's circuital law.
Magnetic circuits: series, parallel and series-parallel circuits.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Define charge, current, voltage and power, resistance etc.
CO 2	Describe the basic circuit laws and circuit analysis techniques.
CO 3	Explain DC circuit analysis.
CO 4	Describe the basic idea about magnetic circuits and Electric Flux.
CO 5	Understand the energy storage elements.
CO 6	Apply different Network Theorems for circuit analysis

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1			X						
CO 2	X	X	X						
CO 3	X		X				X		
CO 4	X	X	X						
CO 5							X	X	
CO 6							X		X

Recommended Books
1. Fundamentals of Electric Circuits by Charles K. Alexander, Mathew N.O. Sadiku R.
2. Electric Circuits by James W. Nilsson, Susan Riedel
3. Introductory Circuit Analysis by Robert L. Boylestad

Course Title: Electrical Circuit I Lab	Year/Semester:1/1	Course Status: Lab (Compulsory, Major)
Course Code: EEE 122	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: EEE 121 (Electrical Circuits I)		

Rationale

In this course students will perform experiments to verify practically the theories and concepts learned in EEE 121. Theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices used in electrical circuits' analysis. This course teaches the fundamentals of electrical circuits, application of circuit laws, theorems and measuring techniques for DC circuits.

Course Objectives are

- To provide the students with capability of implementing different real-life dc circuits.
- To provide the students with the techniques of solving of different types of circuits by network theorem.
- To teach the voltage, current and load relationship in a network.
- To facilitate necessary knowledge about transient analysis and steady state analysis of a capacitor and inductor network.

Course Contents:

This lab has two parts, hardware experimentation and software simulation. In this course students will perform experiments to verify practically the theories and concepts learned in EEE-101.

1. To make students familiar with the operation of different electrical instruments.
2. To verify the following theorems for DC circuits:
   i. KCL and KVL,
   ii. Superposition theorem,
   iii. Thevenin's theorem,
   iv. Norton's theorem and
   v. Maximum power transfer theorem

3. To perform other experiments relevant to this course.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Recognize different types of electrical instruments and measuring devices.
CO 2	Describe the idea about complex circuit network.
CO 3	Interpret transient response about capacitor and inductor circuits.
CO 4	Design experiments to interpret different types of circuit analysis theorem and laws
CO 5	Implement electrical circuits for real life application.
CO 6	Demonstrate team-based communication skills, magnify their moral standards and apply these in practical life.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1			X						
CO 2	X	X		X					
CO 3	X	X							
CO 4	X	X	X						
CO 5	X		X	X					
CO 6					X	X	X	X	

Recommended Books

1. Fundamentals of Electric Circuits by Charles K. Alexander, Mathew N.O. Sadiku R.
2. Electric Circuits by James W. Nilsson, Susan Riedel
3. Introductory Circuit Analysis by Robert L. Boylestad

Course Title: Introduction to Computer Language		Year/Semester:1/1	Course Status: Theory (Compulsory, Non-major)
Course Code: CSE 101E	Credits: 2.0	Contact hours: 2 hours lecture per week	
Pre-requisite: None			

Rationale
To familiarize the student with basic concepts of computer programming and developer tools. To present the syntax and semantics of the "C" language as well as data types offered by the language. To allow the students to write their own programs using standard language infrastructure regardless of the hardware or software platform.

Objectives
- To provide students a basic understanding of computer hardware and how a computer works.
- To teach students the basic terminology used in computer programming
- To teach how to write, compile and debug programs in C language
- To help students write programs involving decision structures, loops and functions
- To teach the students the concepts and usage of pointers
- To teach students good programming practices and how to build up their own logics and how to implement them.

Course Contents:

Introduction to digital computers: Early history of computing devices; Computers; Major components of a computer; **Hardware:** processor, memory, I/O Devices; **Software:** Operating system, application software; Basic architecture of a computer; Basic Information Technology; The Internet; **Number systems:** binary, octal, hexadecimal, binary arithmetic.
Structured Programming using C: Basic programming concepts, program development stages: flow charts; programming constructs: data types, operators, expressions, statements, control statements, functions, array, pointers, structure unions, user defined data types, input-output and files.
Object-oriented Programming using C++: introduction, classes and objects; polymorphism; function and operator overloading; inheritance.

Course Learning Outcomes: After the successful completion of the course, the student will be able to-

CO 1	Understand the concepts of computer hardware and how it works.
CO 2	Recall the basic terminology used in computer programming
CO 3	Construct, compile and debug programs in C language
CO 4	Apply control-flow tools such as loop, if-else etc.
CO 5	Understand the usage of pointers, structures and some advanced topics.
CO 6	Employ good programming practices for betterment of society.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X								
CO 3	X			X					
CO 4	X			X					
CO 5	X			X					
CO 6							X		X

Recommended Books
01. Schaum's Outline of Programming with C by Byron S. Gottfried
02. C: The Complete Reference by Herbert Schildt

Course Title: Introduction to Computer Language Sessional		Year/Semester:1/1	Course Status: Lab (Compulsory, Non-major)
Course Code: CSE 102E	Credits: 1.5	Contact hours: 4 hours lab per week	
Pre-requisite: None			

Rationale:
To familiarize the student with basic concepts of computer programming and developer tools. To present the syntax and semantics of the "C" language as well as data types offered by the language. To allow students to write their own programs using standard language infrastructure regardless of the hardware or software platform.

Objectives:

- To develop skills to work with C++ compilers and how to use run programs on the computer.
- Foster the analytical and critical knowledge to build up logic and implement them using C.
- To facilitate necessary knowledge about how to design programs involving decision structures, loops and functions
- To develop skills to debug codes by giving an in-depth idea about different syntax errors, exceptions and how to fix them.
- To facilitate necessary knowledge about the concepts and usage of pointers, structures and some advanced topics.
- To provide the knowledge of good programming practices.

Course Contents:
Laboratory works based on the theory course.

Course Learning Outcomes: After the successful completion of the course, the student will be able to-

CO 1	Recognize C compilers and necessary tools to run programs on the computer.
CO 2	Interpret logic and implement them using C.
CO 3	Design programs involving decision structures, loops and functions
CO 4	Debug codes by giving means of an in-depth idea about different syntax errors, exceptions and how to fix them.
CO 5	Implement good programming practices.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1		X	X						
CO 2		X	X						
CO 3		X	X						
CO 4				X					
CO 5								X	

Recommended Books

1. Schaum's Outline of Programming with C by Byron S. Gottfried
2. C: The Complete Reference by Herbert Schildt

Course Title: Physics I	Year/Semester:1/1	Course Status: Theory (Compulsory, Non-major)
Course Code: PHY 101E	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: None		

Rationale:

In this course, Students will be able to gather knowledge of thermal properties of materials and apply the knowledge in different thermal situations. This course will also provide basic knowledge on wave and oscillations. Physical optics will be covered by this course through which students will be familiar with interference, Bi-prism and diffraction.

Course Objectives

- To learn about thermometer and its construction.
- To learn basic principles of thermodynamics.
- To know wave behaviour and Lissajous figure.
- To learn physical optics and problem-solving technique.

Physical Optics: Theories of light: Huygen's principle and construction. **Interference of light:** Young's double slit experiment, Fresnel bi-prism, Newton's rings, interferometers. **Diffraction of light:** Fresnel and Fraunhoffer diffraction, diffraction by single slit, diffraction by double slit, diffraction gratings, polarization, production and analysis of polarized light, optical activity, optics of crystals.

Heat and Thermodynamics: Temperature, zeroth law of thermodynamics. **Thermometers**: constant volume, platinum resistance, thermocouple. First law of thermodynamics and its application, molar specific heats of gases, isothermal and adiabatic relations, work done by a gas. **Kinetic theory of gases**: explanation of gas laws, kinetic interpretation of temperature, equipartition of energy and calculation of ratio of specific heats, mean free path, Vander Waals equation of state, second law of thermodynamics: reversible and irreversible processes, Carnot cycle, efficiency, Carnot's theorem, entropy.

Waves and Oscillations: Simple harmonic motion, damped simple harmonic oscillations, forced oscillations, resonance, vibrations of membranes and columns. Combination and composition of simple harmonic motions, Lissajous figures. Transverse and longitudinal nature of waves, travelling and standing waves, intensity of a wave, energy calculation of progressive and stationary waves, phase velocity, group velocity. Sound waves: velocity of longitudinal wave in a gaseous medium. Doppler Effect. Architectural acoustics: Sabine's formula, requisites of a good auditorium.

Course Learning outcomes

After the successful completion of the course, students will be able to :

CO1	Explain thermometer, kinetic theory of gases, mean free path, Brownian motion, Vân der walls equation and related problems.
CO2	Learn basic law of thermodynamics and solve related problems.
CO3	Understand and use simple harmonics motion.
CO4	Learn wave behaviour and calculate wave properties for different situations.
CO5	Know physical optics and related problems.

Mapping of the COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		x			x		x		x
CO2	x	x					x		

CO3	x	x		x					
CO4		x		x			x		x
CO5		x		x					x

Recommended Books

1. Halliday, D. and Resnick, R: physics (Vol.I and Vol II)

2. Physics for Engineers. Dr. Giasuddin Ahmed

Course Title: History of the Emergence of Independent Bangladesh	Year/Semester:1/1	Course Status: Theory (Compulsory)
Course Code: SSS 100	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: None		

Rationale

This is a special compulsory course for all students of Bachelor program of Sylhet Engineering College, Sylhet. This course deals with the interrelated themes and topics that are essential to understand the emergence of Bangladesh.

Course Objectives are

The objective of this course is to make students understand about the causes of liberation war, rising of Bengali nationalism and identity, feelings of victory of Bangladesh. The specific course objectives are:

01. Give an outline about the concept of liberation war and freedom fighter.
02. Clarify the role of different people in liberation war.
03. Explain the role of Bangabandhu in liberation war.
04. Develop an insight about the value of the sacrifice of martyrs for motherland.

Course Contents:

1. **Description of the country and its people**
   a. Impact of Geographical features
   b. Ethnic composition of Bangladesh
   c. Development of Bengali Language and its impact
   d. Cultural syncretism and religious tolerance
   e. Distinctive identity of Bangladesh in the context of undivided Bangladesh

2. **Proposal for undivided sovereign Bengal, the partition of the Subcontinent, 1947 and Foreshadowing Bangladesh**
   a. Rise of communalism under the colonial rule, Lahore Resolution 1940
   b. The proposal of Suhrawardi and Sarat Bose for undivided Bengal : consequences
   c. The creation of Pakistan 1947
   d. Foundation of Awami Muslim League and Foreshadowing Bangladesh

3. **Pakistan: Structure of the state and disparity**
   a. Central and provincial structure
   b. Influence of Military and Civil bureaucracy
   c. Economic, social and cultural disparity

4. **Language Movement and quest for Bengali identity**
   a. Misrule by Muslim League and Struggle for democratic politics
   b. The Language Movement: context, phases and International Recognition of Bengali Language

c. United front of Haque – Vasani – Suhrawardi: election of 1954, consequences

5. Military rule: the regimes of Ayub Khan and Yahia Khan (1958-1971)
   a. Definition of military rules and its characteristics
   b. Ayub Khan's rise to power and characteristics of his rule (Political repression, Basic democracy, Islamisation)
   c. Fall of Ayub Khan and Yahia Khan's rule

6. Rise of nationalism and the Movement for self-determination
   a. Resistance against cultural aggression and resurgence of Bengali culture
   b. Sheikh Mujibur Rahman and the 6 points movement
   c. Reactions : Importance and significance
   d. The Agortola Case 1968

7. The mass- upsurge of 1969 and 11 point movement
   a. Background
   b. Programme
   c. Significance

8. Election of 1970 and its Impact
   a. Legal Framework Order (LFO)
   b. Programe of different political parties
   c. Election result and centres refusal to comply

9. Non-cooperation Movement and 7th March Speech, 1971
   a. The non-cooperation movement
   b. Speech of 7th March : Background of the speech, major characteristics of the speech,
   c. impact of this speech
   d. International recognition of 7th March Speech as part of world heritage

10. Declaration of Independence of Bangladesh
   a. Operation Searchlight
   b. Declaration of Independence of Bangladesh by Bangobondhu
   c. Beginning of the Liberation War of Bangladesh

11. The war of Liberation 1971
   a. Genocide, repression of women, refugees
   b. Formation of Bangladesh government and proclamation of Independence
   c. The spontaneous early resistance and subsequent organized resistance (Mukti Fouz, Mukti Bahini, guerillas and the frontal warfare)
   d. Publicity Campaign in the war of Liberation (Shadhin Bangla Betar Kendra, the Campaigns abroad and formation of public opinion)
   e. Contribution of students, women and the masses (Peoples war) and different political parties
   f. The role of Great powers and the United Nations in the Liberation war
   g. The contribution of India in the Liberation War
   h. The Anti-liberation activities of the occupation army, the Peace Committee, Al- Badar, Al-Shams, Rajakars, pro Pakistan political parties and Pakistani Collaborators , killing of the intellectuals
   i. Trial of Bangabandhu and reaction of the World Community
   j. Formation of joint command and the Victory
   k. The overall contribution of Bangabandhu in the Independence struggle

12. The Bangabandhu Regime 1972-1975
   a. Homecoming; Speech of 10 January
   b. Making of the constitution
   c. Reconstruction of the war-ravaged country
   d. Foreign Policy of Bangabandhu; Bangabandhu's First Speech in the United Nations
   e. The murder of Bangabandhu and his family and the ideological turn-around

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Know liberation war of Bangladesh and role of freedom fighters
CO 2	Know the causes of developing movement and nationalism
CO 3	Know different disparities and deprivation of Bangladesh by Pakistan
CO 4	Know the declaration and continuing breathtaking moments of liberation war.
CO 5	Know the lifelong contributions of Bangabandhu Sheikh Mujibur Rahman in the creation of independent Bangladesh.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1									X
CO 2									X
CO 3									X
CO 4									X
CO 5									X

Recommended Books

1. Ahmed, Salahuddin and Bazlul Mobin Chowdhury (eds.), *Bangladesh: National Culture and Heritage: An Introductory Reader* (Dhaka: Independent University Bangladesh, 2004)
2. Harun-or-Roshid, *The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim Politics, 1906-194*7 (Dhaka : The University Press Limited, 2012)
3. Jahan Rounaq,*Pakistan: Failure in National Integration,(Dhaka :* The University Press Limited, 1977)
4. Maniruzzaman Talukder, *Radical Politics and the Emergence of Bangladesh, (Dhaka :* Mowla,Brothers, 2003)
5. Muhith, A M A,*History of Bangladesh: A Subcontinental Civilization*, (Dhaka: UPL, 2016)
6. Samad Abdus, *History of Liberation War of Bangladesh*, (Dhaka : Aparajeyo Bangla Prakashani, 2019)
7. Milton Kumar Dev, Md. Abdus Samad, *History of Bangladesh* (Dhaka : Biswabidyalya Prokasoni, 2014)

৮. শেখ মুজিবুররহমান : *অসমাপ্তআত্মজীবনী, (*ঢাকা :দি ইউনিভার্সিটি প্রেসলিমিটেড, ২০১২)
৯. নীহাররঞ্জনরায় : *বাঙালীরইতিহাস, (*কলকাতা : দে’ জ পাবলিশিং, ১৪০২ সাল)
১০. সালাহ্উদ্দিনআহমেদ ও অন্যান্য (সম্পাদিত),*বাংলাদেশের মুক্তি সংগ্রামেরইতিহাস* ১৯৪৭-১৯৭১, (ঢাকা : আগামীপ্রকাশনী, ২০০২)
১১. আবুলমালআবদুলমুহিত : *বাংলাদেশ: জাতিরাষ্ট্রের উদ্ভব, (ঢাকা :* সাহিত্য প্রকাশ, ২০০০)
১২. সিরাজুলইসলাম (সম্পাদিত), *বাংলাদেশেরইতিহাস ১৭০৪-১৯৭১,* ৩ খন্ড, (ঢাকা : এশিয়াটিক সোসাইটি অব বাংলাদেশ, ১৯৯২)
১৩. হারুন-অর-রশিদ :*বঙ্গীয় মুসলিম লীগ পাকিস্তান আন্দোলন বাঙালির রাষ্ট্রভাবনা ও বঙ্গবন্ধু,* (ঢাকা : অন্য প্রকাশন, ২০১৮)
১৪. হাসান হাফিজুর রহমান : *বাংলাদেশেরস্বাধীনতাযুদ্ধদলিলপত্র,*(সম্পাদিত), (ঢাকা: গণপ্রজাতন্ত্রীবাংলাদেশসরকার, ১৯৮৫)
১৫. সৈয়দ আনোয়ার হোসেন : *বাংলাদেশের স্বাধীনতাযুদ্ধে পরাশক্তির ভূমিকা,*(ঢাকা :ডানা প্রকাশনী, ১৯৮২)
১৬. মুনতাসীর মামুন ও অন্যান্য,*স্বাধীনবাংলাদেশেরঅভ্যুদয়ের ইতিহাস,* (ঢাকা: সুবর্ণ, ২০১৭)
১৭. আবুমো দেলোয়ার হোসেন,*স্বাধীনবাংলাদেশের অভ্যুদয়ের ইতিহাস,* (ঢাকা : বিশ্ববিদ্যালয়প্রকাশনী, ২০১৪)
১৮. আশফাক হোসেন, *স্বাধীনবাংলাদেশেরঅভ্যুদয়ের ইতিহাস,* (ঢাকা: প্রতিশূণ্য প্রকাশন, ২০১৯)
১৯. আবুমো দেলোয়ার হোসেন, *বাংলাদেশের ইতিহাস, ১৯০৫-১৯৭১,*
২০. আশফাক হোসেন : *বাংলাদেশেরমুক্তিযুদ্ধ ও জাতিসংঘ,* (ঢাকা: বাংলাএকাডেমি, ২০০৩)
২১. আবু মো. দেলোয়ার হোসেন, ড. মোহাম্মদ সেলিম (সম্পাদনা) : *বাংলাদেশ ও বহির্বিশ্বে, (*ঢাকা : বাংলাদেশ ইতিহাস সমিতি, ২০১৫)
২২. আশফাক হোসেন, *বাংলাদেশের মুক্তিযুদ্ধ ও ইন্দ্রিরা গান্ধী* (ঢাকা : সুবর্ণ প্রকাশনী, ২০১৭)

Course Title: Differential and Integral Calculus		Year/Semester:1/1	Course Status: Theory (Compulsory, Non-major)
Course Code: MATH 101E	Credits: 3.0	Contact hours: 3 hours lecture per week	

Rationale: Mathematics is the language of science which develops thinking and critical problem-solving skills. Differential calculus deals with the calculation of instantaneous rate of change and integral calculus deals with finding out the limit of a summation of the infinitely many small factors. The calculus has wide applications in science, engineering, economics, finance, statistics etc. The content of the course comprises functions, limits, continuity, derivatives, tangent and normal, different theorems such as Rolle's, Mean value, Taylor's, Leibnitz's and Euler's theorems etc., indefinite and definite integrals and their applications in real life situations.

Course Objectives:

- Know the basic concept of function and its applications to real – life problems.
- Explore the concepts, properties, and aspects of the differential and integral calculus of single variable functions.
- Learn the concepts of limits, continuity and derivative.
- Learn to finding out the derivative of different type of functions applying the formulae of derivatives.
- Know the application of derivatives to solve maximum and minimum value problems.
- Study various types of integrations for different cases.
- Apply the techniques of integration to solve the real-life oriented problems such as length, areas and volumes etc.

Course Contents: Differential Calculus: Limits, continuity and differentiability. Successive differentiation of various types of functions. Leibnitz's theorem. Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's theorems in finite and infinite forms. Lagrange's form of remainders. Cauchy's form of remainders. Expansion of functions, evaluation of indeterminate forms of L' Hospital's rule. Partial differentiation. Euler's theorem. Tangent and normal. Sub tangent and subnormal in Cartesian and polar co-ordinates. Determination of maximum and minimum values of functions. Curvature. Asymptotes. Curve tracing.
Integral Calculus: Definitions of integrations; Integration by parts, the method of substitution. Standard integrals. Integration by successive reduction. Definite integrals, its properties and use in summing series. Walli's formulae. Improper integrals. Beta function and Gamma function. Area under a plane curve and area of a region enCOsed by two curves in Cartesian and polar co-ordinates. Volumes and surface areas of solids of revolution.

Course Learning Outcomes (CO):

After completing the course, the students will be able to

CO 1	understand the fundamental ideas and principles as well as geometrical meaning of differential and integral calculus of single valued functions.
CO 2	evaluate limits, derivatives, limits in indeterminate forms and apply the derivatives to analyze and sketch the graph of various types of functions.
CO 3	find maxima and minima, critical points and inflection points of functions.
CO 4	know standard indefinite integrals and evaluate integrals by substitution, by partial fractions and by parts.
CO 5	understand the concept of definite integral and evaluating definite integrals including the evaluation of improper integrals.
CO 6	calculate the area of regions in the plane, the volume and surface area of solids of revolution.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X	X					X		
CO 2	X	X		X			X		
CO 3	X	X		X			X		
CO 4	X	X		X			X		
CO 5	X	X		X			X		
CO 6	X	X		X			X		

Books

1. Thomas Finney*: Calculus and Analytic Geometry*
2. Das and Mukherjee: *Differential Calculus*
3. Das and Mukherjee: *Integral Calculus*

Course Title: Complex Variable and Vector Analysis		Year/Semester:1/1	Course Status: Theory (Compulsory, Non-major)
Course Code: MATH 103E	Credits: 3.0	Contact hours: 3 hours lecture per week	

Rationale: This course is designed primarily for those students taking courses in mathematics, physics, mechanics, electromagnetic theory, aerodynamics, geophysics, metrology or any of the numerous other fields in which vector methods are applicable. In complex variable part, the students will learn algebra and geometry of complex numbers, mappings in the complex plane, the calculus of functions of single complex variable, analyticity of a complex function, theory of multi-valued functions, contour integrations and some properties of complex mappings. Vector algebra have become basic part of fundamental mathematical background required of those in engineering, sciences and allied disciplines

Course Objectives:

- Represent complex numbers algebraically and geometrically
- Understand complex function and complex plane. Then analyze limit, continuity and differentiability of Complex number.
- Understand conformal mappings in the complex plane.
- Work with multi-valued functions (logarithmic, complex power) and determine branches of these functions.
- Understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions
- Determine the number of singularities, zeros of a polynomial in the unit disk and in the right half plane.
- Evaluate a contour integral using parametrization, fundamental theorem of calculus and Cauchy's integral formula.
- Basic concepts of the complex sequences and infinite series. Find the Taylor series and Laurent series of a complex function and determine its circle or annulus of convergence.
- Introduce students to the fundamentals of vector algebra.

Course Contents:
Complex Variable: Complex number system; general functions of a complex variable; limit and continuity of a function of complex variables and related theorems; complex differential and the Cauchy-Riemann equations; mapping by elementary functions; 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; evaluation of residues; contour integration; conformal mapping.

Vector Analysis: Definitions of line, surface and volume integrals; gradient of a scalar function; divergence and curl of a vector function; physical significance of gradient, divergence and curl - various formulae; integral forms of gradient; divergence theorem, Stoke's theorem, Green's theorem and Gauss's theorem.

Course Learning Outcomes (CO):
By the end of this course the students will be able to

CO 1	Perform basic mathematical operations and prove basic properties of complex numbers in Cartesian form using complex arithmetic and complex conjugates to fine comparison with limits/continuity/differentiability between real valued function and complex valued function..
CO 2	Know about analyticity, different types of singularities, application of Taylor series expansion.
CO 3	Able to known the residue of a function and use the residue, applications of related theorems in complex plane and evaluate a contour integral or an integral over the complex plane
CO 4	Adept about conformal mappings, bilinear transformations and their properties and finally, comparison all the applications with real analysis and complex analysis.
CO 5	Adept about conformal mappings, bilinear transformations and their properties and finally, comparison all the applications with real analysis and complex analysis
CO 6	Provide working tools for students in some branches of applied mathematics.
CO 7	Develops ability to solve mathematical problems involving vectors.
CO 8	Competently use vector algebra as a tool in the field of applied sciences and related fields.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2	X								
CO 3	X								
CO 4	X								
CO 5	X								
CO 6	X								
CO 7	X								
CO 8	X					X			

Books Recommended:
- M. R. Spiegel: *Vector Analysis*
- Churchill: *Introduction to Complex Variable and Applications*
- Macrobeat: *Complex Variable*
- Spiegel, M.R. *Complex Variable*

First Year Second Semester

Course Title: Electrical Circuit II	Year/Semester:1/2	Course Status: Theory (Compulsory, Major)
Course Code: EEE 131	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: EEE 121 (Electrical Circuit I)		

Rationale:

This course helps students EEE students in gaining a broad idea of single and three phase power systems with various resistive and reactive loads. Using the basic concepts taught in Electrical Circuits I, this course provides knowledge about the relationship between real, apparent and reactive power - including the use of phasor and impedance diagrams, methods of measuring power, calculation of power factor.

Course Objectives are

1. To familiarize the students with the basic concepts related to measurement of voltage, current, power and phase shift in AC power circuits.
2. To teach the modeling and analysis of single phase RLC circuits for impedances, voltages, currents, powers and phase shift.
3. To make students understand phase rotation and Wye/Delta connections in 3-phase systems.
4. To teach the analysis of 3-phase RLC circuits (balanced and unbalanced) for impedance, voltage, current, power (P, Q and S), phase shift and power factor
5. To make the students understand the methods of determining appropriate components for power factor correction in power systems.
6. To teach the students the ways to apply Wye/Delta transformations and network theorems for the analysis of AC circuits.

Course Contents:

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

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

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

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Understand and explain the basic circuit concepts and responses.
CO 2	Calculate the real, reactive and apparent power of AC networks.
CO 3	Model and analyze single phase RLC circuits for impedances, voltages, currents, powers and phase shift.

CO 4	Apply the transformation techniques and network theorems to facilitate necessary knowledge to analyze AC circuits and networks.
CO 5	Design components for power factor correction in power systems.
CO 6	Analyze various three phase circuits.

Mapping of CO with PO:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**						**X**		
CO 3	**X**								
CO 4	**X**						**X**		**X**
CO 5	**X**						**X**		**X**
CO 6	**X**								**X**

Recommended Books

1. Alternating Current Circuits by Russel M. Kerchner, George F. Corcoran
2. Introductory Circuit Analysis by Robert L. Boylestad
3. Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N.O. Sadiku
4. Networks, lines and fields by J. D. Ryder

Course Title: Electrical Circuit II Lab	Year/Semester:1/2	Course Status: Lab (Compulsory, Major)
Course Code: EEE 132	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: EEE 131 (Electrical Circuit II)		

Rationale

EEE students need to have a broad idea of single and three phase power systems with various resistive and reactive loads. They should also know the relationship between real, apparent and reactive power - including the use of phasor and impedance diagrams, methods of measuring power, calculation of power factor. The theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices. This course is designed to complement the theoretical course EEE 131.

Course Objectives are

1. Acquaint students with the basic circuit theorems.
2. Helping the students to develop ability in building AC electrical circuits and perform experiments on them.
3. To make the students understand the mechanism of power transmission.
4. To teach the analysis of three phase circuits.
5. To teach students the analysis of analyze resonant circuits.

Course Contents:

1. To be familiar with the operation of different electrical instruments.
2. To verify the following theorems:

    i) Superposition theorem

    ii)Thevenin's theorem

    iii) Norton's theorem

    iv) Maximum power transfer theorem and

    v) KCL and KVL theorem
3. To design and construct of low pass and high pass filter and draw their characteristics curves.
4. To investigate the voltage regulation of a simulated transmission network.
5. Study the characteristics of Star-Delta connection
6. Study the frequency response of an RLC circuit and find its resonant frequency.
7. Measuring of three phase power by two-watt meter & three-watt meter method.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Explain and apply basic circuit theorems.
CO 2	Describe the mechanism of power transfer through transmission line.
CO 3	Assess problems as a team effectively
CO 4	Differentiate series and parallel resonant circuits.
CO 5	Analyze three phase circuits.
CO 6	Able to measure single & three phase power in lab and real life as well as in industries

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2								X	
CO 3						X			
CO 4	X								
CO 5	X					X			
CO 6							X	X	

Recommended Books

1. Alternating Current Circuits by Russel M. Kerchner, George F. Corcoran
2. Introductory Circuit Analysis by Robert L. Boylestad
3. Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N.O. Sadiku
   Networks, lines and fields by J. D. Ryder

<table>
<tr><td colspan="2">Course Title: Chemistry (Inorganic and Quantitative Analysis)</td><td colspan="2">Year/Semester:1/2</td><td>Course Status: Theory (Compulsory, Non-major)</td></tr>
<tr><td colspan="3">Course Code: CHE 205</td><td>Credits: 3.0</td><td>Contact hours: 3 hours lecture per week</td></tr>
<tr><td colspan="5">Pre-requisite: None</td></tr>
</table>

Rationale
This is a basic course on Chemistry to familiarize students with the basic concepts.

Course Objectives In this course the students will be able to

- To familiarize the students with the basic concept of electronic structure
- Acquire the knowledge about the properties of elements on the periodic table
- Understand the concept of chemical formula and equation
- Acquire the basics of acid-base concepts and apply them to identify different acids and bases
- Introduce preliminary ideas of chemical equilibrium and kinetics
- Acquaint students with the fundamentals of organic chemistry

Course Contents:

Atoms, molecules and ions: Atomic Theory, components of atoms.

Electronic Structure: Quantum theory, atomic spectrum of hydrogen and the Bohr model, Quantum numbers, Concept of Energy levels and atomic orbital, electronic configuration, Chemical bonding and molecular structure.

The periodic Table: Development of the periodic table, Electron arrangements and the periodic table, Noble Gases with properties and uses, Summarized chemical properties of s-block, p-block, d-block and f-block elements.

Chemical formulas and equations: Types of formulas, Percent composition from formula, Formulas from experiment, Formulas of ionic compounds, Names of compounds, Writing and balancing chemical equations, Limited reactant and theoretical yield. Concept of mole.

Different Types of Solutions: Normal solution, Molar solution, Molal solution, Percent solution, Mole fraction, Raoult's law, Properties of dilute solution.

Chemical Equilibrium: Reversible and irreversible reaction, Law of mass action and equilibrium constant, Kc and Kp, Le Chatelier's Principle, Application of Chemical Equilibrium.

Acids and Bases: Theories and Modern definition of acids and bases, Dissociation constant, strength, pH, Buffer solution etc.

Introduction to Chemical Kinetics: Rate laws, rate constant, equilibrium constant, order of reaction etc.

Electro-chemistry: Mechanism of electrolytic conduction, Transport number, Kohl-Rausch's law. Different types of cells, Cell emf. Single electrode potentials, their determination and application. Secondary Cells or Accumulators, lead accumulator and alkaline accumulator.

Organic Chemistry: Introduction**,** Classification, Nomenclatures and Properties (Physical & Chemical) of (i) Aliphatic and aromatic hydrocarbons, (ii) Carbonyl compounds, (iii) Carboxylic acids and (iv) Carbohydrates (mono- and disaccharides).

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Classify elements, correlate atomic models, orbit & orbitals, electron distribution & energy level, hydrogen spectral series etc.
CO 2	Apply different principles to determine the configuration for any atom or ion
CO 3	Explain the development of the periodic table of elements, analyze and compare periodic trends in physical and chemical properties of elements in periodic table
CO 4	Calculate the percent composition of a compound and derive empirical formulas from experimental data
CO 5	Understand the concept and use of different concentration unit, limiting reactant and percent of yield
CO 6	Define and apply the modern concepts of acids and bases to identify and classify the acids and bases and their strength and explain acidic and basic properties of species
CO 7	Understand the relationship between chemical kinetics and equilibrium
CO 8	Name and understand the proper structure of different organic compounds
CO 9	Predict physical and chemical properties of different organic compounds
CO 10	Understand different types of cells and calculate cell emf

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**								
CO 3	**X**								
CO 4	**X**								
CO 5	**X**			**X**					
CO 6	**X**								
CO 7	**X**								
CO 8	**X**								
CO 9	**X**								
CO 10	**X**								

Recommended Books

01. Essentials of Physical Chemistry, *B.S. Bahl and Arun Bahl.*
02. S. Z. Haider, *Introduction to Modern Inorganic Chemistry.*
03. Haque and Mollah, *Physical Chemistry*
04. R. T. Morrison and R. N. Boyd, *Organic Chemistry* (6th edition)
05. Raymond Chang, *General Chemistry*

Course Title: Chemistry (Inorganic and Quantitative Analysis) Sessional	Year/Semester:1/2	Course Status: Lab (Compulsory, Non-major)
Course Code: CHE 206	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: None		

Rationale
This is a basic lab course to familiarize students with the basic experiments in chemistry.

Course Objectives are to

- Make the students skilled for the theoretical and practical knowledge
- Make them able to perform the qualitative analysis
- To perform titration practically

Course Contents:
Volumetric analysis: acid-base titration, oxidation-reduction titrations, determination of Fe, CU and Ca volumetrically.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Calculate weight of molecule by Redox process
CO 2	Determine the concentration of various unknown solution using titration
CO 3	Detect metals in various compounds

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1		X	X		X				
CO 2		X	X		X				
CO 3		X	X		X				

Recommended Books
1. Vogel, *Qualitative Inorganic Analysis*
2. A.I. Vogel, *A Text Book of Practical Organic Chemistry*
3. A.I. Vogel, *Elementary Practical Organic Chemistry* (Part 1)
4. Vogel, *Text book of Quantitative Analysis.*

Course Title: Energy Economics	Year/Semester:1/2	Course Status: Theory (Compulsory, Non-major)
Course Code: EEE 131	Credits: 2.0	Contact hours: 2 hours lecture per week
Pre-requisite: None		

Rationale
We know the engineers need to understand present economic condition in their field to optimize the production and distribution of sustainable energy. This course will give brief idea in this regard.

Course Objectives
In this course the students will be able to

- Understand present energy condition of the world.
- Analyze energy data.

- Comparative study of conventional and renewable energy prices.
- Various aspects of energy sectors.

Course Content:
Introduction to Energy Economics, Energy Data and Energy Balance, Understanding and Analyzing Energy Demand, Energy Demand Management, Economic Analysis of Energy Investments, Economics of Fossil Fuel Supply, Non-Renewable Resource Supply, Electricity Supply, Renewable Energy Supply, Energy Markets and Principles of Energy Pricing, Energy Pricing and Taxation, Overview of Global Energy Challenges, Impact of High Energy Prices, Energy Security Issues, Investment Issues in the Energy Sector, Regulation of Energy Industries.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Understand demand, management of energy
CO 2	Solve scientific problems related to this field
CO 3	Get a idea of various aspects of conventional and renewable energy
CO 4	Get a brief idea of the energy crisis of the world and how to mitigate the challenges.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2	X								
CO 3		X					X		
CO 4		X							X

Recommended Books:
1. Subhes C. Bhattacharyya, Energy Economics (Concepts, Issues, Markets and Governance)
2. Peter M. Schwarz. Energy Economics.

Course Title: Physics II	Year/Semester:1/2	Course Status: Theory (Compulsory, Non-major)
Course Code: PHY 103E	Credits: 3.0	Contact hours:3 hours lecture per week
Pre-requisite: None		

Rationale
In this course, Students will be able to gather knowledge of electrical properties of materials and apply the knowledge to find the situations of some basic problems. The basic concept regarding electric field, electric potential and dielectric and their application on several theory will enhance the ability to understands the application. students will be introduced to the aspect of megnetic properties and able to use them for problem solving.
This course will also provide basic knowledge of mechanics such as linear motion, angular motion, planetary motion, Quantum mechanics will also introduced on a beginners level.

The concept of modern physics will provide fundamental information regarding relativity and application based on special theory of relativity. This course will also give some knowledge on nuclear physics and its applications.

Course Objectives

- To learn about electric charge and its applications.
- To learn basic principles of magnetism.

- To know special theory of relativity and its applications.
- To learn mechanics and problem-solving technique.

Course Content:

Electricity & Magnetism: electric charge and Coulomb's law, Electric field, concept of electric flux and the Gauss's law-some applications of Gauss's law, Gauss's law in vector form, Electric potential, relation between electric field and electric potential, capacitance and dielectrics, gradient, Laplace's and Poisson's equations, Current, Current density, relativity, the magnetic field, Ampere's law, Biot-Savart law and their applications, Laws of electromagnetic induction-Maxwell's equation.
Modern physics: Galilean relativity and Einstein's special theory of relativity; Lorentz transformation equations, Length contraction, Time dilation and mass-energy relation, photoelectric effect, Compton effect; De Broglie matter waves and its success in explaining Bohr's theory, Pauli's exclusion principle, Constituent of atomic nucleus, Nuclear binding energy, different types of radioactivity, radioactive decay law; Nuclear reactions, nuclear fission, nuclear fusion, atomic power plant.
Mechanics: Linear momentum of a particle, linear momentum of a system of particles, conservation of linear momentum of a particle, angular momentum of a system of particles, Kepler's law of planetary motion, the law of universal Gravitation, the motion planets and satellites, introductory quantum mechanics; Wave function; Uncertainty principle, postulates, Schrodinger time independent equation, expectation value, Probability, Particle in a zero potential, calculation of energy.

Course Learning Outcomes:

After the successful completion of the course, students will be able to:

CO1	Learn electric charge and its behavior.
CO2	Know magnetic fields and its applications.
CO3	Understand relativity and concepts regarding with this field.
CO4	Learn nuclear physics and its applications.
CO5	Explain motion and problems related with it.
CO6	Learn basic quantum mechanics.

Mapping of the COs with POs

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	**X**	**X**	**X**				**X**		
CO2	**X**		**X**				**X**		
CO3	**X**			**X**			**X**		
CO4	**X**	**X**					**X**		**X**
CO5	**X**		**X**				**X**		
CO6	**X**	**X**		**X**			**X**		

Recommended Books

1.Halliday, D. and Resnick, R: physics (Vol.I and Vol II)

2. Physics for Engineers, Dr. Giasuddin Ahmed

Course Title: Physics II Lab	Year/Semester:1/2	Course Status: Theory (Compulsory, Non-major)
Course Code: PHY 104E	Credits: 1.5	Contact hours:3 hours lab per week
Pre-requisite: PHY 103E		

Rationale:

In this course students will perform some laboratory experiments that will help to visualize some fundamental concepts of physics.

Course objectives:

- To enable the students to carry out some fundamental experiments for finding out the numerical values of some physical parameters based on various laws, principles and theorem of physics.

Course contents:

1. Determination of the value of ‘g’ gravity by using compound pendulum.

2. Determination of the spring constant and effective mass of a spiral spring .

3. Determination of the focal length of a convex lens.

4. Determination of the mechanical equivalent of heat by electrical method.

5. Determination of the velocity of sound by water tube and tuning fork.

6. Calculation of the plank’s constant using LED.

7. Determination of angle of rotation of a sugar solution using half-shade polarimeter.

8. Determination of the radius of curvature of a Plano-convex lens by Newton’s ring method.

9. Determination of specific heat of a liquid by the method of cooling.

10. Comparison of e.m.f of two cells by potentiometer.

11. Determination of Frequency of tuning fork by Melde’s apparatus.

12. Determination of refractive index of a prism.

Course learning outcomes

After successfully completion of the course, the student will be able to-

CO1:	Determine the value of ‘g’ gravity by using compound pendulum.
CO2:	Determine the spring constant and effective mass of a spiral spring.
CO3:	Determine the focal length of a convex lens.
CO4:	Determine the mechanical equivalent of heat by electrical method.
CO5:	Determine the velocity of sound by water tube and tuning fork.
CO6:	Calculate the Planck’s constant using LED.

CO7:	Determine angle of rotation of a sugar solution using half-shade polarimeter.
CO8:	Determine the radius of curvature of a Plano-convex lens by Newton's ring method.
CO9:	Determine specific heat of a liquid by the method of cooling.
CO10:	Compare e.m.f of two cells by potentiometer.
CO11:	Determine Frequency of tuning fork by Melde's apparatus.
CO12:	Determine refractive index of a prism.

Mapping of the COs with POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2		✓	✓	✓		✓			
CO3	✓	✓			✓	✓	✓	✓	✓
CO4		✓	✓	✓			✓	✓	
CO5	✓	✓	✓		✓			✓	✓
CO6	✓	✓		✓	✓	✓	✓	✓	✓
CO7		✓	✓	✓		✓	✓	✓	✓
CO8	✓		✓	✓	✓	✓	✓		
CO9		✓	✓		✓		✓	✓	✓
CO10	✓		✓	✓	✓	✓	✓		
CO11	✓	✓	✓	✓	✓			✓	✓
CO12		✓	✓	✓	✓	✓	✓	✓	

Recommended Books

1.Practical Physics: Dr. Giasuddin ahmed & Md.Shahabuddin

Course Title: Differential Equations, Laplace & Fourier Transform	Year/Semester:2/1	Course Status: Theory (Compulsory, Non-major)
Course Code: MATH 105E	Credits: 3.0	Contact hours: 3 hours lecture per week

Rationale: Differential equation defines a relationship between a function and derivatives. Differential equation used to calculate the movement or flow of electricity, motion of an object, to or from like a pendulum, to explain thermodynamics concepts. Differential equation has remarkable ability to predict future earth and world around us. They can describe exponential growth and decay. This course provides introduction to ordinary and partial differential equation with applications. Topics include classification of and what is meant by the solution of a differential equation, first-order equations for which exact solutions are obtainable and higher order differential equation .The Laplace transform reduces a linear differential equation to an algebraic equation ,which can be solved by the formal rules of algebraic equation .The Laplace transform converts a signal to a complex plane and the Fourier transform is a subset of Laplace transform .Fourier transform used in designing electric circuit ,solving differential equations ,signal processing ,signal analysis ,image processing and filtering .

Course Objectives:

- Teach techniques and method to solve first order differential equations and its application.
- Acquire the concept of ordinary differential equation and how to formulate them from engineering related problems.
- Learn the concept of Fourier and Laplace transformation to solve problems related with their discipline.

Course Content:

Differential Equation: Definition. Formation of differential equations. Solution of first order differential equations by various methods. Solution of differential equation of first order and higher degrees. Solution general linear equations of second and higher orders with constant co-efficient. Solution of Euler's homogeneous linear equations. Solution of differential equations in series by the method of Fresenius. Bessel's functions, Legendre's polynomials and their properties.

Partial Differential Equation: Introduction. Equations of the linear and non-linear first order. Standard forms. Linear equations of higher order. Equations of the second order with variable co-efficient.

Laplace transforms: definition of Laplace transforms, sufficient conditions for existence of Laplace transforms; inverse Laplace transforms; Laplace transforms of derivatives; the unit step function; some special theorems on Laplace transforms; partial fraction; solutions of differential equations by Laplace transforms.

Fourier Analysis: Periodic function; Fourier series, sufficient conditions for existence of Fourier Transform, convergence of Fourier series; Fourier integral; Fourier transforms and their applications.

Course Learning Outcomes (CO):

By the end of this course the students will be able to

CO 1	Identify types of first order and higher linear differential equation and learn how to solve it.
CO 2	To find series solution of special types of differential equation such as Frobinius method Legendre, Hermite, Bessel and analyze their properties.
CO 3	Solve various types partial differential equation.
CO 4	Find Laplace transform of basic functions, derivatives, antiderivatives of a function and solve initial value problem of ODE and PDE.
CO 5	Learn about Fourier series and Fourier Transform to help in the analysis of signal processing.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X		X				X		
CO 2	X		X				X		
CO 3	X		X				X		
CO 4	X		X				X		
CO 5	X		X				X		

Recommended Books:

1. Stephenson: Mathematical Method
2. Ross, S.: Introduction to differential equations
3. Richard Bronson: Differential Equations
4. Spiegel, M.R.: Laplace Transform
5. Method of Applied Mathematics: Abu Yousuf

Course Title: Engineering Drawing	Year/Semester:1/2	Course Status: Theory (Compulsory, Non-major)
Course Code: CE 210	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: None		

Rationale
It is a drawing course where students can lean drawing different linear and curved geometric figures and solid geometry. Concept of isometric objects and orthographic views are discussed for clear understanding of students. In this course students will be able to learn how to draw the plan, elevation and sectional view of one storied building. Students also learn how to draw an electrical drawing of building or factory.

Course Objectives

- To get familiar with different drawing instruments and technical standards.
- To develop a deep understanding of different geometric figures
- To gain knowledge about drawing isometric and orthographic views.
- To understand the concept of plan, elevation and sectional views of one storied building.

Course Content:
Introduction-lettering, numbering and heading; instrument and their use; sectional views and isometric views of solid geometrical figures. Plan, elevation and section of multistoried building; building services drawings; detailed drawing of lattice towers.
Introduction to CAD packages and computer aided drafting: drawing editing and dimensioning of simple objects. Plan, elevations and sections of multi-storied buildings; reinforcement details of beams, slabs, stairs etc. Plan and section of septic tank, Detailed drawings of roof trusses, Plans, elevations and sections of culverts, bridges and other hydraulic structures, Building services drawings.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Explain the process of Lettering, numbering, and heading by hand on drawing.
CO 2	Draw different types of solid geometric elements by hand.
CO 3	Create 2-dimensional drawing through AutoCAD software.
CO 4	Draw electrical plan and various building service of multi-storied buildings through AutoCAD.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2			X						
CO 3	X								
CO 4	X								X

Recommended Books:
1. Civil Engineering Drawing by - Gurcharan Singh & Subash Chandra
2. Prathomic Engineering Drawing by - Hamonto Kumar Bhottacharjo
3. Engineering Drawing by Basant Agrawal and C M Agrawal

Course Title: Viva	Year/Semester: 1/2	Course Status: Lab (Compulsory, Major)
Course Code: EEE 199	Credits: 1.0	Contact hours: 1 hour lecture per week
Pre-requisite: All Previous Courses		

Rationale
This course endeavors to build a comprehensive idea on all the previously taken courses.

Course Objectives
- To get the general idea on basic concepts.
- To familiarize with viva voce.
- To increase communicative skills.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	To get the general idea on basic concepts.
CO 2	To familiarize with viva voce.
CO 3	To increase communicative skills.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								X
CO 2	X			X					X
CO 3	X								X

Second Year First Semester

Course Title: Electronics I	Year/Semester:2/1	Course Status: Theory (Compulsory, Major)
Course Code: EEE 221	Credits: 3.0	Contact hours:3 hours lecture per week
Pre-requisite: None		

Rationale
This course endeavors to build on the knowledge and skill in analyzing and designing electronic circuits involving transistors and diodes. The course covers: the basic principles of operation and device characteristics of diodes, Bipolar Junction Transistors, Junction Filed Effect Transistors and Metal Oxide Semiconductor Field Effect Transistors.

Course Objectives
- To make the students acquainted with the semiconductor theory.
- To introduce the basic operations, device and circuit characteristics of diodes and BJT JFET and MOSFET transistors.
- To make the students understand the basic concept of biasing and apply proper biasing according to the application.
- To facilitate necessary knowledge about analysis and design of analogue circuits such as amplifiers.

- To introduce the idea about DC and AC analysis of different amplifier circuits.
- To familiarize the students with the important parameters that define the response of analog circuits.

Course Content:

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

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Explain the theoretical principles essential for understanding the operation of electronic circuits
CO 2	Interpret and analyze the device characteristics of diodes, BJT, MOSFET and JFET.
CO 3	Distinguish different types of transistor biasing techniques and apply proper biasing to ensure the correct operation of the transistor networks.
CO 4	Determine appropriate parameters to define the response of analog circuits.
CO 5	Design and analyze single and multi-stage amplifier using BJT, MOSFET and JFET.
CO 6	Recognize the need for and demonstrate the ability to engage in life-long learning to apply the most advanced electronic technologies to design energy efficient circuits.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2	X			X					
CO 3	X								
CO 4	X			X					
CO 5	X								
CO 6						X		X	X

Recommended Books:
1. Microelectronic Circuit by Adel Sedra, K.C. Smith
2. Electronic Devices and Circuit Theory by Robert L. Boylestad
3. Electronics Principles. By Malvino

Course Title Electronics I Lab	Year/Semester:2/1	Course Status: Lab (Compulsory, Major)
Course Code: EEE 222	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: EEE 221		

Rationale:

In this course students will perform experiments to verify practically the theories and concepts learned in EEE 221. Theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices. This is an introductory experimental laboratory that exPOres the design, construction, and debugging of electronic circuits on performance characteristics of diodes, transistors, JFETs, and MOSFETS, including the construction of a small audio amplifier and preamplifier. The course provides opportunity to simulate real-world problems (as given as assignment) and solutions that involve tradeoffs and the use of engineering judgment.

Course objectives are:

- Acquaint students with the basic idea about implementing different types of diode circuits and investigate the voltage, current relationships.
- To help the students to develop ability to verify the theoretical concepts through laboratory and simulation experiments.
- To provide the knowledge about the procedure of determination of voltage gain, current gain, overall gain in a single and multistage BJT, JFET and MOSFET amplifiers.
- To provide the students with the capability of implementing different real life analog electronic circuits.

Course Contents:

1. The study of V-l Characteristics curve of P-N junction diode.
2. The study of Half-Wave and Full Wave Rectification circuit.
3. The study of Clipping and clamping circuits.
4. Measurement of the voltage regulation Zener diode circuits.
5. The study of operation of BJT and analyze the characteristics curve
6. Study of the DC analysis of BJT amplifier circuit: Different biasing circuits and determination of the best biasing circuit.
7. Calculate the voltage gain, current gain of a multistage BJT amplifier circuit
8. Study of the operation of JFET and analysis of the characteristics curve.
9. Study of the DC analysis of JFET amplifier circuit: different biasing circuits and investigates the best biasing circuit.
10. **C**alculation of the voltage gain, current gain of a multistage JFET amplifier circuit.
11. The study of operation of MOSFET and analysis of the characteristics curve.
12. **C**alculation of the voltage gain, current gain of a multistage MOSFET amplifier circuit.
13. Implementation the BJT and MOSFET switching network.
14. Students will be assigned real-life hardware/software-based projects.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Identify the characteristics of electronic circuits and present experimental results in order to reach a valid conclusion about the behavior of circuits.
CO 2	Compute the main parameters of electronic circuits to facilitate necessary knowledge to analyze circuit performance.
CO 3	Assemble simple analogue electronic circuits.
CO 4	Solve problems, starting from the acquired knowledge essential for the design of economically feasible electronic circuits.
CO 5	Comply with ethical values for collecting and documenting experimental data.
CO 6	Develop the ability to work as a part of the team to achieve specified and measurable results while performing the experiments.
CO 7	Formulate the ability to communicate individual opinion effectively across the members of the team.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**		**X**						
CO 2			**X**						
CO 3			**X**						
CO 4			**X**						
CO 5			**X**						**X**
CO 6		**X**			**X**				
CO 7		**X**		**X**					**X**

Recommended Books

1. Microelectronic Circuit by Adel Sedra, K.C. Smith
2. Electronic Devices and Circuit Theory by Robert L. Boylestad
3. Electronics Principles. By Malvino
4. **Lab Manual:** Will be supplied by course teacher.

Course Title: Energy Conversion I	Year/Semester: 2/1	Course Status: Theory (Compulsory, Major)
Course Code: EEE 223	Credits: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 121 (Electrical Circuits I), EEE 131 (Electrical Circuits II)		

Rationale:

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. Generation of electricity includes electric machineries. So student should have insight knowledge of how electric machineries works and how to handle them. This course examines the basic theory, characteristics, construction operation and application of rotating electrical machines. It includes the study of poly-phase induction motors and transformer.

Course objectives are:

- To teach the construction, characteristics, operation and application of A.C. rotating and standstill electrical machines.

- To help the students develop skills to solve magnetic circuit problems using formulae, certain Laws (Faraday, Lenz) and Rules (Fleming).
- To help the students develop skills to solve problems relating to generated voltage, terminal voltage, currents, load power factors, input and output power, efficiency, and voltage regulation in transformers.
- To help the students develop skills to solve problems relating to synchronous speed, slip, rotor frequency, rotor voltage, rotor current, torque, developed power, efficiency and power factor in poly-phase induction motors.
- To provide the knowledge to explain the results of laboratory tests on various rotating and static electrical machines under load conditions.
- Helping the students to develop ability in safely wire and operate electrical rotating machines and their associated metering and starting equipment.
- To describe the design of major classes of electric machines

Course Contents:

Transformer: Ideal transformer- transformation ratio, no-load and load vector diagrams; actual transformer-equivalent circuit, regulation, short circuit and open circuit tests. **Three phase induction motor**: Rotating magnetic field, equivalent circuit, vector diagram, torque-speed characteristics, effect of changing rotor resistance and reactance on torque-speed curves, motor torque and developed rotor power, no-load test, blocked rotor test, starting and braking and speed control. **Single phase induction motor:** Theory of operation, equivalent circuit and starting.

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Understand the transformer operating principle.
CO 2	Identify the losses of Transformers and how to reduce them.
CO 3	Explain induction motor design and working principle.
CO 4	Compute transformer parameters theoretically and practically.
CO 5	Calculate induction motor parameters theoretically and practically.
CO 6	Apply measures for efficient operation of electrical machines.
CO 7	Formulate proper procedure for speed control, starting and braking.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	X										
CO 2		X									
CO 3	X										
CO 4			X								
CO 5			X								
CO 6									X		
CO 7									X		

Recommended Books:

1. A Textbook of Electrical Technology (Volume II) by B.L. Theraja and A.K. Theraja
2. Electric Machines by Charles I. Hubert
3. Principles of Electrical Machines by V.K. Mehta and Rohit Mehta

Course Title: Energy Conversion I Lab	Year/Semester: 2/1	Course Status: Lab (Compulsory, Major)
Course Code: EEE 224	Credits: 1.5	Contact hours: 3 hours of lab per week
Pre-requisite: EEE 121 (Electrical Circuits I), EEE 131 (Electrical Circuits II), EEE 223 (Energy Conversion I)		

Rationale:

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. Generation of electricity includes electric machineries. So student should have insight knowledge of how electric machineries works and how to handle them. The theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices used in Energy Conversion. This course is designed to complement the theoretical course EEE 223.

Course objectives are:

- To facilitate necessary knowledge about different AC machines and skills to handle various lab apparatus.
- Acquaint students with voltage transformation ratio and turn ratio of transformer and experience their importance.
- Helping the students to develop ability in examining the effect of resistive, inductive and capacitive loading of single-phase transformer.
- To provide the knowledge of calculating different transformer parameters without actually loading the transformer.
- Foster the analytical knowledge to calculate different AC asynchronous motor parameters without actually loading the motor.

Course Contents:

1: Familiarization with the lab, its equipment and laboratory regulation.
2: Determination of voltage transformation ratio and turn ratio of a single-phase transformer.
3: Determination of regulation and efficiency with resistive, inductive and capacitive loading of a single phase and three phase transformer.
4: Short circuit and open circuit of single-phase transformer.
5: No load test and blocked rotor test of three phase induction motor.
6: Three phase induction motor speed control and drawing torque-speed curve.
7: Single phase capacitor-run induction motor speed control.

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Explain the safety procedures for high voltage electrical machines.
CO 2	Identify and interpret different electrical machines.
CO 3	Implement circuits to calculate transformer and induction motor parameters practically.
CO 4	Illustrate equivalent circuit of transformers and induction motors from experiments.
CO 5	Operate induction motor speed control techniques.
CO 6	Design efficient ways for machine operation.
CO 7	Develop the ability to work as a part of the team to achieve specified and measurable results while performing the experiments.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1			**X**								
CO 2		**X**									
CO 3			**X**								
CO 4			**X**								
CO 5			**X**								
CO 6						**X**					
CO 7					**X**						

Recommended Books:

1. A Textbook of Electrical Technology (Volume II) by B.L. Theraja and A.K. Theraja
2. Electric Machines by Charles I. Hubert
3. Principles of Electrical Machines by V.K. Mehta and Rohit Mehta

Course Title: Co-ordinate Geometry and Linear Algebra	Year/Semester:2/1	Course Status: Theory (Compulsory, Non-major)
Course Code: MATH 207E	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: None		

Rationale: This course is designed to cover the fundamental properties of linear algebraic structures such as the algebra of matrices, vector space, and inner product space.

Course Objectives:

- To provide expertise on common matrix operations including cofactor expansions and row reductions, and applying these tools in calculating determinant, rank, inverse, and echelon forms of matrices.
- To make students able to investigate the consistency of a system of linear equations and to choose an appropriate method to find the solution of a given system of linear equations.
- Acquaint students with the fundamental properties of vector spaces and subspaces including null space and column space, and their bases and dimensions.
- To facilitate students understand the properties of linear transformations, transformation matrices and their changes for a given basis with respect to the standard basis of a vector space.
- To make students able to find the characteristic polynomial, eigenvalues, associated eigenvectors, and the diagonalized matrix of a transformation matrix.
- To facilitate students to understand inner product spaces, orthogonal vectors, orthonormal bases,and orthogonalization processes.

Course Contents:

Coordinate geometry: Coordinate geometry of two dimensions: Change of axes; transformation of co-ordinates; pair of straight lines; general equation of second degree. Coordinate geometry of three dimensions: System of co-ordinates; distances of two points; section formula; projection; direction cosines; equations of planes and straight lines. **Matrix:** Matrix and matrix operations; different types of matrices; algebraic operations on matrices; cofactors and minors; determinant of a square matrix; adjoint and inverse of a matrix; elementary transformation of matrices; normal and canonical form of a matrix; rank of a matrix; the row-reduced form of a matrix and rank;equivalent systems of linear equations; the general solution of a system of linear equations; homogeneous systems;eigenvalues and eigenvectors; diagonalization of matrices. **Vector space:** Vector spaces and subspaces; linear dependence and independence; spanning set and basis; coordinates and dimension; null space, row space and column space; change of basis. **Linear transformations:** Linear transformations; composition of transformations; matrix representation; change of basis; diagonalization representation of a linear transformation by a diagonal matrix; the eigenvalues and eigenvectors of a symmetric matrix; quadratic form; functions of a square matrix. **Inner product spaces:** Definition and examples; Cauchy-Schwartz inequality; orthogonality; orthonormal basis and Gram-Schmidt process.

Course Learning Outcomes (CO):

By the end of this course the students will be able to:

CO 1	Calculate the determinant, rank, inverse, and echelon forms of a given matrix by using the cofactor expansion method or the row reduction method.
CO 2	Investigate the nature of the solution of a system of linear equations and find the solution of a given system of linear equations by choosing an appropriate method.
CO 3	Test the independence of vectors and find the dimension and basis of a given vector space and its subspaces.
CO 4	Find the matrix representing a linear transformation under a given basis and observe how the matrix changes if the basis is changed.
CO 5	Determine the eigenvalues, associated eigenvectors, diagonalization, and different factorizations of a transformation matrix.
CO 6	Determine orthogonal vectors and orthonormal basis, apply the Gram-Schmidt orthogonalization process, and understand the bilinear and quadratic forms.

Mapping of CO with PO:

CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X	X	X						
CO 2	X	X	X	X					
CO 3	X	X							
CO 4	X	X		X					
CO 5	X	X							
CO 6	X	X							

Books Recommended:

1. Howard Anton and Chris Rorres: *Elementary linear algebra applications*
2. Steven J. Leon: *Linear algebra with applications*, Prentice Hall, 1998
3. Rahman and Bhattacharjee: *Co-ordinate geometry of two and three dimensions*
4. Loney, S. L.: *Coordinate Geometry of Two dimensions*
5. Golub, Van Loan: *Matrix Computation*

Course Title: Numerical Analysis Lab	Year/Semester:2/1	Course Status: Lab (Compulsory, Major)
Course Code: EEE 226	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: MATH 101E, MATH 103E, MATH 105E		

Rationale:

This course introduces students to numerical methods for the solution of basic mathematical problems that cannot be solved by hand using programming techniques. The course aims to introduce students to the toolbox of widely-used numerical methods in engineering. Students will be able to apply these methods to problems in a variety of engineering problem.

Course objectives are:

- To teach the numerical methods used in engineering.
- To teach to apply numerical methods to problems in practice.
- To familiarize with, use, and understand software which uses numerical methods.
- To engage in scientific and technical communication.

Course Contents:

Numerical analysis: Errors in numerical calculations. **Error:** Definitions, sources, examples. Propagation of Error. **Root finding:** The bisection method and the iteration method, the method of false position. Newton-Raphson method. **Methods of approximation theory:** Polynomial interpolation: Lagrange form, divided formula for interpolation. **Solution of systems of Linear equations:** Gaussian elimination. The pivoting strategy, Iteration method solution of tridiagonal systems. **Numerical solution of ordinary differential equations:** Euler's method (including modified form), Runge-Kutta method. **Numerical Integration:** Trapezoidal method. Simpson's method. Weddle's method; Eigen value problems for matrices, Use of computer to implement projects in numerical methods.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Perform an error analysis for a given numerical method by going through the stages (mathematical modeling, solving and implementation) of solving a particular physical problem
CO 2	Apply numerical methods to obtain approximate solutions to mathematical problems.
CO 3	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations using software.
CO 4	Analyze and evaluate the accuracy of common numerical methods.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X								
CO 3			X						
CO 4				X					

Recommended Books

1. Numerical Methods for Engineers - Steven C. Chapra, Raymond P. Canale.
2. Introduction to Numerical Analysis - F.B. Hildebrand.

Course Title: English		Year/Semester:1/1	Course Status: Theory (Compulsory, Non-major)
Course Code: ENG 201E	Credits: 3.0	Contact hours: 3 hours lecture per week	
Pre-requisite: None			

Rationale
This course will develop two basic skills i.e., reading and writing. A variety of reading strategies and texts will be used to effectively develop first year students' academic reading skills thereby facilitating their future study. Also, the course focuses on developing the writing skills of students by familiarizing them with grammar rules, providing them with practice thereby enabling them to demonstrate the accurate use of grammar in their writing.

Course Objectives are
(i) To enable students to write with accuracy
(ii) To facilitate effective and comprehensible writing
(iii) To raise awareness of common errors that occur in writing
(iv) To develop student's ability to understand write-ups on issues of general concern.
(v) To improve the vocabulary of learners for effective communication.

Course Contents:
a) Reading
- Different Reading Strategies
- Guessing Meaning from the Context
- Critical Reading (Analyze)
- Critical Reading (Synthesize)
- Critical Reading (Evaluate)
- Annotation
- Summary Writing
- Material
- A selection of 08-10 editorials and reports from newspapers/magazines/journals,etc
- Reading texts in New Headway Upper Intermediate Student's Book (Current edition)
- Selected passages from recommended books
- A selection of other material may be supplied as handouts as deemed necessary by the instructor.

b) Writing
- Forms and functions of different word categories (Noun, verb, adjective, etc.)
- Aspects and uses of tense
- Subject-verb agreement
- Use of infinitive, gerund, present participle, past participle, modals, causatives,
- conditionals, subjunctives, modals.
- Use of sentence connectors/ cohesion markers/ punctuation
- Effective combination of sentences (simple, complex, compound)
- Developing a paragraph

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	apply grammar rules
CO 2	produce grammatically correct meaningful sentences
CO 3	express oneself correctly by using appropriate words, phrases, sentences or ideas
CO 4	critically reflect on a text (grasp abstract ideas and interpret them effectively, arrive at well-reasoned conclusions and solutions).
CO 5	extract information from passages accurately

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1		**X**		**X**					
CO 2		**X**		**X**					
CO 3		**X**		**X**					
CO 4		**X**		**X**					
CO 5								**X**	

Recommended Books

1. Tibbitts, E. E. ed. Exercises in Reading Comprehension. Longman
2. Liz and John Soars. (Current edition). New Headway Upper Intermediate Student's Book.
3. Oxford: Oxford University Press
4. Cliff's TOEFL
5. Other Resources recommended by course instructors

Course Title: Communication in English Practice	Year/Semester:1/1	Course Status: Lab (Compulsory, Non-major)
Course Code: ENG 202E	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite:		

Rationale

This course is designed to improve the speaking and listening skills of students in the English language. Emphasis is laid on proper pronunciation for accurate articulation and recognition of speech sounds as well as correct stress, intonation and language use in varied situations.

Course Objectives are

(i) To enable students' understanding of the variations in pronunciation
(ii) To teach proper pronunciation and accurate articulation.
(iii) To facilitate appropriate stress and intonation in speech.
(iv) To encourage use of English effectively in everyday situations.
(v) To ensure overall improvement of oral communication through listening and speaking.

Course Contents:

(a) Speaking

- Articulators
- English Phonetic Alphabet (British and American) and International Phonetic Alphabet
- (IPA)
- Stress rules of English
- Intonation rules and functions of intonation
- Communication Styles and Cultural Context
- Fluency, mistakes, misunderstandings, audience, taboos, self-esteem, confidence
- Activities: dialogue, debate, extempore speech, interview, role-play

(b) Listening

- Basics of listening
- Various types of Pronunciation

- IPA, RP, Transcription
- Different accents and intonation patterns
- Activities for Meaning-focused Listening, Information Transfer Strategies,
- Listening Practice through selection of audio clips.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	read the symbols of the International Phonetic Alphabet used to represent the sounds of the English language.
CO 2	understand all that is being said in English in varied accents
CO 3	interpret information accurately
CO 4	apply appropriate intonation and stress patterns in English words and sentences.
CO 5	produce continuous speech clearly and convincingly.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1			**X**	**X**					
CO 2			**X**	**X**					
CO 3			**X**	**X**					
CO 4			**X**	**X**					
CO 5	**X**								

Recommended Books

1. Anderson, A. & Lynch, T. Listening. Oxford: Oxford University Press. 1988
2. Hancock, Mark. English Pronunciation in Use. New York: Cambridge University Press. 2004
3. Anderson, Kenneth, et al. Study Speaking. Cambridge University Press, 2007
4. Hancock, Mark. English Pronunciation in Use. Cambridge University Press, 2004
5. Jones, Daniel. Cambridge English Pronunciation Dictionary. Cambridge University Press, 2011
6. Richards J, et al. Person to Person. Oxford University Press, 2007
7. Richards, Jack C, and David Bohlke. Speak Now: 1. Oxford University Press, 2013
8. Roach, Peter. English Phonetics and Phonology. Cambridge University Press, 2009

Course Title: Financial and Managerial Accounting	Year/Semester:2/1	Course Status: Theory (Compulsory, Non-major)
Course Code: ACC 201E	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: None		

Rationale

It is a basic course on business principles and cost management

Course Objectives are

1. To describe the cost concepts, cost behavior, and cost accounting techniques that are applied to manufacturing and service businesses.
2. To be capable to interpret cost accounting statements,
3. To provide the students with the capability to apply theoretical knowledge in decision making.
4. To be able to analyze and evaluate information for cost ascertainment, planning, control of business operations.
5. To discuss the various techniques available to measure managerial performance and to motivate emPOyees toward organizational goals.
6. To identify and analyze both qualitative and quantitative standards to formulate best control methods

Course Contents:

Introduction to Cost Accounting: Definition of Cost Accounting, Comparison of Cost Accounting and Financial Accounting; The role of Cost Accounting; Methods and Techniques of Cost Accounting; Characteristics of an Ideal Cost Accounting System.

Cost Concepts, Classifications and Statements: Cost Object; Expenditures, Cost, Expense and Loss; Cost Classifications; Cost Data and Uses; The Chart of Accounts; Statement of Cost of Goods Manufactured and Sold; Cost Statement or Cost Sheet.

Costing and Control of Materials: Classification of Materials; Accounting for Materials; Store ledger (FIFO & WAM) method; Inventory Planning; Ordering Cost, Holding Cost and EOQ; Effect of Quantity Discounts on EOQ; Safety Stock and Reorder Point; Material Control Methods; Materials Requirement Planning System. Practical problem.

Costing and Control of Labor: Productivity and Labor Costs; Costs included in Labor; Accounting for Labor; Time Keeping, Computation of total payroll and Allocation of Payroll costs; Different incentive plan; Labor cost Control, Labor Turnover and Control of Labor Turnover; Learning Curve Theory. Practical problem & solution

Costing and Control of Manufacturing Overhead: Manufacturing Overhead Costs; Actual Vs. Normal Costing of Manufacturing Overhead; Production Capacity, Predetermined Overhead Rates; Departmental vs. Plant-wise Overhead Rates; Separating Mixed Costs. Scatter-graph; High-low Method and Regression Analysis; Accounting for Manufacturing Overhead; Analysis and Disposition of Under-applied-and Over-applied Overhead

Contract Costing: Determination of profit of completed and incomplete contracts.

Cost Terms, Concepts and Classifications: Cost Behavior (Analysis and Use): General cost classifications- product costs versus period costs- cost classifications on Financial Statements. Types of cost behavior patterns- the Analysis of Mixed Costs, High-low method

Cost-Volume-Profit Relationships: The basics of CVP analysis- Break -even analysis- Break-even chart- Sales Mix. Business application and mathematical problem of CVP analysis

Budget: Define Budget, Types of Budgets, Cash budget, purchase budget, sales budget, flexible budget and related problems

Standard Costing: Meaning and Objectives- Types of ratios. Standard Costing and its uses for making business decision. Variance calculation, Decision making process from these calculations.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	use cost accounting for decision making and performance evaluation.
CO 2	demonstrate how materials, labor and overhead costs are added to a product at each stage of the production cycle.
CO 3	express the place and role of cost accounting in the modern economic environment.
CO 4	recognize and apply the skills necessary for carrying out effective management decision-making and strategic management planning;
CO 5	select the costs according to their impact on business and society.
CO 6	interpret the impact of the selected costs method.
CO 7	design management control process in different business areas.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1		X							
CO 2		X							X
CO 3									X
CO 4						X	X	X	X
CO 5		X							
CO 6		X							
CO 7									X

Recommended Books

1. Cost Accounting –Volume-1 by Basu and Das;
2. Managerial Accounting by Ray H. Garrison, Eric W. Noreen
3. Cost Accounting by Mutz Uzry et al

Second Year Second Semester

Course Title: Electronics II	Year/Semester:2/2	Course Status: Theory (Compulsory, Major)
Course Code: EEE 231	Credits: 3.0	Contact hours:3 hours lecture per week
Pre-requisite: EEE 221 (Electronics I)		

Rationale

Electronics I is continued in this course. The purpose of this course is to introduce students to advanced electronic principles. With the aid of theoretical and hands-on problem solving, the main goal of this course is to comprehend and apply complex electronic circuits, such as amplifiers, passive and active filters, etc. Students will study the workings of operational amplifiers, oscillators, power amplifiers, feedback amplifiers, and active filters in this course, as well as their operating characteristics. Transistor and Op-Amp circuits, as well as the frequency response of transistor amplifiers and the usage of cascaded amplifiers to boost gain and bandwidth, are just a few of the subjects covered. In addition to providing them with a foundational understanding of these fundamental gadgets, this course will also adequately prepare them to increase the effectiveness of various technological devices.

Course Objectives

- To facilitate necessary knowledge to analyze amplifiers for frequency response.
- Acquaint students with the basic tools to identify, select and handle transistor and ICs for amplifier design.
- To help students develop understanding differential amplifiers.
- To facilitate necessary knowledge to analyze and design feedback circuits using op-amp.
- To facilitate necessary knowledge to analyze and design oscillator circuits using op-amp and other transistors.
- To provide basic knowledge about power amplifiers.

Course Content:

Frequency response of amplifiers: Poles, zeros and Bode POts, amplifier transfer function, techniques of determining 3 dB frequencies of amplifier circuits, frequency of determining 3 dB frequencies of amplifier circuits, frequency response of single-stage and cascade amplifiers, frequency response of differential amplifiers.
Operational amplifiers (Op-Amp): Properties of ideal Op-Amps, non-inverting and inverting amplifiers, inverting integrators, differentiator, weighted summer and other applications of Op-Amp circuits, effects of finite open loop gain and bandwidth on circuit performance, logic signal operation of Op-Amp, DC imperfections.
General purpose Op-Amp: DC analysis, Small –signal analysis of different stages, gain and frequency response of 741 Op-Amp.
Negative feedback: Properties, basic topologies, feedback amplifiers with different topologies, stability, frequency compensation.
Active filters: Different types of filters and specifications, transfer, realization of first and second order low, high and band pass filters using Op-Amps.
Signal generators: Basic principle of sinusoidal oscillation, Op-Amp RC oscillators, LC and crystal oscillators.
Power Amplifiers: Classification of output stages, class A, B and AB output stages.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Describe the theoretical concepts necessary to comprehend how various amplifiers, filters, and signal generators operate.
CO 2	Understand the basic concept of feedback and distinguish the characteristics of different types of feedback amplifiers.
CO 3	Explain frequency response and stability of differential amplifiers and Op-Amps.

CO 4	Design appropriate amplifiers with high efficiency for various frequency applications (Single stage and multistage).
CO 5	Analyze low order and high order active filters.
CO 6	Model different signal generators using op-amp and other transistors.
CO 7	Recognize the need for and show aptitude for lifelong learning in order to apply cutting-edge electronic technologies to the design of energy-efficient circuits.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2	X			X					
CO 3	X								
CO 4	X			X					
CO 5	X			X					
CO 6	X			X					
CO 7						X	X		X

Recommended Books:

1. Microelectronic Circuit by Adel Sedra, K.C. Smith
2. Electronic Devices and Circuit Theory by Robert L. Boylestad
3. Electronics Principles. By Malvino
4. Operational Amplifier and Linear Integrated Circuits by Robert F. Coughlin, Frederick F. Driscoll

Course Title Electronics II Lab	Year/Semester:2/1	Course Status: Lab (Compulsory, Major)
Course Code: EEE 232	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: EEE 222		

Rationale:

In this course students will perform experiments to verify practically the theories and concepts learned in EEE-401. Theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices. This is an introductory experimental laboratory that exPOres the design, construction, and analysis of Op-Amp and power amplifier in different frequency range, active filters and oscillators.

Course objectives are:

- To help students to develop the ability to interpret the frequency response of single stage and cascaded amplifiers.
- To make students understand the basic properties of a non-ideal op-amp:741.
- To provide the knowledge about the procedures to design and observe characteristics of coupled amplifiers.
- To teach students the methods to design and observe characteristics of different types of filters.
- To teach students the methods to design and observe characteristics of different types of oscillators.
- To provide the students with the capability of implementing different real life analog electronic circuits.

Course Contents:

1. Study of R-C coupling.
2. Study of Transformer coupling.
3. Study of Direct coupling.
4. Study of R-C Phase Shift Oscillator.
5. Study of Differential Amplifier.
6. Study of Inverting, Non-Inverting and Summing Op-Amp circuit.

7. Study of Integrator and Differentiator Op-Amp circuit.
8. Study of Transistor Tuned Oscillator.
9. Study of Negative feedback circuit.
10. Students will be assigned real-life hardware/software-based projects.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Determine the characteristics of electronic circuits and present experimental results.
CO 2	Construct and analyze different types of amplifiers and measure the performance parameters.
CO 3	Design and analyze characteristics of various filters.
CO 4	Analyze properties of different negative feedback circuit using op-amp.
CO 5	Keep ethics in mind while you gather and record data from experiments.
CO 6	Develop the ability to work as a part of the team to achieve specified and measurable results while performing the experiments.
CO 7	Formulate the ability to communicate individual opinion effectively across the members of the team.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**		**X**						
CO 2			**X**	**X**					
CO 3			**X**	**X**					
CO 4				**X**					
CO 5								**X**	**X**
CO 6		**X**			**X**				
CO 7		**X**			**X**				**X**

Recommended Books

1. Microelectronic Circuit by Adel Sedra, K.C. Smith
2. Electronic Devices and Circuit Theory by Robert L. Boylestad
3. Electronics Principles. By Malvino
4. Operational Amplifier and Linear Integrated Circuits by Robert F. Coughlin, Frederick F. Driscoll
5. **Lab Manual:** Will be supplied by course teacher in the beginning of the course.

Course Title: Energy Conversion II	Year/Semester: 2/2	Course Status: Theory (Compulsory, Major)
Course Code: EEE 233	Credits: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 223 (Energy Conversion I)		

Rationale:

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. Generation of electricity includes electric machineries. So student should have insight knowledge of how electric machineries works and how to handle them. This course examines the basic theory, characteristics, construction operation and application of rotating electrical machines. It includes the study of DC and AC machines.

Course objectives are:

- Help them conceptualize the construction, characteristics, operation and application of both DC and AC machines including dc motor, dc generator, alternator and synchronous motor.
- To develop skills on solving magnetic circuit problems using formulae, certain Laws (Faraday, Lenz) and Rules (Fleming).
- To enhance the skills on solving problems relating to generated voltage, terminal voltage, currents, torque, speed, input and output power, efficiency, and voltage/speed regulation in DC generators.
- To provide knowledge on solving problems relating to rotor speed, flux, torque, developed power, efficiency in DC motors.
- Facilitate necessary knowledge to solve problems relating to generated voltage, terminal voltage, current, frequency, load power factors, and synchronous impedance in poly-phase alternators.
- Accumulate basic ideas about synchronous speed, slip, rotor frequency, rotor voltage, rotor current, torque, developed power, efficiency and power factor in poly-phase synchronous motors.
- To provide students the basic knowledge to explain the results of laboratory tests on various rotating electrical machines under load conditions.
- Enhancing skills on safely wire and operate electrical rotating machines and their associated metering and starting equipment.
- To describe the design of major classes of electric machines.

Course Contents:

Synchronous Generator: excitation systems, equivalent circuit, vector diagrams at different loads, factors affecting voltage regulation, synchronous impedance, synchronous impedance method of predicting voltage regulation and its limitations. Parallel operation: Necessary conditions, synchronizing, circulating current and vector diagram. **Synchronous motor**: Operation, effect of loading under different excitation condition, effect of changing excitation, V-curves and starting. **DC generator:** Types, no-load voltage characteristics, build-up of a self-excited shunt generator, critical field resistance, load-voltage characteristic, effect of speed on no-load and load characteristics and voltage regulation. **DC motor**: Torque, counter emf, speed, torque-speed characteristics, starting and speed regulation. Introduction to wind turbine generators.

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Understand three phase power generation
CO 2	Describe the three-phase synchronous generator operating principle
CO 3	Explain DC machine working principle.
CO 4	Interpret synchronous generators voltage regulation on different loads
CO 5	Compute DC machine parameters theoretically and practically.
CO 6	Calculate electrical system's efficiency and improve it.
CO 7	Design systems with parallelly connected generators.
CO 8	Formulate proper procedure for speed control, starting and braking.
CO 9	Differentiate between AC and DC machines.
CO 10	Evaluate which machine is effective in different conditions.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X								
CO 3	X								
CO 4			X						
CO 5			X						

CO 6									**X**
CO 7								**X**	
CO 8			**X**						
CO 9			**X**						
CO 10			**X**						

Recommended Books:

1. A Textbook of Electrical Technology (Volume II) by B.L. Theraja and A.K. Theraja
2. Electric Machines by Charles I. Hubert
3. Principles of Electrical Machines by V.K. Mehta and Rohit Mehta
4. Electrical Machinery Fundamentals by Stephen J. Chapman

Course Title: Energy Conversion II Lab	Year/Semester: 2/2	Course Status: Lab (Compulsory, Major)
Course Code: EEE 234	Credits: 1.5	Contact hours: 3 hours of Lab per week
Pre-requisite: EEE 223 (Energy Conversion I), EEE 224 (Energy Conversion I Lab)		

Rationale:

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. Generation of electricity includes electric machineries. So student should have insight knowledge of how electric machineries works and how to handle them. The theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices used in Energy Conversion. This course is designed to complement the theoretical course EEE 225.

Course objectives are:

- To facilitate necessary knowledge about different DC and AC machines and handle various lab apparatus.
- To help students develop skills to control the speed of dc motor and observe the existence of back EMF.
- To describe the importance of residual magnetism on voltage build-up of dc generator.
- To help students develop skills to determine voltage regulation of dc generator.
- To provide the basic knowledge to obtain O.C.C and loading curve of synchronous generator.
- To provide the basic knowledge to obtain V-curve of synchronous motor.

Course Contents:

1: Familiarization with different electrical machines and components in an electrical system.
2: Speed control of DC shunt motor
3: Verify the existence of back EMF in a DC shunt motor.
4: Determining torque-speed characteristics of DC motor.
5: Determining voltage regulation of DC shunt generator.
6: No load and loading characteristics of synchronous generator.
7: Determining V-curve of synchronous motor.

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Explain the safety procedures for high voltage electrical machines.
CO 2	Identify and interpret different electrical machines.
CO 3	Implement circuits to calculate synchronous generators voltage regulation on different loads..
CO 4	Calculate DC machine parameters theoretically and practically.
CO 5	Interpret torque-speed characteristics of different machines.
CO 6	Differentiate between AC and DC machines
CO 7	Compare synchronous motor and machine V-curve
CO8	Develop the ability to work as a part of the team to achieve specified and measurable results while performing the experiments.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**								
CO 3	**X**								
CO 4			**X**						
CO 5			**X**						
CO 6									**X**
CO 7									**X**
CO 8					**X**				

Recommended Books:

1. A Textbook of Electrical Technology (Volume II) by B.L. Theraja and A.K. Theraja
2. Electric Machines by Charles I. Hubert
3. Principles of Electrical Machines by V.K. Mehta and Rohit Mehta
4. Electrical Machinery Fundamentals by Stephen J. Chapman

Course Title: Electromagnetic Fields and Waves		Year/Semester: 2/2	Course Status: Theory (Compulsory, Major)
Course Code: EEE 235	Credits: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: None			

Rationale:
This subject deal with the basic theory and practice relevant to all forms of electronic communications. Illustrative examples taken from conventional (RF, mobile, microwave, and optical communications) and novel aspects of communications (radar, computer interconnections, mobile wireless systems, radio-telescopes, satellite communications etc.) will be given. This course will help students to have a basic knowledge of electromagnetics in a telecommunications context, to know how to formulate and solve simple problems in electromagnetics and to gain an understanding of how other disciplines relate to the study of electromagnetics.

Course objectives are:

- To acquaint students with the properties of static electric field systems and methods to solve electrostatic problems.
- To accumulate basic ideas about the properties of static magnetic field systems and methods to solve magnetostatic problems.
- To understand basic electromagnetic induction theory and methods to solve related problems.
- To help students conceptualize Maxwell's equations and their use in deriving time harmonic wave equation.
- To facilitate necessary knowledge about electromagnetic wave propagation process in lossy and lossless medium & EM power flow.

Course Contents:

Review of Vector Algebra and Co-ordinate System: Curvilinear Co-Ordinates, Rectangular Cylindrical and Spherical Co-Ordinates, Gradient, Divergence, Curl and Formulas involving Vector Operations.

Electrostatics: Coulombs law, Gauss's theorem, Laplace's and Poisson's equations, Energy of an electrostatic system.

Magneto static: Ampere's law, Biot-Savart law, Energy of magneto static system. Maxwell's equations: Their derivations, Continuity of charges, Concept of displacement current, Electro-Magnetic Energy, Boundary conditions, The Wave Equations with Sources. Potentials used with varying charges and currents, Retarded potentials, Maxwell's equation in different co-ordinate systems.

Relation between circuit theory and field theory: Circuit concepts and the derivation from the field equations, high frequency circuit concepts, Circuit radiation resistance, Skin effect and circuit impedance, Concept of good and Perfect conductors and dielectrics, Propagation in good conductors, Reflection of uniform plane waves, standing wave ratio, Dispersion in dielectrics.

Propagation of electromagnetic waves: Plane wave propagation, Polarization, Power flow and pointing theorem, Transmission line analogy, Display lines ion in dielectrics, Liquids and solids.

Radio wave propagation: Different types of radio wave propagation Ionosphere, Vertical heights and critical frequencies of layers, Propagation of RW through Ionosphere, Reflection of RW, Skip distance and MUF, Fading, Static and noise, Two way communication.

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Explain basics of orthogonal coordinate systems and vector properties.
CO 2	Describe different laws of Electrostatics and Magnetostatics like Gauss's law and Ampere's law.
CO 3	Explain wave propagation through different mediums.
CO 4	Understand electromagnetic waves travelling in transmission lines.
CO 5	Explain the different ways of electromagnetic wave propagation through the atmosphere.
CO 6	State the basic polarization concepts of electromagnetic wave.
CO 7	Compute electromagnetic field quantities for various conditions.
CO 8	Calculate the energy stored by static electric and magnetic fields.
CO 9	Point out the importance of Maxwell's equations.
CO 10	Calculate propagation delay, attenuation factor, skin depth, group velocity of waves in different mediums
CO 11	Evaluate the Electromagnetic wave equation to interpret how electric and magnetic field coexists.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**				**X**				
CO 2	**X**								

CO 3	**X**				**X**				
CO 4	**X**			**X**					**X**
CO 5	**X**								**X**
CO 6	**X**				**X**				
CO 7		**X**		**X**					
CO 8				**X**					
CO 9	**X**				**X**				
CO 10		**X**		**X**	**X**				
CO 11	**X**				**X**				

Recommended Books:

1. Field and Wave Electromagnetic by David K. Cheng
2. Elements of Electromagnetics by Matthew N.O. Sadiku
3. Engineering Electromagnetics by William H.Hayt, John A. Buck

Course Title: Circuit Simulation Lab		Year/Semester: 2/2	Course Status: Lab (Compulsory, Major)
Course Code: EEE 236	Credits: 3.0	Contact hours: 3 hours Lab per week	
Pre-requisite: None			

Rationale:

The Simulation Laboratory, COsely aligned with the theoretical foundations of the EEE (Electrical and Electronic Engineering) curriculum, serves as a pivotal bridge between theory and practical application. This lab course, meticulously designed, draws upon the knowledge imparted in EEE 121, EEE 131, EEE 221, and EEE 231 theory courses, providing EEE students with a hands-on platform to validate and comprehend complex concepts through simulation software tools like PSpice, Proteus, and Matlab.

Course objectives are:

- To provide the students with the techniques of solving of different types of circuits by network theorem using simulation.
- To teach the analysis of three phase circuits by using different simulating software
- Teach the analysis of three phase circuits
- Acquaint students with the basic idea about simulating different types of diode circuits and investigate the voltage, current relationships.
- To provide the knowledge about the procedure of determination of voltage gain, current gain, overall gain in a single and multistage BJT, JFET and MOSFET amplifiers.
- To help the students to develop ability to verify the theoretical concepts through laboratory and simulation experiments.

Course Contents:

Simulation laboratory based on EEE 121, EEE 131, EEE 221 and EEE 231 theory courses.
Students will verify the theories and concepts learned in EEE 121, EEE 131, EEE 221 and EEE 401 using simulation software like PSpice, Proteus and MATLAB.

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Design experiments to interpret different types of circuit analysis theorem and laws
CO 2	Simulate electrical circuits for various application.
CO 3	Design and understand the mechanism of power transfer through transmission line
CO 4	Differentiate series and parallel resonant circuits by simulation
CO 5	Compute and simulate the main parameters of electronic circuits to facilitate necessary knowledge to analyze circuit performance.
CO 6	Identify the characteristics of electronic circuits and present experimental results in order to reach a valid conclusion about the behavior of circuits.
CO 7	Design and analyze characteristics of various filters.
CO 8	Analyze properties of different negative feedback circuit using op-amp.
CO 9	Develop the ability to work as a part of the team to achieve specified and measurable results while performing the experiments.
CO 10	Demonstrate team-based communication skills, magnify their moral standards and apply these in practical life.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**	**X**	**X**		**X**				
CO 2	**X**		**X**						
CO 3			**X**						
CO 4	**X**		**X**	**X**					
CO 5	**X**								
CO 6			**X**						
CO 7		**X**		**X**					
CO 8				**X**					
CO 9		**X**			**X**			**X**	
CO 10		**X**			**X**	**X**	**X**	**X**	

Course Title: Mechanical Engineering Fundamentals		Year/Semester: 2/2	Course Status: Theory (Compulsory, Major)
Course Code: ME 201E	Credits: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: None			

Rationale:
This course is a fundamental course on mechanical structure and designing which is designed to provide the basic concepts of mechanical tools and equipment to electrical engineering students.

Course objectives are:
The objectives of this course are:

- To understand the various forms of conventional energy resources
- To introduce students to the Thermodynamics
- To learn about Thermodynamics Laws.
- To learn about different Fluid Machineries
- To understand the working principle of different Thermal Engines

Course Contents:

1. To study the Cochran and Babcock & Wilcox Boilers.

2. To study Two stroke & Four-stroke Diesel Engines.
3. To study Two-stroke & Four-stroke Petrol Engines.
4. To study the vapor compression Refrigeration System and determination of its C.O.P.
5. To study the functioning window room air conditioner.

Course Learning Outcome:
After the successful completion of the course, the student will be able to-

CO 1	Understand working principles of different types of boilers
CO 2	Understand working principles of different types of Diesel engines.
CO 3	Understand working principles of different types of Petrol engines.
CO 4	Understand refrigeration system and COP.
CO 5	Understand the working principle of Air Conditioning.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**								
CO 3	**X**								
CO 4	**X**								
CO 5	**X**								

Recommended Books:
1. Devendra Vashist - Mechanical Engineering: Fundamentals
2. R.L. Timings - Fundamentals of Mechanical Engineering
3. Claus Borgnakke, Richard E. Sonntag - Fundamentals of Thermodynamics
4. Munson - Fundamentals of Fluid Mechanics

Course Title: Mechanical Engineering Fundamentals Lab		Year/Semester: 2/2	Course Status: Lab (Compulsory, Major)
Course Code: ME 202E	Credits: 1.5	Contact hours: 3 hours lab per week	
Pre-requisite: None			

Rationale:
This lab course is a designed based on the learning of mechanical engineering theory course to provide the basic concepts for EEE students.

Course objectives are:
The objectives of this course are:
- To understand the various forms of conventional energy resources
- To introduce students to the Thermodynamics
- To learn about Thermodynamics Laws.
- To learn about different Fluid Machineries
- To understand the working principle of different Thermal Engines

Course Contents:

Introduction to sources of energy: Steam generating units with accessories and mountings; steam turbines. Introduction to internal combustion engines and their cycles, gas turbines.
Refrigeration and air conditioning: applications; refrigerants, different refrigeration methods.
Fluid machinery: impulse and reaction turbines; centrifugal pumps, fans, blowers and compressors. Basics of conduction and convection: critical thickness of insulation.

Course Learning Outcome:
After the successful completion of the course, the student will be able to-

CO 1	Understand working principles of different types of boilers
CO 2	Understand working principles of different types of Diesel engines.
CO 3	Understand working principles of different types of Petrol engines.
CO 4	Understand refrigeration system and COP.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1			X						
CO 2			X						
CO 3			X						
CO 4			X						

Recommended Books:
1. Devendra Vashist - Mechanical Engineering: Fundamentals
2. R.L. Timings - Fundamentals of Mechanical Engineering
3. Claus Borgnakke, Richard E. Sonntag - Fundamentals of Thermodynamics
4. Munson - Fundamentals of Fluid Mechanics

Course Title: Probability and Statistics		Year/Semester: 2/2	Course Status: Theory (Compulsory, Major)
Course Code: MATH 209E	Credits: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: None			

Rationale:

Acquiring knowledge on the statistical tools and techniques for exPOring and analyzing the data.

Course objectives are:
- To learn to present data,
- To know descriptive statistical measures,
- To study probability and probability distributions,
- To perform correlation and regression analysis.

Course Contents:

Introduction. Sets and probability. Random variable and its probability distributions. Treatment of grouped sampled data. Some discrete probability distributions. Normal distribution. Sampling theory. Estimation theory. Tests of hypotheses. Regression and correlation. Analysis of variance.

Course Learning Outcome:
After the successful completion of the course, the student will be able to-

CO 1	Gather knowledge on types of data, scale of measurement, construction of frequency distribution, and graphical presentation of data;
CO 2	Acquire knowledge on different measures of central tendency, dispersion and shape characteristics, and prove important theorems related to these measures;
CO 3	Compute measures of central tendency, measures of dispersion and shape characteristics
CO 4	Acquire basic concepts of probability
CO 5	Acquire knowledge on random variable and its uses
CO 6	Gain knowledge on the study of Binomial, Poisson and Normal distributions, solve problems on finding probabilities from these distributions
CO 7	Gather knowledge on correlation and regression analysis

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**								
CO 3	**X**								
CO 4	**X**			**X**	**X**				
CO 5	**X**								
CO 6	**X**								
CO 7	**X**								

Recommended Books:

1. Devore J., (2009), Probability and Statistics for Engineering and the Sciences, 8th Edition, Brooks/Cole, Cengage Learning, California
2. Montgomery, D.C., Runger, G.C., (2003), Applied Statistics and Probability for Engineers, 3rd Edition, John Wiley & Sons, Inc., NY
3. Ross, S.M., (2007), Introduction to Probability Models, 9th Edition, Academic Press, NY

Course Title: Viva	Year/Semester: 2/2	Course Status: Lab (Compulsory, Major)
Course Code: EEE 299	Credits: 1.0	Contact hours: 1 hour lecture per week
Pre-requisite: All Previous Courses		

Rationale
This course endeavors to build a comprehensive idea on all the previously taken courses.

Course Objectives

- To get the general idea on basic concepts.
- To familiarize with viva voce.
- To increase communicative skills.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	To get the general idea on basic concepts.
CO 2	To familiarize with viva voce.
CO 3	To increase communicative skills.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								X
CO 2	X			X					X
CO 3	X								X

Third Year First Semester

Course Title: Communication I		Year/Semester: 3/1	Course Status: Theory (Compulsory, Major)
Course Code: EEE 321	Credit: 3.0	Contact hours: 3 hours Lecture per week	
Prerequisite: EEE 221, MATH 105E			

Rationale:

A graduate of Electrical and Electronic Engineering is expected to acquire profound knowledge about basic communication techniques. The course also introduces analytical techniques to evaluate the performance of communication systems.

Course objectives are:

- To help students develop a solid background on the fundamental concepts of analog & digital communication technologies.
- Getting idea about other communication courses in the upcoming semesters and postgraduate studies.
- To facilitate necessary knowledge about pursuing research in communications

Course Contents:

Overview of communication systems: Basic Principles, fundamental elements, system limitations, message source, bandwidth requirements, transmission media types, bandwidth and transmission capacity.
Noise: Source, characteristics of various types of noise and signal to noise ratio.
Information theory: Measure of information, source encoding, error free communication over a noisy channel, channel capacity of a continuous system and channel capacity of a discrete memory less system.
Communication systems: Analog and digital.
Continuous wave modulation: Transmission types-base-band transmission.
Carrier transmission: amplitude modulation-introduction, double side band, single side band, vestigial side band, quadrate, spectral analysis of each type, envelope and synchronous detection; angle modulation-instantaneous frequency, frequency modulation (FM) and phase modulation (PM), spectral analysis, demodulation of FM and PM.
Pulse modulation: Sampling-sampling theorem, Nyquist criterion, aliasing, instantaneous and natural sampling; pulse amplitude modulation-principle, bandwidth requirements; pulse code modulation (PCM)-quantization principle quantization noise, non-uniform quantization signal to quantization error ratio, differential PCM, demodulation of PCM; delta modulation (DM)-principle adaptive DM; line coding-formats and bandwidths.
Digital modulation: Amplitude-shift Keying-principle, ON-OFF keying, bandwidth requirements, detection, noise performance; phase-shift keying (PSK)- principle, bandwidth requirements, detection, differential PSK, quadrature PSK, noise performance; frequency-shift keying (FSK)-principle, continuous and discontinuous phase FSK, minimum shift keying, bandwidth requirements, detection of FSK. Multiplexing: Time-division multiplexing (TDM)-principle, receiver synchronization, frame synchronization, TDM of multiple bit rate systems; frequency-division multiplexing (FDM)-principle, de-multiplexing; wavelength-division multiplexing, multiple-access network-time-division

multiple-access (TDMA), frequency-division multiple access (FDMA); code-division multiple-access (CDMA)-spread spectrum multiplexing, coding techniques and constraints of CDMA. Communication system design: design parameters, channel selection criteria and performance simulation.

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Explain analog and digital communication basics.
CO 2	Understand how sampling and quantization is done.
CO 3	Describe time division and frequency division multiplexing processes.
CO 4	Formulate an efficient form of digital communication.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**								
CO 3	**X**								
CO 4	**X**					**X**			

Recommended Books:

1. Modern Analog & Digital Communication System- B.P.Lathi & Z.Ding.
2. Communication System by Simon Haykin & M.Moher.

Course Title: Communication I Lab	Year/Semester: 3/1	Course Status: Lab (Compulsory, Major)
Course Code: EEE 322	Credits: 1.5	Contact hours:3 hours lab per week
Prerequisite: EEE 221, MATH 105E		

Rationale

This course provides a thorough introduction to the basic principles and techniques used in analog and digital communications. A graduate of Electrical and Electronic Engineering is expected to acquire profound knowledge about these basic communication techniques. The theoretical knowledge is incomplete without hands on experiments using the basic components and training modules showing modulation and demodulation techniques. This course is designed to complement the theoretical course EEE 321.

Course Objectives are

- To develop skills to simulate modulation techniques of analog communication systems.
- To help explore and understand demodulation techniques of analog communication systems
- To enhance the skills to simulate modulation techniques of digital communication systems.

- Acquaint students with experiments of demodulation techniques of digital communication systems
- To enable the students to establish the connection and understand differences between analog and digital representation and transmission of information.

Course Contents:

1. AM modulation and demodulation technique.
2. FM modulation and demodulation technique.
3. PM modulation and demodulation technique.
4. DM modulation and demodulation technique.
5. PWM and PCM modulation and demodulation technique.
6. Line coding and decoding
7. ASK modulation and demodulation technique.
8. FSK modulation and demodulation technique.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Understand AM, FM, PM and DM modulation and demodulation technique
CO 2	Explore PWM and PCM modulation and demodulation technique
CO 3	Implement FSK modulation and demodulation technique
CO 4	Demonstrate Different kind of line coding techniques and demodulation of those line coding
CO 5	Conduct experiment on ASK modulation and demodulation technique
CO 6	Evaluate the quality of teamwork and effective communication skills.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1		**X**		**X**					
CO 2		**X**		**X**					
CO 3		**X**		**X**					
CO 4		**X**		**X**					
CO 5		**X**		**X**					
CO 6					**X**	**X**			

Recommended Books

1. Communication Systems by Simon S. Haykin
2. Communication Theory: Epistemological Foundations by James Arthur Anderson
3. Modern Digital and Analog Communication System by B.P. Lathi

Course Title: Digital Electronics	Year/Semester: 3/1	Course Status: Theory (Compulsory, Major)
Course Code: EEE 323	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: EEE 221 (Electronics I)		

Rationale

The main aim of this course is to provide sound knowledge of the principles and practices of digital systems, both at the device and circuit level. The course covers topics in digital electronics including: Number Theory, Boolean Algebra, Logic Circuits, Logic Minimization Techniques, Multiplexers, Adders, Flip-Flops, Counters, Registers, State Machines, Memory Circuits, Digital / Analog Conversion, Programmable Logic Circuits and Microcomputer Bus Architecture. Upon completion, students should be able to construct, analyze, verify, and troubleshoot digital circuits using appropriate techniques and test equipment.

Course Objectives

- To make students understand the fundamental principles in design and implementation of digital logic circuits including combinational circuits, sequential circuits, and finite state machines.
- To develop skills to perform decimal, octal, hexadecimal, and binary conversions.
- To provide the knowledge to apply Boolean algebra to solve logic functions.
- To help students in learning the analysis of pulse circuits.
- To develop skills for multiplexing digital circuits.
- Help students conceptualize with the basics of logic family.
- Make the students devise logic switching circuits.
- Accumulate the basic idea of memory storage devices.
- To acquaint students with the basic tools to plan and execute projects in digital circuits
- Foster the analytical and critical knowledge to develop logic design circuits with Programmable Logic Devices

Course Contents:

Introduction to number systems and codes. Analysis and synthesis of digital logic circuits: Basic logic functions, Boolean algebra, combinational logic design, minimization of combinational logic.

Implementation of basic static logic gates in CMOS and BiCMOS: DC characteristics, noise margin and power dissipation. Power optimization of basic gates and combinational logic circuits.
Modular combinational circuit design: pass transistor, pass gates, multiplexer, demultiplexer and their implementation in CMOS, decoder, encoder, comparators, binary arithmetic elements and ALU design.
Programmable logic devices: Logic arrays, field programmable logic arrays and programmable read only memory. Sequential circuits: different types of latches, flip-flips and their design using ASM approach, timing analysis and power optimization of sequential circuits.
Modular sequential logic circuit design: shift registers, counters and their applications.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Explain binary, octal, hexadecimal, BCD number systems
CO 2	Reproduce logic expressions using binary Boolean algebra
CO 3	Generate the prime implicates of logic functions of 5 or fewer variables using graphical (Karnaugh map) method, and to obtain their minimal two-level implementations with and without don't cares.
CO 4	Analyze combinational circuits

CO 5	Use basic functional & timing (COcking) properties of latches & flip-flops.
CO 6	Manipulate synchronous sequential circuits to extract next state/output functions
CO 7	Translate a word statement specifying the desired behavior of a simple sequential system into a finite state machine (FSM), to simplify and build the architecture that consists of state register and next state/output logic
CO 8	Apply simple digital systems using controller and basic data path components such as registers, memories, counters, multiplexers, ALUs, etc.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**								
CO 3	**X**								
CO 4	**X**								
CO 5	**X**								
CO 6	**X**								
CO 7	**X**								
CO 8	**X**								

Recommended Books

1. Digital Logic Design by Morris Mano
2. Digital Systems by Ronald Tocci, Neal Widmer, Greg Moss
3. Digital Principles and Applications by Donald P Lech, Albert Paul Malvino and Goutam Saha

Course Title: Digital Electronics Lab	Year/Semester: 3/1	Course Status: Lab (Compulsory, Major)
Course Code: EEE 324	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: EEE 222 (Electronics I Lab)		

Rationale

The main aim of this course is to provide practical knowledge of the principles and practices of digital systems, both at the device and circuit level. The course covers practical experiments of the topics of digital electronics including: Number Theory, Boolean Algebra, Logic Circuits, Logic Minimization Techniques, Multiplexers, Adders, Flip-Flops, Counters, Registers, State Machines, Memory Circuits, Digital / Analog Conversion, Programmable Logic Circuits and Microcomputer Bus Architecture. Upon completion, students should be able to construct, analyze, verify, and troubleshoot digital circuits using appropriate techniques and test equipment.

Course Objectives are:

- Help students to conceptualize the fundamental principles in design and implementation of digital logic circuits including combinational circuits, sequential circuits, and finite state machines.
- To develop skills to perform decimal, octal, hexadecimal, and binary conversions.
- To provide the knowledge to apply Boolean algebra to solve logic functions.
- Accumulate the basics for multiplexing digital circuits.
- Acquaint the students with logic switching circuits and pulse circuits.
- Apply the knowledge of mapping memory storage devices.
- To acquaint students with the basic tools to plan and execute projects in digital circuits.

- To enhance the skills of logic design with Programmable Logic Devices.

Course Contents:
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE-323. In the second part, students will design simple systems using the principles learned in EEE 323.

1. To construct and study the following logic gates: AND, OR, NOT. NAND, NOR, EXOR
2. Verify the DE Morgan's Law.
3. To verify different kind of applications of Boolean algebra.
4. To construct an AND gate by diode resistors and observe its characteristics.
5. To verify the characteristics of Exclusive OR and Exclusive NOR using basic logic gate.
6. Verification of De-Morgan's Theorem for 2 input Variable.
7. To simplify the given Boolean function by using K-map and implement it with logic Diagram.
8. ABCD to 7 Segment Decoder
9. Study of 4-bit BCD adder.
10. Study of Asynchronous & Synchronous R-S Flip-Flop.
11. Study of J-K Flip-Flop.
12. Study of 4-bit binary Ripple Counter.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Understand and analyze combinational circuits
CO 2	Generate the prime implicates of logic functions of 5 or fewer variables using graphical (Karnaugh map) method efficiency, and to obtain their minimal two-level implementations with and without don't cares.
CO 3	Manipulate logic expressions using binary Boolean algebra
CO 4	Use basic functional & timing (Clocking) properties of latches & flip-flops.
CO 5	Analyze synchronous sequential circuits to extract next state/output functions
CO 6	Translate a word statement specifying the desired behavior of a simple sequential system into a finite state machine (FSM), to simplify and build the architecture that consists of state register and next state/output logic
CO 7	Demonstrate team-based communication skills, magnify their moral standards and apply these in practical life
CO 8	Designing simple digital systems using controller and basic data path components such as registers, memories, counters, multiplexers, ALUs, etc.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1		**X**	**X**	**X**	**X**				
CO 2		**X**	**X**	**X**	**X**				
CO 3		**X**	**X**	**X**					
CO 4		**X**	**X**	**X**	**X**				
CO 5		**X**	**X**	**X**	**X**				
CO 6		**X**			**X**				
CO 7						**X**	**X**	**X**	**X**
CO 8		**X**	**X**	**X**					

Recommended Books

1. Digital Logic Design by Morris Mano
2. Digital Systems by Ronald Tocci, Neal Widmer, Greg Moss
3. Digital Principles and Applications by Donald P Lech, Albert Paul Malvino and Goutam Saha

Course Title: Power System I	Year/Semester: 3/1	Course Status: Theory (Compulsory, Major)
Course Code: EEE 325	Credit: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite: Pre-requisite: EEE 223 (Energy Conversion I), EEE 233 (Energy Conversion II),		

Rationale:
Modern power systems have grown larger with many interconnections between neighboring power systems. This course will provide strong foundation in classical methods and modern techniques in power systems for senior level electrical engineering students.

Course objectives are:
- Acquaint students with basics of major types of components used in electrical power systems.
- To facilitate necessary knowledge to analyze different types of short-circuit faults.
- Get the basic ideas to calculate the steady-state power flow in a power system.
- Enhancing the skills to calculate the power system dynamics and its stability.
- Foster the analytical and critical knowledge to determine the economic dispatch in a power system.
- To provide knowledge of power system control.
- To provide knowledge of smart grid structure and operation.

Course Contents:
Representation of an Electric Network: One Line Diagram, Impedance and Reactance Diagrams.
Per Unit System: Basic idea about Per- unit system, Per-unit impedances in single phase Transformer circuits, Per-unit impedances in three phase Transformer circuits, Advantages of Per-unit computation**.**
Line Representation: Equivalent circuit of short, medium and Long lines. Interpretation of equations of long transmission line, Surge impedance loading, Hyperbolic form of the equation of long transmission line, Ferranti effect.
Load Flow Analysis: Bus Admittance matrix, Power flow equation, bus classification, Gauss Seidel Power flow solution, Line Flows and Losses, Newton-Raphson Method.
Control of power flow: Prime mover and excitation control of generators, Control of tap-changing transformers, phase shifting, booster and regulating transformer, Switching of shunt capacitor banks, Power factor correction/ Improvement.
Fault Analysis: Short circuit current and reactance (transient, sub transient and synchronous) of a synchronous machine, Internal voltages of loaded machine under transient conditions, Short Circuit Capacity (SCC).
Symmetrical Components: Positive, negative and zero sequence components, Three-phase complex power in terms of symmetrical components, Sequence impedance, Determination of sequence impedance matrix, Drawing positive, negative and zero sequence networks.
Unsymmetrical Faults: Single Line to Ground fault (L-G), Line to Line fault (L-L), Line to Line to Ground fault (L-L-G), Line to Ground Fault(L-G) through and impedance at the terminal of an unloaded generator, Line to Line(L-L) fault through and impedance at the terminal of an

unloaded generator, Double Line to ground (L-L-G) fault through an impedance at the terminal of an unloaded generator.
Protection: Introduction to relays, differential protection and distance protection, introduction to circuit breakers.
Typical layout of a substation: Variable Load on Power Station: Structure of Electric Power System, Variable Load on Power System, Load Curves, Important Terms & Factors: Demand Factor, Diversity Factor, Load Factor, Capacity factor, Plant Factor, Units Generated per annum, Load Duration Curves, Types of load. Unit Commitment and Optimization.

Course Learning Outcome:
After the successful completion of the course, the student will be able to-

CO 1	Understand power system networks and different types of faults occurred in power system.
CO 2	Identify faults, remove faults and predict them.
CO 3	Explain power plant parameters for operation and expansion.
CO 4	Apply methods to control real and reactive power flow.
CO 5	Analyzing symmetrical and unsymmetrical system faults.
CO 6	Design an efficient power system network.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	**X**								
CO 2	**X**	**X**							
CO 3	**X**								
CO 4	**X**	**X**							
CO 5	**X**	X							
CO 6	**X**	X							X

Recommended Books:
1. Power System Analysis by John J. Grainger, William D. Stevenson, Jr
2. Principle of Power System by V.K. Mehta
3. Power System Analysis by Hadi Sadat

Course Title: Power System I Lab	Year/Semester: 3/1		Course Status: Lab (Compulsory, Major)
Course Code: EEE 326	Credit: 1.5	Contact hours: 3 hours lab per week	
Pre-requisite: EEE 325			

Rationale:
Proper planning, operation and control of large power systems require advanced computer-based techniques. This lab course includes five experiments and two practice sessions to study various aspects of power systems. The course will train students with modern computer-based techniques for solving a wide range of power system problems, which includes load flow, balanced and unbalanced faults and transient stability analyses.

Course objectives are:
- Allow students to practically verify several basic concepts and procedures learned in power system modeling and analysis.
- To develop hands-on experience of how certain procedures of power system operation are carried out.
- Help students carry out system studies using state of the art power systems analysis software to assess system operation in steady state and under faulted conditions.

Course Contents:
1: To get familiar with Power World -17 Simulator
2: Computing Bus Admittance Matrix Y bus.
3: Investigate the reactive power compensation in power grid.
4: Jacobian matrix and power-flow solution by Newton–Raphson.
5: Symmetrical Fault Analysis.

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Identify faults, remove faults and predict them in the power system network
CO 2	Implement one line diagram power system networks.
CO 3	Calculate Bus Admittance and Impedance Matrix using laboratory apparatus
CO 4	Apply methods to control real and reactive power flow.
CO 5	Analyzing symmetrical and unsymmetrical system faults
CO 6	Develop the ability to work as a part of the team to achieve specified and measurable results while performing the experiments.
CO 7	Formulate the ability to communicate individual opinion effectively across the members of the team.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X	X		X					
CO 2	X	X		X					
CO 3	X	X	X	X					
CO 4	X	X	X	X					
CO 5	X	X	X	X					
CO 6			X	X	X	X	X	X	
CO 7						X	X	X	X

Recommended Books:
1. Power System Analysis by John J. Grainger, William D. Stevenson, Jr
2. Principle of Power System by V.K. Mehta
3. Power System Analysis by Hadi Sadat

Course Title: Electrical Properties of Materials	Year/Semester: 3/1	Course Status: Theory (Compulsory, Major)
Course Code: EEE 327	Credits: 3.0	Contact hours:3 hours lecture per week
Pre-requisite: EEE 121 (Electrical Circuits I), EEE 123 (Electrical Circuits II)		

Rationale

Creative engineering materials are continuously being developed, selected and used in all facets of industries, from consumer products to space exPOration. Purposefully designed materials provide the means for modern products and tools to be built. Materials design and behavior assessment is a function of mathematics, experimentation and a firm understanding of metallurgy and material science principles.

Course Objectives are:
- To provide the idea about classification and study of a solid material according to certain rules.
- To introduce basic quantum physics and use the ideas to create a simple understanding of how electrical conduction takes place in each crystalline solid.
- To help students learn about the origin of various properties of dielectric and insulating materials.
- To provide a basic understanding of the magnetic properties of materials, including reasoning and examples.
- To make students familiarize about modern materials those are being used in everyday science.

Course Contents:

Crystal structures: Types of crystals, lattice and basis, Bravais lattice and Miller indices.
Classical theory of electrical and thermal conduction: Scattering, mobility and resistivity, temperature dependence of metal resistivity, Matthiessen’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; Heisenberg’s uncertainty principle and quantum box.
Band theory of solids: Band theory from molecular orbital, Bloch theorem, Kronig-Penny model, effective mass, density-of-states.

Carrier statistics: Maxwell-Boltzmann and Fermi-Dirac distributions, Fermi energy.
Modern theory of metals: Determination of Fermi energy and average energy of electrons, classical and quantum mechanical calculation of specific heat.
Dielectric properties of materials: Dielectric constant, polarization- electronics, ionic and orientational; internal field, Clausius-Mossotti equation, spontaneous polarization, frequency dependence of dielectric constant, dielectric loss and piezoelectricity.
Magnetic properties of materials: Magnetic moment, magnetization and relative permittivity, different types of magnetic materials, origin of ferromagnetism and magnetic domains.
Introduction to superconductivity: Zero resistance and Meissner effect, Type I and Type II superconductors and critical current density.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Identify different kinds of crystal structures and different directions and planes in the structure.
CO 2	Understand certain modern properties of different materials like piezoelectricity, meta material property etc.
CO 3	Describe different terms of polarization and how it happens in dielectric materials.
CO 4	Develop the concept of quantum physics to analyze dynamics of particle like electron and photon.
CO 5	Derive and explain some classical models of electrical and thermal conduction and use these models to calculate and explain different properties of a material.
CO 6	Analyze the electrical, magnetic and optical properties of materials.
CO 7	Distinguish the structure of different types of materials.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**								
CO 3	**X**								
CO 4	**X**	**X**				**X**			
CO 5	**X**	X							
CO 6	**X**	X							
CO 7	**X**								

Recommended Books
1) Principles of Electronic Materials and Devices by Safa O. Kasap
2) Electronic Properties of Materials, by Rolf Hummel.

<table>
<tr><td colspan="2">Course Title: Continuous Signals and Linear System</td><td>Year/Semester: 3/1</td><td>Course Status: Theory (Compulsory, Major)</td></tr>
<tr><td>Course Code: EEE 329</td><td>Credit: 3.0</td><td colspan="2">Contact hours: 3 hours Lecture per week</td></tr>
<tr><td colspan="4">Prerequisite: EEE 121, EEE 131, MATH 105E</td></tr>
</table>

Rationale:

In order to prepare students for more advanced courses like Digital Signal Processing, Communication Theory, and Control System Engineering, this course is designed to introduce students to the fundamental ideas of signals and linear systems in the continuous time domain. The course is unique in that, like Electronics I and II for Electronics majors and Machine I and II for Power majors, it is the very foundational subject that supports in convincing one to pursue higher education in the field of communication and signal processing. For those who intend to work in the future in areas like artificial intelligence, audio, video, and image processing, understanding the course material is essential.

Course objectives are:

- To obtain knowledge of system classifications, definitions used to describe systems, and system characteristics.
- To gain knowledge of 1st order and 2nd order electrical circuits solving differential equations etc.
- To provide knowledge about Fourier series representation of periodic and Fourier transform of aperiodic signals and its use in analysis of continuous time signals and systems.
- To help students developing basics of Laplace Transform and its use in analysis of continuous time signal and systems.
- To assist students in learning the fundamentals of state space analysis and how to utilize it to analyze continuous time signals and systems.
- To apply the theoretical concepts in various problem solving like stability criteria determination and electrical circuit modeling,

Course Contents:

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

Course Learning Outcome:

After the successful completion of the course, the student will be able to-

CO 1	Define common signals and explain the basic operations of signals.
CO 2	Classify systems based on their properties, understand the properties as well as analysis and design implications for system interconnections in time domain.
CO 3	Calculate correlation, convolution, and orthogonality of signals.
CO 4	Analyze Fourier series, Fourier spectra, Effect of symmetry, Fourier Transform
CO 5	Interpret and illustrate Fourier transformed magnitude and phase spectra for aperiodic/periodic case.
CO 6	Determine Laplace transform; interpret & POt magnitude and phase spectra.
CO 7	Apply Laplace transform for solution of different problems.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**			**X**		**X**			
CO 3	**X**								
CO 4	**X**								
CO 5	**X**			**X**					
CO 6	**X**			**X**					
CO 7	**X**								

Recommended Books:

1. Signals & Linear Systems-B.P. Lathi
2. Continuous and Discrete Signals and Systems-Samir S. Soliman and Mandyam D. Srinath.
3. Linear Signals and Systems- D K Cheng

Third Year Second Semester

Course Title: Digital Signal Processing I		Year/Semester: 3/2	Course Status: Theory (Major, compulsory)
Course Code: EEE 331	Credit: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: EEE 329 (Signals and Linear systems)			

Rationale

The interesting and quickly developing topic of digital signal processing is introduced in this course. After successfully completing the course, it is anticipated that students will have acquired the skills necessary to comprehend and apply the fundamentals of digital signal processing. The learner gains a strong skill foundation for their future emPOyment when they can recognize a system and a signal for what they are: information in motion.

Course Objectives are:

- To assist students in acquiring the skills necessary to convert signals from analog to digital and vice versa.
- Make sure the students comprehend the various properties of signals in the time and frequency domain, as well as discrete time systems.
- Apply the understanding of the z-transform to the study of discrete temporal signals and systems.
- To build skills to conduct Fourier transform in the analysis of discrete time signals and systems.
- To facilitate necessary information about the construction, use, and design of significant discrete time systems and filters.

Course Contents:

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

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Describe the fundamental categories of discrete-time signals and systems, convolution sum, impulse response, frequency response, and difference equation realization of LTI systems for linear, time-invariant (LTI) systems.
CO 2	Describe periodic sampling of analog signals and the relation between Fourier transforms of the sampled analog signal and the resulting discrete-time signal.
CO 3	Convert A/D and D/A signal and analyze characteristics
CO 4	Evaluate difference equations by applying transformation.
CO 5	Understand behavior by analyzing signal and system models.
CO 6	Construct signal flow graph and block diagram representations of difference equations that realize digital filters: (i) Learns direct forms 1 and 2 for IIR filter realization. (ii) Learns direct form for FIR filter realization.

CO 7	Formulate basic digital filter design methods: (i) Learns analog Butterworth and Chebyshev filters transformed to yield digital IIR filters, (ii) impulse-invariance and bilinear transformation methods for IIR filter design and (iii) FIR filter design methods based on windowing.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X								
CO 3	X								
CO 4	X								
CO 5	X								
CO 6	X	X		X					
CO 7	X	X		X					

Recommended Books

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

Course Title: Digital Signal Processing I Lab		Year/Semester: 3/2	Course Status: Theory (Major, compulsory)
Course Code: EEE 332	Credit: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: EEE 329 (Signals and Linear systems)			

Rationale

The course will be taught in a practical way. After successfully completing the course, it is anticipated that students would have gained the competence to code and comprehend complex digital signal processing algorithms. A thorough comprehension of the algorithms is reinforced by being able to code well-known digital signal processing techniques. This course is intended to be taken in addition to EEE 331, a theoretical course.

Course Objectives are:

- Foster the analytical and critical skills to implement Digital Signal Processing algorithms in MATLAB.
- To develop skills for applying problem-solving skills in Digital Signal Processing through an emphasis on practical usage.
- To assist students to increase understanding of the theory of IIR and FIR filters through coding and implementation algorithms in MATLAB.

Course Contents:

1. Study of Sampling Quantization and Encoding
2. Time Domain Analysis of DT Signals and Systems
3. Z-Transform and Analysis
4. Frequency Domain Analysis of DT Signal and Systems
5. Digital Filter Design

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	ExPOre several time domain operations and analysis of discrete time signals.
CO 2	Implement sampling, quantization and encoding
CO 3	Compare several time domain behaviors of discrete time signals in Z-domain.

CO 4	Analyze fundamental concepts of DTFT, DTFS and DFT and ExPOre the problem of aliasing
CO 5	Develop the quality of teamwork and effective communication skills.
CO 6	Design digital filters from specification through coefficient calculation and apply the knowledge in practical applications.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2	X								
CO 3	X								
CO 4	X								
CO 5					X				
CO 6	X	X	X			X			

Recommended Books

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

Course Title: Control System I	Year/Semester: 3/2	Course Status: Theory (Major, compulsory)
Course Code: EEE 333	Credit: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 329 (Signals and Linear systems)		

Rationale

"Control System Engineering" is concerned with modelling and manipulating physical systems so that they behave in a desired way. Desired behaviors are articulated by specification. This course will introduce the students to the formalisms, tools, and methodologies that form the foundations control systems engineering. At the completion of this course, they will have developed an understanding of the scope and application of control systems engineering, they will have enhanced their modelling and analysis skills, and they will have developed skills in control system design. Students from previous years often comment that the broad nature of this course expands their intellectual horizons.

Course Objectives are:

- To assist students in building systems models of mechanical, electrical, and electromechanical systems.
- To facilitate necessary knowledge to analyze the transient and steady state performance of these systems.
- To provide basic knowledge to use the principle of feedback to alter this performance to achieve a desired behavior specification.

Course Contents:

Introduction to control systems. Linear system models: transfer function, block diagram and signal flow graph (SFG).
State variables: SFG to state variables, transfer function to state variable and state variable to transfer function.
Feedback control system: Closed loop systems, parameter sensitivity, transient characteristics of control systems, effect of additional pole and zero on the system response and system types and steady. Root stability criterion.
Analysis of feedback control system: Root locus method and frequency response method.

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

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Understand system models
CO 2	Apply frequency response design technique and interpreting bode POt.
CO 3	Illustrate the root locus of transfer functions to design practical systems.
CO 4	Analyze system models to understand their behavior
CO 5	Design and Implement Feedback Control Loops
CO 6	Formulate a control system with required specification

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2	X								
CO 3	X								
CO 4	X								
CO 5	X								
CO 6	X				X			X	

Recommended Books

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

Course Title: Control System I Lab	Year/Semester: 3/2	Course Status: Lab (Major, compulsory)
Course Code: EEE 334	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: EEE 329 (Signals and Linear Systems)		

Rationale

EEE students need to have a broad idea in modelling and manipulating physical systems so that they behave in a desired way. At the completion of this course the students will have developed an understanding of the scope and application of control systems engineering, they will have enhanced their modelling and analysis skills, and they will have developed skills in control system design. The theoretical knowledge is incomplete without hands on experiments using the basic components and measuring devices used in Control engineering. This course is designed to complement the theoretical course EEE 333.

Course Objectives are

- To assist students in building systems models of mechanical, electrical, and electromechanical systems.
- To facilitate necessary knowledge to analyze the transient and steady state performance of these systems.

- To provide basic knowledge to use the principle of feedback to alter this performance to achieve a desired behavior specification.

Course Contents:

1. Generating State Space Representation from a Transfer Function and vice versa via Simulation
2. Time Performance Analysis of Systems by evaluating the Effect of Pole Location upon the Time Response of 1st & 2nd -order systems.
3. Implementation of Block Diagram Reduction
4. Stability Analysis
5. Analysis of Steady-State Performance for Step and Ramp Inputs.
6. Designing the Gain of a Controller via Root Locus.
7. Understanding phase and gain margin by Bode POt.
8. Designing a PID Controller

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Explain the equivalency of the basic forms and basic moves and the effect of pole location upon stability
CO 2	Explore the root locus technique as a tool for estimating the effect of open-loop gain upon the transient response of Closed-loop systems.
CO 3	Design a PID controller using MATLAB's SISO Design Tool to observe the effect of a PI and a PD controller on the magnitude and phase responses at each step of the design of a PID controller
CO 4	Estimate symbolic transfer functions from the state-space representation and state space representations from the equations of motion.
CO 5	Evaluate the effect of pole and zero location upon the time response of first- and second-order systems
CO 6	Devise the quality of teamwork and effective communication skills.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1		X		**X**					
CO 2		**X**		**X**	**X**				
CO 3		**X**	**X**	**X**	**X**				
CO 4		**X**		**X**					
CO 5		X		**X**					
CO 6						**X**	**X**	**X**	**X**

Recommended Books

1. A Course in Electrical and Electronic Measurement by A.K. Shawney
2. Modern Control Engineering by Katsuhiko Ogata
3. Modern Control Systems by Richard C. Dorf

Course Title: Measurement and Instrumentation	Year/Semester: 3/2	Course Status: Theory (Major, compulsory)
Course Code: EEE 333	Credit: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 121 (Electrical Circuit I), EEE 131 (Electrical Circuit II)		

Rationale

Engineers have to deal with measurement in every aspect of life. This course enables the students to know how to measure various components related to EEE, compensate error and noise, how to transform various signals by transducers, record and transmit/receive that data by telemetry.

Course Objectives are:

- To assist students in familiarizing with the elements of measuring systems related to EEE.
- To facilitate necessary knowledge to work with various transducers.
- To provide basic knowledge to compensate noise and error in measuring devices.
- To understand data transmission and telemetry.

Course Contents:

Introduction: Applications, functional elements of a measurement system and classification of instruments. **Measurement of electrical quantities:** Current and voltage, power and energy measurement. Current and potential transformer. **Transducers:** mechanical, electrical and optical. **Measurement of non-electrical quantities:** Temperature, pressure, flow, level, strain, force and torque. **Basic elements of DC and AC signal conditioning:** Instrumentation amplifier, noise and source of noise, noise elimination compensation, function generation and linearization, A/D and D/A converters, sample and hold circuits. **Data Transmission and Telemetry:** Methods of data transmission, DC/AC telemetry system and digital data transmission. Recording and display devices. Data acquisition system and microprocessor applications in instrumentation.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	To assist students in familiarizing with the elements of measuring systems related to EEE
CO 2	To facilitate necessary knowledge to work with various transducers
CO 3	To provide basic knowledge to compensate noise and error in measuring devices
CO 4	To understand data transmission and telemetry

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X				X				
CO 2	X				X				

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 3	X				X				
CO 4	X				X				

Recommended Books

1. A course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney
2. Principles of Measurement Systems by John P. Bantley
3. Principles of Electrical Measurements by S Tumanski
4. Digital Systems by Ronald J. Tocci
5. Operational Amplifiers and Linear Integrated circuits by Robert F. Coughlin

Course Title: Measurement and Instrumentation Lab	Year/Semester: 3/2	Course Status: Lab (Major, compulsory)
Course Code: EEE 336	Credits: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: EEE 121 (Electrical Circuit I), EEE 131 (Electrical Circuit II)		

Rationale

EEE 335 requires practical hands-on laboratory work. In this course, student will be able to understand the theory part of EEE 335 practically.

Course Objectives are

- To assist students to do lab-based work related to EEE 335
- To do a team project by preparing any simple measuring device related to EEE under the course teacher's supervision.

Course Contents:

1. Familiarize with current and potential transformers.
2. Understand analog to digital transformation and vice versa by ADC/DAC.
3. Observe the working principles of various transducers.
4. Team project to prepare a simple measuring device related to EEE.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Understand the working principle of CT and PT
CO 2	Understand the analog-digital conversion by ADC/DAC
CO 3	Understand the principles of transducers
CO 4	Work in a team to complete a particular task

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1		X							
CO 2		X							
CO 3		X							
CO 4						X	X	X	X

Recommended Books

1. A course in Electrical and Electronic Measurements and Instrumentation by A.K. Sawhney
2. Principles of Measurement Systems by John P. Bantley
3. Principles of Electrical Measurements by S Tumanski
4. Digital Systems by Ronald J. Tocci
5. Operational Amplifiers and Linear Integrated circuits by Robert F. Coughlin

Course Title: Power System II	Year/Semester: 3/2	Course Status: Theory (Compulsory, Major)
Course Code: EEE 337	Credit: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 325 (Power System I)		

Rationale:
Modern power systems have grown larger with many interconnections between neighboring power systems. Proper planning, operation and control of such large power systems require advanced computer-based techniques. This course will provide a strong foundation in classical methods and modern techniques in power systems for senior level electrical engineering students. Course content includes the concepts of Series Impedance of Transmission Lines, Capacitance of Transmission Lines, Underground Cables, Mechanical Design of Overhead Line, Stability, Compensation in Power System and High Voltage DC Transmission System.

Course Objectives are

- To provide students with a good understanding to formulate and solve the mathematical models describing steady-state physical behavior of transmission and distribution lines.
- To assist students to understand and describe operational concepts such as: flow of active & reactive power, voltage profile, steady-state stability, power flow limits & line load ability, voltage regulation, Surge Impedance Loading.
- To facilitate necessary knowledge to analyze line compensation techniques as applied in reactive power – voltage control and active power flow control.
- To make students familiarize with the stability problem in power systems, rotor dynamics and swing equation.
- To provide the basic concepts related to the power quality of transmission system.

Course Contents:
Series Impedance of Transmission Lines: Resistance, Inductance, Inductance of a Conductor due to Internal Flux, Flux Linkage Between two points external to an isolated conductor, Inductance of a single-phase two-wire line, Flux linkages of one conductor in a group,

Inductance of Composite-Conductor lines, Inductance of three-phase lines with equilateral spacing, Inductance of three-phase lines with unsymmetrical spacing, Bundled Conductors.
Capacitance of Transmission Lines: Electric field of a long straight conductor, The potential difference between two points due to a charge, Capacitance of a two-wire line, Capacitance of a three-phase line with equilateral spacing, Capacitance of a three-phase line with unsymmetrical spacing, Effect of earth on the capacitance of three-phase transmission line, Bundled Conductors.
Underground Cables: Construction of cables, Insulating material of cables, Classification of cables, Cables for three-phase service, laying of cables, Insulating resistance of a single-core cable, Capacitance of a single core cable, Dielectric stress of single core cable, Grading of cable, Capacitance grading, Inter-sheath grading, Capacitance of 3-core cable,
Measurement of C_e and C_c, Current carrying capacity of cable, Thermal resistance, Permissible current loading, Types of cable fault.
Mechanical Design of Overhead Line: Main components of overhead line, Conductor Material, Line Support, Insulators, Types of Insulators, Potential Distribution over Suspension insulator String, String efficiency, Method of improving string efficiency, Corona, Sag in overhead Line, Calculation of Sag,
Stability: Swing equation, Synchronous machine models for stability studies, Steady –State Stability, Transient-Stability- Equal area criterion, Application to sudden increase in power input, Application to three-phase fault, Numerical solution of Swing equation, Multi machine system, Multi machine transient stability, Factors affecting stability.
Compensation in Power System: load compensation, line compensation, series compensation, shunt compensators, flexible ac transmission systems (facts), facts controllers.
Flexible AC Transmission Systems (FACTs): FACTs devices and Application.
High Voltage DC Transmission System: Comparison of DC and AC system, Application of DC Transmission System, Types of HVDC system, HVDC system configuration and components, Control of HVDC system, Response to DC and AC system faults.
Power Quality: Electromagnetic phenomena and power quality; temporary phenomena (transient, long duration voltage variations, sustained interruptions, short duration voltage variations), Interruption, Voltage sags and swells, harmonics. steady state phenomena; voltage imbalance, waveform distortion, voltage fluctuation and flicker, power frequency variations.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Explain in detail and critically evaluate technologies and information systems for operational management of conventional and modern electric power systems.
CO 2	Recognize the need to continuously follow the advancements in technology and incorporating them in the present system to improve efficiency.
CO 3	Choose the appropriate type of power generating station following norms and guidelines related to cost, environment, societal and ethical issues. Also review the different tariff systems available and determine the one most appropriate for a given scenario to optimize the revenue earned.
CO 4	Analyze the stability of a power transmission system by measuring appropriate parameters.
CO 5	Implement the knowledge of basic mathematical, physical and electrical principles to formulate significant electrical hazards.
CO 6	Evaluate the suitability of installing overhead and underground power transmission strategies considering electrical, mechanical, environmental, performance, safety and economic constraints.
CO 7	Formulate the mathematical models Using the effect of inductance and capacitance for interconnected electrical power networks.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	**X**	X									
LO 2	**X**	X									X
CO 3	**X**	X			X					X	X

CO 4	**X**	X									
CO 5	**X**	X									
CO 6	**X**	X			X						X
CO 7	**X**	X									

Recommended Books

1. Power System Analysis by John J. Grainger, William D. Stevenson, Jr
2. Principle of Power System by V.K. Mehta
3. Power System Analysis by Hadi Sadat

Course No.: IPE 301E	Course Status: Theory (Compulsory, Major)	Year/Semester: 3/2	**Credit: 3.00**
Course Title: Management for Engineers		Contact hours: 3 hours Lecture per week	

Rationale of the Course:

The purpose of this course is to provide an understanding of the theories and principles of industrial management and encourage the course participants to make an appreciation of these principles in relation to their own experiences and selected managerial case studies.

Course Objectives:

- provide knowledge about basic principles of management, and the five major functions of managers e.g., planning, organizing, staffing, leading and controlling and challenges managers face in each stage
- Make students think critically and strategically about management theories and issues which will enable them to develop their decision-making and analytical skills
- Familiarize students with the employment function as well as wage and incentive scheme
- Let the students understand about different marketing issues and fundamental of technology management.

Course Content:

Industrial Management: Definition, functions, managerial skills, levels of management, organization (formal and informal), *Operations & Quality Management*, Statistical Process Control, *Management Accounting*- Financial Accounting, budgeting.
Marketing Management: Introduction, marketing environment, marketing mix, market segmentation, positioning and targeting, product and product life cycle, advertising.
Material Management: Introduction, overview of material flow, *Management of Independent Demand*- The concept of inventory and its management (EOQ, P system and Q system).

Course Learning Outcomes, CO

By the end of this course the students will be able to

CLO 1. understand the theories and principles of management and able to design an organogram

CLO 2. describe contemporary theories of motivation and discuss the challenges managers face in motivating distinctive group of people

CLO 3. know about leadership and implement its ideas in organizations/industries

CLO 4. know about different task of personnel management such as recruitment, selection, wages and incentives

CLO 5. identify what marketing strategies organizations might practice to attract and retain customer

CLO 6. understand the concepts and techniques of strategic management of technology.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X						X		
CO 3	X								X
CO 4	X								X
CO 5	X								
CO 6	X						X		

Books Recommended:

1. Management-A Global Perspective, Heinz Weihrich and Harold Koontz, McGRAW HILL International Edition.
2. Industrial Engineering and Management -A New Perspective, Philip E. Hicks, McGRAW -HILL International Editions.
3. Industrial Engineering and Management, O.P. Khanna and A. Sarup, Dhanpat Rai Publication Ltd.

Course Title: Viva	Year/Semester: 3/2	Course Status: Lab (Compulsory, Major)
Course Code: EEE 399	Credits: 1.0	Contact hours: 1 hour lecture per week
Pre-requisite: All Previous Courses		

Rationale
This course endeavors to build a comprehensive idea on all the previously taken courses.

Course Objectives

- To get the general idea on basic concepts.
- To familiarize with viva voce.
- To increase communicative skills.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	To get the general idea on basic concepts.
CO 2	To familiarize with viva voce.
CO 3	To increase communicative skills.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								X

CO 2	X			X					X
CO 3	X								X

Fourth Year First Semester

Course Title: Solid State Devices	Year/Semester: 4/1	Course Status: Theory (Major, Compulsory)
Course Code: EEE 421	Credits: 3.0	Contact hours: 3 hours Lecture per Week
Pre-requisite: EEE 221 (Electronics I)		

Rationale:
This course is the next stage of learning about electronic devices and electrical materials that had been taught previously in Electronics I and Electrical Properties of Materials i.e. using the said material properties in our favor by creating the said electronic devices. The lectures start from basic ideas about material properties and goes onto using them in the electronic devices that we use daily, i.e. Diodes, transistors. These are the devices that we use today on regular basis and learning about their internal mechanism from a microscopic point of view should be quiet fun! This course is the steppingstone on pursuing higher learning in fields of device and material synthesis and will act as prerequisite for courses like Compound Semiconductor and Hetero-junction Devices, Optoelectronics, and Semiconductor Device Theory.

Course Objectives are
- To provide the basic concepts of semiconductor fundamentals and drift diffusion model for charge carriers in semiconductors,
- To provide the knowledge for the analysis of basic functions of nonlinear devices like p-n junctions, BJTs, MOSFETs and JFETs.
- To develop ability to facilitate necessary knowledge to analyze the basic device parameters, associated with device geometry, doping profile and applied voltages for SPICE simulation.
- To help in developing the skills to apply the knowledge of device parameters to improve device/circuit performance.

Course Contents:
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.
Carrier transport processes and excess carriers: Drift and diffusion, generation and recombination of excess carriers, built-in-field, Einstein relations, continuity and diffusion equations for holes and electrons and quasi-Fermi level.
PN junction: Basic structure, equilibrium conditions, contact potential, equilibrium Fermi level, space charge, non-equilibrium condition, forward and reverse bias, carrier injection, minority and majority carrier currents, transient and AC conditions, time variation of stored charge, reverse recovery transient and capacitance.
Bipolar Junction Transistor: Basic principle of pnp and npn transistors, emitter efficiency, base transport factor and current gain, diffusion equation in the base, terminal currents, coupled-diode model and charge control analysis, Ebers-Moll equations and circuit synthesis.
Metal-semiconductor junction: Energy band diagram of metal semiconductor junctions, rectifying and ohmic contacts.
MOS structure: MOS capacitor, energy band diagrams and flat band voltage, threshold voltage and control of threshold voltage, static C-V characteristics, qualitative theory of MOSFET operation, body effect and current-voltage relationship of a MOSFET.
Junction Field-Effect-Transistor: Introduction, qualitative theory of operation, pinch-off voltage and current-voltage relationship.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Explain the basic physics of semiconductor electronic devices. The importance of electrons and holes in semiconductors, the charge density and distribution, the charge transport mechanisms.
CO 2	Describe the internal workings of the most basic solid-state electronic devices.
CO 3	Explain the physics of a p-n junction and semiconductor-metal junctions.
CO 4	Apply device models To facilitate necessary knowledge to analyze basic functions of p-n junction and other diode devices and calculate, analyze and modify device parameters by changing device physical characteristics to change device/circuit performance.
CO 5	Apply device models To facilitate necessary knowledge to analyze basic functions of BJT, MOS and JFET devices and calculate, analyze and modify device parameters by changing device physical characteristics to change device/circuit performance.
CO 6	Pursue an engineering approach to develop devices that are sustainable and economically feasible.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**	**X**							
CO 2	**X**	**X**							
CO 3	**X**	**X**							
CO 4				**X**	**X**				
CO 5				**X**	**X**				
CO 6						**X**			**X**

Recommended Books
1. Semiconductor Physics and Devices Basic Principles by Donald A. Neamen
2. Solid State Electronics Devices (6th Edition) by Ben Streetman and Sanjay Banerjee

Course Title: Microprocessor and Interfacing		Year/Semester: 3/2	Course Status: Theory (Major, compulsory)
Course Code: EEE 423	Credit: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: EEE 503 (Digital Electronics)			

Rationale:
We live in the new era of "Smart Machines." Think about self-driving cars, phones, washing machines or any device with built-in intelligence - what governs this intelligence? Microprocessors! Today, the use of a processor is limited only by the engineer's imagination. The purpose of this course is to teach students the fundamentals of microprocessor and microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a microprocessor/controller implementation.

Course objectives are:
- To help students to understand the main components and working principals of the Intel 80x86 microprocessor.
- To develop skills to program and debug in assembly language.
- To provide basic knowledge to understand the memory organization and memory interfacing.
- To develop skills to interface a microprocessor to external input/output devices and perform input/output device programming in assembly.
- Help students conceptualize the hardware and software interrupts and their applications.
- Make the students to understand the properties and interfacing of the parallel and serial port.
- Apply the knowledge to design and program software for programmable peripheral devices.

- To familiarize students with the future trends in microprocessors and microcontrollers.

Course Contents:
Introduction to microprocessors, microprocessor evolution and type, introduction to Intel microprocessor family, Intel 8086 microprocessor: Architecture, bus timing, addressing modes, instruction sets, assembly language programming. Memory organization, interrupts, interrupt types, interrupt vector table. Interfacing: programmable peripheral interface, programmable timer, serial communication interface, programmable interrupt controller, direct memory access controller, keyboard and display interface. Serial and parallel communication types, serial I/O communication (Synchronous & Asynchronous) Introduction to micro-controllers.

Course Learning Outcome:
After the successful completion of the course, the student will be able to-

CO 1	Understand the internal workings of an Intel 8086 microprocessor.
CO 2	Describe microcontroller working principles.
CO 3	Explain how serial and parallel communication work.
CO 4	Discuss how a computer system is interfaced with peripheral input/output devices.
CO 5	Interpret how computer systems are designed.
CO 6	Demonstrate how memory is organized in systems and synchronized with systems.
CO 7	Apply assembly language to write different programs.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**								
CO 3	**X**								
CO 4	**X**	**X**							
CO 5	**X**								
CO 6	**X**								**X**
CO7	**X**	**X**				**X**	**X**		

Recommended Books:
1. Microprocessors and Interfacing: Programming and Hardware by Douglas V. Hall.
2. Microprocessors, PC hardware and Interfacing by N. Mathivanan.
3. Assembly Language Programming and Organization of the IBM PC by Ytha Yu and Charles Marut.

Course Title: Microprocessor and Interfacing Lab	Year/Semester: 3/2	Course Status: Lab (Major, compulsory)
Course Code: EEE 424	Credit: 1.5	Contact hours: 3 hours lab per week
Pre-requisite: EEE 324 (Digital Electronics Lab)		

Rationale:
We live in the new era of "Smart Machines." Think about self-driving cars, phones, washing machines or any device with built-in intelligence - what governs this intelligence? Microprocessors! Today, the use of a processor is limited only by the engineer's imagination. The purpose of this course is to teach students the fundamentals of microprocessor and microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a microprocessor/controller implementation. The theoretical knowledge is incomplete without hands on experiments using the 8086 module and microprocessor/microcontroller-based project work. This course is designed to complement the theoretical course EEE 333.

Course objectives are:

- To help students to understand the main components and working principals of the Intel 80x86 microprocessor.
- To develop skills to program and debug in assembly language.
- To provide basic knowledge to understand the memory organization and memory interfacing.
- To help students debug and understand how every instruction in 8086 works.
- To provide basic knowledge to interface 8086 kits with computer and program using more advance assembler.

Course Contents:
1. Familiarization with MDA-8086 microprocessor kit and its operation in "Machine Code" mode using arithmetic instructions.
2. Logic operation in 'Machine Code' mode and verification.
3. Control operation in 'Machine Code' mode and verification.
4. Study on the programming of 8255 PIO controller by utilizing the 7-segment display and the LEDs in the MDA-8086 module.
5. Study on the programming of 8255 PIO controller by utilizing the 8x8 LED ARRAY or DOT MATRIX ARRAY.
6. Study on interface between PC and MDA-8086 using serial monitor and performing advance assembly programming using PC.
7. Design microprocessor-based systems.

Course Learning Outcome:
After the successful completion of the course, the student will be able to-

CO 1	Identify different assembly language instructions.
CO 2	Understand 8086 microprocessor's working principle.
CO 3	Interpret different registers and pointer values.
CO 4	Demonstrate the instructions executed and their affect on Flag register.
CO 5	Program different output devices.
CO 6	Design small microprocessor systems.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X	X							
CO 2	X	X	X						
CO 3	X	X	X	X					
CO 4	X	X	X	X					
CO 5	X	X	X	X					X
CO 6	X	X	X	X	X				X

Recommended Books:
1. Microprocessors and Interfacing: Programming and Hardware by Douglas V. Hall.
2. Microprocessors, PC hardware and Interfacing by N. Mathivanan.
3. Assembly Language Programming and Organization of the IBM PC by Ytha Yu and Charles Marut.

Fourth Year Second Semester

Course Title: Electrical Service Design	Year/Semester: 2/2		Course Status: Lab (Compulsory, Major)
Course Code: EEE 432	Credits: 1.5	Contact hours: 3 hours of Lab per Week	
Pre-requisite: EEE 121 (Electrical Circuits I), EEE 123 (Electrical Circuits II)			

Rationale:

This course gives students basic knowledge about practical implementation of system design. Electrical services are a vital component in any building, so it is necessary for engineers to understand the basic principle of services design. This Course content includes the concepts of wiring system design, various lighting schemes, design of substation layout of equipment and design of security systems. This course will help them to trouble shoot a design problem on a single/multi-storied building/structure.

Course Objectives are

- To develop an understanding of the most common types of wiring design requirements.
- To train electrical/electronic engineers and equip them with appropriate knowledge and skills required for the lighting design, power supply design and their installations.
- To make the student suitable for starting out a career in electrical services design and installation within consultancy, contracting, and in-company design engineers.
- Provide students with opportunities to be conversant to the electrical/electronic codes and safeties regulating electrical/electronic activities locally and internationally.

Course Contents:

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

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Implement theoretical knowledge on practical wiring design of household electrical equipment.
CO 2	Understand the basic concept of lighting design, power supply distribution design and installations in order to design an energy efficient and sustainable building.
CO 3	Interpret various components of the service design of the building that includes general and specialized loads, lighting systems and distribution systems and design the building according to the needs of the clients.
CO 4	Determine the professional scope of an electrical design project.
CO 5	Use AutoCAD to draw/generate electrical/electronic engineering drawings.
CO 6	Design substation layout of equipment and related installation of the equipment.
CO 7	Practice the ethical, economic, societal, technical and environmental standards and regulations that guide the electrical design process.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	**X**	**X**							
CO 2		**X**							
CO 3	**X**	**X**							
CO 4	**X**			**X**					
CO 5				**X**				**X**	**X**
CO 6				**X**					
CO 7								**X**	**X**

Recommended Books

1. Electrical Wiring Estimating and Costing by S.L. Uppal and G.C.Grag

Elective I

Course Title: Power Plant Engineering	Year/Semester: 4/1		Course Status: Theory (Major, optional)
Course Code: EEE 425	Credits: 3.0	Contact hours: 3 hours lecture per week	
Pre-requisite: EEE 337 (Power System II)			

Rationale

Power plant engineering is a subfield of electrical engineering that deals with the generation, transmission, distribution and utilization of electric power, and the electrical apparatus connected to such systems. This course deals with the generation part of power engineering.

Course Objectives are

- To familiarize with energy sources and current fossil fuel status of Bangladesh
- To help students develop necessary skills to analyze different types of steam, diesel and gas cycles and estimate efficiencies.
- To describe basic working principles of hydro-electric, gas turbine and diesel engine power plants.
- To explain the performance characteristics and components of such power plants.
- To help students develop necessary skills to evaluate cycle efficiency and performance of various nuclear power plant.
- To explain the terms and factors associated with power plant economics.
- To help students develop necessary skills to calculate present worth, depreciation and cost of different types of power plants.
- To help students develop necessary skills to estimate the cost of producing power per kW

Course Contents:

Power plants: general layout and principles, steam turbine, gas turbine, combined cycle gas turbine, hydro and nuclear power plant instrumentation.

Selection of location: Technical, economic and environmental factors, Load forecasting.

Generation scheduling: deterministic and probabilistic.

Electricity tariff: formulation and types.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Discuss the energy resources and energy conversion methods available to produce electric power in Bangladesh
CO 2	Identify the major types of diesel power plant and estimate power generation potential.
CO 3	Outline the basic principles of thermal-fission and fast-breeder nuclear power plants, such as pressurized-water, boiling-water, and heavy-water reactors.
CO 4	Calculate the performance of gas turbines with reheat and regeneration and discuss the performance of combined cycle power plants.
CO 5	Determine the efficiency and output of a modern Rankine cycle steam power plant from given data, including superheat, reheat, regeneration, and irreversibility
CO 6	Distinguish the major types of hydropower and wind-power turbines and estimate power generation potential.
CO 7	Interpret the electricity tariff system

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
CO 1	**X**										
CO 2	**X**										
CO 3	**X**										
CO 4	**X**										
CO 5				**X**	**X**						
CO 6				**X**	**X**						
CO 7		**X**									

Recommended Books

1. Power Plant Engineering by G.R. Nagpal
2. Principles of Power System by V.K. Mehta and Rohit Mehta
3. Power Station Engineering and Economy by Bernhardt G.A. Skrotzki, William A. Bhopat

Course Title: Processing and Fabrication Technology		Year/Semester: 4/1	Course Status: Theory (Major, Optional)
Course Code: EEE 427	Credit: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: EEE 221, EEE 222			

Rationale

The course covers process technologies that are used in micro- and nanofabrication of devices and systems on wafers. Applications include all technologies that are based on wafer scale fabrication such as integrated circuits, micro-electro-mechanical systems and optical devices. The basic unit processes deposition, patterning, etching, doping and heat treatment are covered, followed by process integration to build complex devices. Moore's law and the basic economics for integrated circuits are covered and exemplified by reviewing the state-of-the art process technology nodes. The course gives the student basic understanding of the sustainability aspects in integrated circuit fabrication.

Course Objectives are:

- To introduce technology and processes those are used in fabricating advanced electronic devices and circuits.

- To make students familiar with the unit process technology.
- Accumulate basic ideas about doping processes.
- Facilitate necessary knowledge about lithography.
- To provide the knowledge of integrated circuit packaging and testing.

Course Contents:

Substrate materials: Crystal growth and wafer preparation, epitaxial growth technique, molecular beam epitaxy, chemical vapor phase epitaxy and chemical vapor deposition (CVD).

Doping techniques: Diffusion and ion implantation. Growth and deposition of dielectric layers: Thermal oxidation, CVD, plasma CVD, sputtering and silicon-nitride growth.

Etching: Wet chemical etching, silicon and GaAs etching, anisotropic etching, selective etching, dry physical etching, ion beam etching, sputtering etching and reactive ion etching.

Cleaning: Surface cleaning, organic cleaning and RCA cleaning.

Lithography: Photo-reactive materials, pattern generation, pattern transfer and metallization.

Discrete device fabrication: Diode, transistor, resistor and capacitor.

Integrated circuit fabrication: Isolation - pn junction isolation, mesa isolation and oxide isolation. BJT based microcircuits, p-channel and n-channel MOSFETs, complimentary MOSFETs and silicon on insulator devices. Testing, bonding and packaging.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Explain various unit-processes in micro/Nano fabrication
CO 2	Analyze, compare and finally gain theoretical experience for the advantages and limitations of different fabrication processes.
CO 3	Design a device using the fabrication processes.
CO 4	Evaluate the better way of fabrication.
CO 5	Describe process integration examples.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2		**X**		**X**					
CO 3				**X**	**X**				
CO 4					**X**				
CO 5		**X**							

Course Title: Digital Signal Processing II		Year/Semester: 4/1	Course Status: Theory (Major, compulsory)
Course Code: EEE 429	Credit: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: EEE 329 (Signals and Linear systems), EEE 331 (Digital signal processing I)			

Rationale

The interesting and quickly developing topic of digital signal processing is introduced in this course. After successfully completing the course, it is anticipated that students will have acquired the skills necessary to comprehend and apply the fundamentals of digital signal processing. The learner gains a strong skill foundation for their future emPOyment when they can recognize a system and a signal for what they are: information in motion.

Course Objectives are:

- To assist students in acquiring the skills necessary to convert signals from analog to digital and vice versa.
- Make sure the students comprehend the various properties of signals in the time and frequency domain, as well as discrete time systems.
- Apply the understanding of the z-transform to the study of discrete temporal signals and systems.
- To build skills to conduct Fourier transform in the analysis of discrete time signals and systems.
- To facilitate necessary information about the construction, use, and design of significant discrete time systems and filters.

Course Contents:

Spectral estimation: Nonparametric methods - discrete random processes, autocorrelation sequence, periodogram; parametric method-autoregressive modeling, forward/backward linear prediction, Levinson-Durbin algorithm, minimum variance method and Eigen structure method I and II. Adaptive signal processing: Application, equalization, interference suppression, noise cancellation, FIR filters, minimum mean-square error criterion, least mean-square algorithm and recursive least square algorithm. Multi rate DSP: Interpolation and decimation, poly-phase representation and multistage implementation. Perfect reconstruction filter banks: Power symmetric, alias-free multi-channel and tree structured filter banks. Wavelets: Short time Fourier transform, wavelet transform, discrete time orthogonal wavelets and continuous time wavelet basis.

.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Understand the principles of spectral estimation and analyze the properties of various spectral estimation methods, including the periodogram, nonparametric methods, and parametric methods.
CO 2	Develop an understanding of adaptive signal processing algorithms, including the LMS and RLS algorithms, and their applications in noise cancellation, echo cancellation, and system identification
CO 3	Analyze the principles of multirate DSP and apply the concepts of sampling rate conversion, polyphase decomposition, and filter banks to design and implement digital systems
CO 4	Develop an understanding of wavelets and their applications in signal processing.
CO 5	Understand the principles of perfect reconstruction filter banks and analyze the properties of various filter banks.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2	X								X
CO 3	X			X					

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 4	X								X
CO 5	X			X					
CO 6	X	X							
CO 7	X	X							

Recommended Books

3. John G. Proakis and D. G. Manolakis: Digital Signal Processing: Principles, Algorithms, and Applications.
4. Alan V. Oppenheim, Ronald W. Schafer with John R. Buck: Discrete-Time Signal Processing.

Course Title: Fundamentals of Nano Electronics & Quantum Transport	Year/Semester: 4/1	Course Status: Theory (Major, optional)
Course Code: EEE 443	Credits: 3.0	Contact hours: 3 hours Lecture per Week
Pre-requisite: EEE (Electronics I)		

Rationale:
This course aims to provide students with a comprehensive understanding of the principles and applications of nanoelectronics and quantum transport. This rapidly evolving field is at the forefront of modern science and technology, with significant implications for various industries, including electronics, energy, healthcare, and materials science. The course is designed to equip students with the knowledge and skills necessary to navigate this exciting field and contribute to its advancements.

Course Objectives are

1. Understand the principles of nanoelectronics: Students will grasp the fundamental principles and concepts of nanoelectronics, including quantum mechanics, electron behavior at the nanoscale, and the unique properties of nanomaterials.
2. Analyze quantum phenomena in nanoscale devices: Students will exPOre quantum phenomena such as quantum confinement, tunneling, and Coulomb blockade.
3. Study device fabrication techniques for nanoelectronics: Students will learn about various techniques used in the fabrication of nanoscale electronic devices, including top-down and bottom-up approaches, lithography, deposition, and self-assembly.
4. Learn quantum transport theory: Students will study the mathematical framework of electron transport through nanoscale devices.
5. Analyze electron transport in nanoscale systems: Students will apply quantum transport theory to analyze and predict electron transport behavior in nanoscale devices.

Course Contents:
An atomistic view of electrical resistance : Energy level diagram, What makes electrons flow? The quantum of conductance , Potential profile, Coulomb blockade end single electron transistors, Atomistic Resistance to Ohm's law Schrodinger equation: Hydrogen atom energy level, Finite and infinite potential wells, Numerical solution of Schrodinger equation Method of finite differences Tight binding Model of Electron in solid and Basis functions :Basis functions for n computing wave function and energy level Equilibrium density matrix, Band structure calculation of solid, Common semiconductors band structure , Effect of spin-orbit coupling ,Sub bands of electron in nanoscale in: Energy level in Quantum wells, wires, dots, and nanotubes, Density of states in Quantum wells wires, dots, and nanotubes, Minimum resistance of a wire Capacitance nanoscale: Model Hamiltonian Electron density/density matrix: Schrodinger and poison Solver, Quantum vs. electrostatic capacitance , multi-band effective mass Hamiltonian ,Level broadening and non-equilibrium Green Function formalism: Open systems , Local density of states, Lifetime of a electron in an energy level, What constitutes a contact (reservoir) .Coherent transport: Overview, Density matrix, Inflow/outflow , Transmission , Examples .Non-coherent transport Why does an atom emit light?, Examples , Inflow and outflow, Heat quanta: phonons ,Thermoelectricity in Nanoscale: Second Law of thermodynamics for electron,

Entropy ,Law of Equilibrium, Inelastic Transport. Spin of Electron Introduction to spintronics devices ,Spin Matricies , Spin-Orbit Interaction Hamiltonian Including Spin, Spin Density, Spin Current, Spin Torque .Exchange Interaction: Correlations and Entanglement, Singlet Triplet States, Correlated Transport, Exchange Interaction.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Demonstrate a comprehensive understanding of the fundamental principles of nanoelectronics, including quantum mechanics, electron behavior at the nanoscale, and the unique properties of nanomaterials.
CO 2	Understand how quantum phenomena including quantum confinement, tunneling, and Coulomb blockade affect nanoscale device behavior and performance.
CO 3	Apply knowledge of device fabrication techniques used in nanoelectronics, including top-down and bottom-up approaches, lithography, deposition, and self-assembly, to design and fabricate nanoscale electronic devices.
CO 4	Utilize quantum transport theory to analyze and predict electron transport behavior in nanoscale systems, considering scattering mechanisms, quantum interference, and the influence of energy levels on transport phenomena.
CO 5	Use analytical and computational methods to analyze and understand nanoelectronics and quantum transport experimental data.
CO 6	Critically solve nanoelectronics and quantum transport challenges using theoretical notions and principles.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**	**X**							
CO 2	**X**	**X**							
CO 3	**X**	**X**							
CO 4				**X**	**X**				
CO 5				**X**	**X**				
CO 6						**X**			**X**

Recommended Books

3. "Introduction to Solid State Physics" by Charles Kittel
4. "Nanoelectronics and Information Technology" by Rainer Waser
5. "Quantum Transport: Atom to Transistor" by Supriyo Datta

Elective II

Course Title: Power Electronics		Year/Semester: 4/1	Course Status: Theory (Major, Optional)
Course Code: EEE 445	Credit: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: EEE 221, EEE 222, EEE 231, EEE 232, EEE 325, EEE 326			

Rationale

Today, a wide range of consumer and industrial electronic products require power electronic circuits. They include switched mode regulated power supplies for TVs, light fixtures, laptops, and other entertainment systems at the low power end. Power electronic converters for variable speed drives, automotive and railroad traction, textile, paper, and steel rolling mills, ship propulsion and positioning, aircraft actuators, and navigation are just a few examples of high-power end industrial applications. Other high power end industrial applications include high voltage DC transmission, grid connection for PV systems and wind generators, and power supply for telecommunication equipment.

Course Objectives are:

- To assist students in comprehending the fundamental parts of power electronics and understanding their salient features.
- To enable the knowledge required to assess, simulate, and forecast the performance of fundamental power converter systems.
- To get knowledge of power electronics topologies.
- To have a thorough understanding of the operating challenges and limitations faced by power converters.
- To assist students to design proper switching circuits to achieve a desired behavior specification.

Course Contents:

Power semiconductor switches and triggering devices: Diodes, BJT, MOSFET, SCR, IGBT, GTO, TRIAC and DIAC, Power computation of sinusoidal and non-sinusoidal waveforms.
Uncontrolled and controlled Rectifiers: single phase and three phase, half wave and full wave rectifiers and applications.
Regulated power supplies: Linear dc-dc regulators, Choppers, switching dc-dc regulators: buck, buck boost, boost, Cuk, SEPIC regulators, DC motor control.
AC voltage controllers: Single and three phase Ac voltage controllers, AC motor control, CyCO-converters.
Inverters: Full bridge inverter, square wave inverters, amplitude and harmonics control in inverters, Fourier series analysis, Multilevel inverters, PWM output in inverters, Harmonics analysis, three phase inverters.
Resonant converters: Resonant switch converters: Zero current switching, zero voltage switching, series and parallel Resonant DC-DC converters.
Power Electronics in Renewable Energy Systems: PE applications in home solar system, solar farms and wind power conversion.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Understand AC and DC machines control systems circuits.
CO 2	Identify the basic components of power electronics like BJT, MOSFET, SCR, IGBT, GTO, TRIAC, UJT and DIAC.
CO 3	Explain inverters working principle and design procedure.
CO 4	Design regulated power supplies.
CO 5	Develop uncontrolled and controlled single phase and three phase rectifiers
CO 6	Describe differences and design of AC and DC power systems.
CO 7	To learn about the sustainable development of solar and wind energy system while taking societal, economic, and environmental restrictions into consideration.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X								
CO 3	X								
CO 4	X					X			
CO 5	X								
CO 6	X								
CO 7	X	X				X			

Recommended Books

1. Power Electronics, Circuits, Devices, and Applications by Muhammad H. Rashid
2. Introduction to Power Electronics by D. W. Hart
3. Power electronics systems: theory and design by Agrawal, Jai P.
4. Modern Power Electronics and AC Drives by Bimal K. Bose

Course Title: Power Electronics Lab		Year/Semester: 4/1	Course Status: Theory (Major, compulsory)
Course Code: EEE 446	Credit: 3.0	Contact hours: 3 hours Lecture per week	
Pre-requisite: EEE 221, EEE 222, EEE 231, EEE 232, EEE 325, EEE 326			

Rationale

EEE students must have a solid understanding of how to model and work with a variety of power converters for various power conversions. After completing this course, students will have a better awareness of the range and applications of power electronics, improved modeling and analysis abilities, and knowledge of converter design. Without practical experiments using the fundamental power electronics components and measuring tools, the theoretical knowledge is deficient. This course is intended to be taken in addition to EEE 445, a theoretical course.

Course Objectives are:

- To help students to understand basic components of power electronics and learn their key characteristics,
- To facilitate necessary knowledge to analyze, model and predict performance of basic power converters systems.
- To develop skills on power electronic topologies.
- To develop a good insight of operational issues and limitations of power converters.
- To assist students to design proper switching circuits to achieve a desired behavior specification.

Course Contents:

1. Study of Switching Characteristic of BJT, MOSFET, SCR, IGBT and TRIAC.
2. Design of basic pulse width generator using BJT, MOSFET and SCR.
2. Switch Mode Power Supply: Buck, Boost & Buck-Boost Converter.
3. Basic Single Phase CyCO-converter Circuit.
4. Basic Single-Phase Inverter Circuits: Push Pull and Half/Full Bridge Inverter.
5. Controlled single phase and three phase Rectifier using SCRs.
6. Operation of a three phase Inverter.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Identify the basic components of power electronics.
CO 2	Understand Buck and Boost converters inner workings.
CO 3	Describe basic components characteristics and working parameters.
CO 4	Explain inverters working principle and design procedure.
CO 5	Design pulse width generators using different components.
CO 6	Develop single phase and three phase rectifiers.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X		X			X			
CO 2	X		X			X			
CO 3	X		X			X			
CO 4	X		X			X			
CO 5	X		X	X		X			
CO 6	X		X			X			

Recommended Books

1. Power Electronics, Circuits, Devices, and Applications by Muhammad H. Rashid
2. Introduction to Power Electronics by D. W. Hart
3. Power electronics systems: theory and design by Agrawal, Jai P.
4. Modern Power Electronics and AC Drives by Bimal K. Bose

Course Title: Microwave Engineering Lab		Year/Semester: 4/1	Course Status: theory (Major, compulsory)
Course Code: EEE 447	Credit: 3		Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 321, EEE 322, EEE 332, EEE 332			

Rationale

EEE students must have a solid understanding of wave and basic idea about communication. After completing this course, students will have a better awareness of the range and applications microwave and their components.

Course Objectives are:

- To develop an understanding of the principles of electromagnetic waves and their behavior in transmission lines, waveguides, and microstrips.
- To become proficient in the analysis and design of transmission lines, waveguides, and microstrips for various applications.
- To understand the basics of microwave antenna theory, radiation, and radiation pattern analysis.
- To develop an understanding of the principles of electromagnetic waves and their behavior in transmission lines, waveguides, and microstrips.

- To become proficient in the analysis and design of transmission lines, waveguides, and microstrips for various applications.
- To understand the basics of microwave antenna theory, radiation, and radiation pattern analysis.
- To gain knowledge of the properties of different types of microwave antennas such as dipole, monopole, patch, horn, and reflector antennas.
- To learn about the applications of microwave engineering in various fields such as communication, radar, remote sensing, and medical imaging.
- To gain hands-on experience with microwave measurement techniques such as power measurement, impedance measurement, and VSWR measurement.
- To learn about the different types of microwave devices such as amplifiers, filters, and mixers and their applications.
- To develop the ability to analyze and design microwave circuits and systems using various simulation tools such as ADS, CST, and HFSS.
- To understand the impact of electromagnetic interference (EMI) and electromagnetic compatibility (EMC) on microwave circuits and systems.
- To gain knowledge of emerging microwave technologies such as 5G, millimeter-wave, and terahertz communication, and their potential applications. To gain knowledge of the properties of different types of microwave antennas such as dipole, monopole, patch, horn, and reflector antennas.
- To learn about the applications of microwave engineering in various fields such as communication, radar, remote sensing, and medical imaging.
- To gain hands-on experience with microwave measurement techniques such as power measurement, impedance measurement, and VSWR measurement.
- To learn about the different types of microwave devices such as amplifiers, filters, and mixers and their applications.
- To develop the ability to analyze and design microwave circuits and systems using various simulation tools such as ADS, CST, and HFSS.

Course Contents:

Transmission lines: Voltage and current in ideal transmission lines, reflection, transmission, standing wave, impedance transformation, Smith chart, impedance matching and lossy transmission lines. Waveguides: general formulation, modes of propagation and losses in parallel plate, rectangular and circular waveguides. Microstrips: Structures and characteristics. Rectangular resonant cavities: Energy storage, losses and Q. Radiation: Small current element, radiation resistance, radiation pattern and properties, Hertzian and halfwave dipoles. Antennas: Mono pole, horn, rhombic and parabolic reflector, array, and Yagi-Uda antenna.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Students will be able to analyze and design transmission lines, waveguides, and microstrips for different microwave frequencies and understand their applications in various fields.

CO 2	Students will be able to analyze and design microwave antennas, including understanding the different types of antennas, their radiation patterns, and the factors that affect their performance.
CO 3	Students will be able to understand the basic principles of microwave propagation and apply this knowledge to analyze and design microwave circuits and systems.
CO 4	Students will be able to apply their knowledge of microwave theory to design and analyze various microwave devices such as amplifiers, filters, and mixers, and understand their applications in different fields.
CO 5	Students will be able to use various simulation tools and measurement techniques to analyze and optimize microwave circuits and systems for different applications. They will also be able to identify and mitigate potential electromagnetic interference (EMI) and electromagnetic compatibility (EMC) issues in microwave systems.
CO 6	Develop critical thinking, problem-solving, and communication skills through laboratory reports and presentations.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X		X			X			
CO 2	X		X			X			
CO 3	X		X			X			
CO 4	X		X			X			
CO 5	X		X	X		X			
CO 6	X		X			X			

Recommended Books

1. Microwave Engineering by David M.
2. Foundations for Microwave Engineering by Robert E. Collin

Course Title: Microwave Engineering Lab	Year/Semester: 4/1	Course Status: Lab (Major, compulsory)
Course Code: EEE 448	Credit: 1.5	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 321, EEE 322, EEE 332, EEE 332		

Rationale

EEE students must have a solid understanding of wave and basic idea about communication. After completing this course, students will have a better awareness of the range and applications microwave and their components.

Course Objectives are:

- Understanding the fundamental principles of microwave propagation, including the concepts of electromagnetic waves, waveguides, and transmission lines.
- Gaining hands-on experience with the design, analysis, and measurement of microwave circuits and systems, including microstrip structures, antennas, and radiation patterns.
- Developing proficiency in the use of microwave test equipment, including vector network analyzers, spectrum analyzers, and power meters.
-
- Learning how to model and simulate microwave circuits and systems using computer-aided design (CAD) tools such as Analysis HFSS or CST Microwave Studio.

- Exploring advanced topics in microwave engineering, such as microwave filters, amplifiers, mixers, and oscillators.
-
- Developing critical thinking and problem-solving skills by working on challenging laboratory assignments and projects that require independent research and experimentation.

Course Contents:

The students will perform experiments to verify practically the following theories and concepts and then design them: Transmission lines: Voltage and current in ideal transmission lines, reflection, transmission, standing wave, impedance transformation, Smith chart, impedance matching and lossy transmission lines. Waveguides: general formulation, modes of propagation and losses in parallel plate, rectangular and circular waveguides. Microstrips: Structures and characteristics. Rectangular resonant cavities: Energy storage, losses and Q. Radiation: Small current element, radiation resistance, radiation pattern and properties, Hertzian and halfwave dipoles. Antennas: Mono pole, horn, rhombic and parabolic reflector, array, and Yagi-Uda antenna

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Design, analyze, and measure various types of transmission lines, waveguides, and microstrip structures using appropriate test equipment.
CO 2	Understands electromagnetic wave propagation and radiation concepts, including wave polarization, reflection, refraction, and diffraction.
CO 3	analyze and design various types of antennas, such as dipole antennas, patch antennas, and horn antennas, and measure their radiation patterns.
CO 4	Simulate and analyze microwave circuits and systems using CAD tools and compare the results with measurements.
CO 5	Work independently and in a team to plan, design, and execute laboratory experiments, and analyze the results.
CO 6	Develop critical thinking, problem-solving, and communication skills through laboratory reports and presentations.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X		X			X			
CO 2	X		X			X			
CO 3	X		X			X			
CO 4	X		X			X			
CO 5	X		X	X		X			
CO 6	X		X			X			

Recommended Books

1. Microwave Engineering by David M.
2. Foundations for Microwave Engineering by Robert E. Collin

Course Title: Microcontroller System Design	Year/Semester: 4/1	Course Status: Theory (Major, optional)
Course Code: EEE 461	Credits: 3.0	Contact hours: 3 hours Lecture per Week
Pre-requisite: EEE 221. EEE 231		

Rationale:
This course aims to equip students with the knowledge and skills necessary to design, implement, and optimize microcontroller-based systems.

Course Objectives are

1. To understand Microcontroller Architecture.
2. To teach students the programming languages and development tools specific to microcontrollers.
3. To provide students with practical skills in connecting and communicating with various hardware components, including digital I/O, analog-to-digital conversion, serial communication protocols (I2C, SPI, UART), and sensor integration.
4. To introduce students to real-time concepts, including task scheduling, interrupt handling, and timers.
5. To provide students with an understanding of current trends, emerging technologies, and industry best practices in microcontroller system design.

Course Contents:
The internal structure and operation of microcontrollers will be studied. The design methodology for software & Hardware applications will be developed through the labs and design projects. The objective of this course
The internal structure and operation of microcontrollers methodology for software and hardware applications will be developed through the labs and design projects The objective of this course is to teach students design and interfacing of microcontroller-based embedded systems. High-level languages are used to interface the microcontrollers to various applications. There are extensive hands-on labs/projects. Embedded system for sensor applications will be introduced. GUI using MATLAB.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Demonstrate a comprehensive understanding of microcontroller architecture, including the central processing unit (CPU), memory, input/output (I/O) interfaces, timers, and serial communication.
CO 2	Write and implement efficient and optimized code for microcontroller-based systems using appropriate programming languages and development tools.
CO 3	Analyze and design real-time systems, including task scheduling, interrupt handling, and timers, to meet timing constraints and ensure timely response to events.
CO 4	Demonstrate problem-solving and critical thinking skills by applying knowledge and skills to analyze and solve complex problems related to microcontroller system design.
CO 5	Troubleshoot and debug microcontroller-based systems using appropriate tools and techniques, identifying and resolving hardware and software issues.
CO 6	Communicate effectively, both orally and in writing, about microcontroller system design concepts, methodologies, and solutions to technical and non-technical audiences.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X	X							
CO 2	X	X							
CO 3	X	X							
CO 4				X	X				
CO 5	X	X		X	X				
CO 6		X	X			X			X

Recommended Books

1. "Embedded Systems: Introduction to the MSP432 Microcontroller" by Jonathan W. Valvano
2. "ARM Microcontroller Interfacing: Hardware and Software" by Warwick A. Smith
3. "Programming 32-bit Microcontrollers in C: Exploring the PIC32" by Lucio Di Jasio
4. "Microcontroller Theory and Applications: HC12 and S12" by Daniel J. Pack and Steven F. Barrett
5. "Microcontrollers: Fundamentals and Applications with PIC" by Fernando E. Valdes-Perez and Ramon Pallas-Areny

Course Title: Microcontroller System Design Lab	Year/Semester: 4/1	Course Status: Theory (Major, optional)
Course Code: EEE 462	Credits: 1.5	Contact hours: 3 hours Lecture per Week
Pre-requisite: EEE 221. EEE 231		

Rationale:
This course is designed to provide students with the practical knowledge and skills required to design, implement, and optimize microcontroller-based systems.

Course Objectives are

1. To demonstrate different Microcontroller.
2. To demonstrate students the programming languages and development tools specific to microcontrollers.
3. To provide students with practical skills in connecting and communicating with various hardware components, including digital I/O, analog-to-digital conversion, serial communication protocols (I2C, SPI, UART), and sensor integration.
4. To introduce students to real-time concepts, including task scheduling, interrupt handling, and timers.

Course Contents:
(I) PIC microcontrollers: introduction and features, (2) CCS C Compiler and PIC18F Development System, (3) PIC Architecture & Programming, (4) PIC 1O Port Programming, (5) PIC Programming in C Hardware Connection and ROM loaders, (7) PIC18 Timers Programming LCD and (8) PIC18 Serial Port Programming, (9) Interrupt Programming, (10) Keypad Interface, (11) External EEPROM and 12C, (12) USB and HID Cla,(13) ADC and DAC, (14) Sensor and other Applications, (15) CCP and ECCP Programming, (16) Capture Mode Programming and Pulse Width Measurement, (17) C # RS232 Interface Programming , (18) C # GUI POt Program , (19) Digital Oscilloscope, spectral Analyzer, and muiti-meter, (20) Impact of engineering solutions in a global, economic, environmental, and societal context, (21) Knowledge of contemporary issues, (22) Final Project

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Design and implement hardware interfaces to connect and communicate with external devices and peripherals, including digital I/O, analog-to-digital conversion, and various serial communication protocols.
CO 2	Write and implement efficient and optimized code for microcontroller-based systems using appropriate programming languages and development tools.
CO 3	Design real-time systems, including task scheduling, interrupt handling, and timers.
CO 4	Demonstrate problem-solving and critical thinking skills by applying knowledge and skills.
CO 5	Troubleshoot and debug microcontroller-based systems using appropriate tools and techniques, identifying and resolving hardware and software issues.
CO 6	Apply practical hands-on skills in designing, implementing, and testing microcontroller-based systems through laboratory exercises, projects, and real-world applications.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X	X							
CO 2	X	X							
CO 3	X	X							
CO 4				X	X				
CO 5	X	X		X	X				
CO 6		X	X			X			X

Recommended Books

1. "Embedded Systems: Introduction to the MSP432 Microcontroller" by Jonathan W. Valvano
2. "ARM Microcontroller Interfacing: Hardware and Software" by Warwick A. Smith
3. "Programming 32-bit Microcontrollers in C: Exploring the PIC32" by Lucio Di Jasio
4. "Microcontroller Theory and Applications: HC12 and S12" by Daniel J. Pack and Steven F. Barrett
5. "Microcontrollers: Fundamentals and Applications with PIC" by Fernando E. Valdes-Perez and Ramon Pallas-Areny

Elective III

Course Title: Renewable Energy Systems	Year/Semester: 4/1	Course Status: Theory (Major, optional)
Course Code: EEE 463	Credits: 3.0	Contact hours: 3 hours lecture per week

Rationale:

This course deals with various sources of renewable energy including wind, solar, and biomass as potential sources of energy and investigates the contribution they can make to the energy profile of the nation. The technology used to harness these resources will be presented. It also examines the issues involved in the integration of various renewable energy sources and their economics for heat, power, and transportation needs. Discussions of economic, environment, politics and social policy are integral components of the course.

Course Objectives are

- To familiarize with the utilization methods of the renewable energy resources.
- To develop an understanding of the most common types of solar photovoltaic energy conversion techniques.
- To explain performance characteristics and approaches to increase solar efficiency.
- To describe about other non-conventional energy resources.
- To help students develop necessary skills to evaluate efficiency, performance and site selection criteria in the field of renewable energy systems.

Course Content:
Instruments: Radiation characteristics of materials: Absorptance, Emittance, Reflectance and Selective Surfaces, Modes of heat transfer.
Solar Collectors: Flat plate collectors, Concentrating collectors, Solar distillation, Solar energy systems for process heating, Solar Thermal Power generation and Solar refrigeration, Solar thermal system optimization and performance study, Solar thermal modeling.
Solar Photovoltaic Energy Conversion: Solar cell fundamental, Basic principle, Types of solar cells, P-N junction as photovoltaic cell, Heterojunction, Schottky barrier junction, Fabrication of solar cell, Effect of environment on solar cells, (effect of irradiance once, and effect of temperature), Effect of shading, Thin film solar cell, Multiple sun solar cells, Fabrication of photovoltaic modules and panels, Dimension of cells, Packing efficiency of cells in modules,

Characterization of cells and modules, Organic and polymer matrix for the fabrication of solar cell, Nanostructure Solar cell.
Power Conditioning of Photovoltaic System: Batteries, Battery charge controllers. Inverters, Maximum power point trackers (MPPT).
Different types of PV system: Stand-alone PV system. Grid-interconnection PV system and Hybrid system, Design of PV system, Standalone PV system sizing.
Other Non-conventional Energy Options: Wind, Geothermal, OTEC, Wave energy, Biomass, MHD, Chemical energy, Fuel cell, nuclear fusion

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Discuss the energy scenario of the current world and different positive and negative aspects of available energy sources.
CO 2	Explain the importance and field applications of solar energy
CO 3	Outline the process of photovoltaic power generation.
CO 4	Illustrate the concepts of hybrid energy systems and the feasibility of their practical implementations.
CO 5	Understand the need of energy conversion and the various methods of energy storage
CO 6	Identify and understand the usability of different renewable energy sources like wind, bio gas, hydro, geothermal etc.
CO 7	Analyze system performance of non-conventional energy sources.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
CO 1		**X**	**X**	**X**		**X**					
CO 2	**X**	**X**		**X**						**X**	
CO 3	**X**	**X**								**X**	
CO 4		**X**	**X**								**X**
CO 5	**X**				**X**						
CO 6				**X**	**X**				**X**	**X**	
CO 7	**X**	**X**			**X**						

Recommended Books

1. Non-Conventional Sources Of Energy by **Rai G. D.**
2. Renewable Energy Sources and Emerging Technologies by Kothari P, K C Singal and Rakesh Ranjan
3. Handbook of Energy Efficiency and Renewable Energy by Frank Kreith and Yogi Goswami D

Course Title: Energy Conversion III	Year/Semester: 4/1	Course Status: theory
Course Code: EEE 465	Credit: 3	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 223, EEE 224, EEE 233, EEE 234		

Rationale

Energy Conversion III is an advanced course designed to provide students with a comprehensive understanding of special machines, generators, and various energy conversion technologies. The course explores a wide range of topics, including specialized motor types, generators, alternative energy sources, and advanced control techniques. Through theoretical knowledge and practical applications, students will develop a deep insight into the principles of energy conversion and its real-world applications.

Course Objectives are:

1. Specialized Machine Understanding: Understand the operating principles, construction, and characteristics of specialized electric machines, including series universal motors, permanent magnet DC motors, brushless DC motors, stepper motors, and reluctance motors.
2. Generator Concepts: Comprehend the fundamental principles of generator operation, including acyclic machines, conduction pumps, induction pumps, magneto hydrodynamic generators, and their applications in energy conversion.
3. Alternative Energy Conversion: Explore alternative energy sources such as fuel cells, thermoelectric generators, flywheels, photovoltaic systems, and wind turbine generators, analyzing their conversion processes, efficiency, and integration into power systems.
4. Control Techniques: Learn advanced control strategies applicable to specialized machines and generators, including vector control, drive circuits, and control transformers, enabling efficient and precise energy conversion.
5. Practical Application: Develop hands-on skills through laboratory experiments, simulations, and projects related to motor and generator performance, control techniques, and alternative energy systems.
6. System Integration: Understand the integration of various energy conversion technologies into larger systems, including grid interfacing for photovoltaic systems and AC-DC-AC conversion for wind turbine generators.
7. Emerging Technologies: Explore emerging trends and technologies in the field of energy conversion, such as linear motors, traction systems, and electrostatic motors, and assess their potential impact on future energy systems.

Course Contents:

Special machines: series universal motor, permanent magnet DC motor, unipolar and bipolar brush less DC motors, stepper motor and control circuits. Reluctance and hysteresis motors with drive circuits, switched reluctance motor, electro static motor, repulsion motor, synchronous and control transformers. Permanent magnet synchronous motors. Acyclic machines: Generators, conduction pump and induction pump. Magneto hydrodynamic generators. Fuel Cells, thermoelectric generators, flywheels. Vector control, linear motors and traction. Photovoltaic systems: stand alone and grid interfaced. Wind turbine generators: induction generator, AC-DC-AC conversion.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Analyze and compare the operating characteristics of different specialized electric machines, explaining their advantages and limitations.
CO 2	Design and simulate control circuits for various motor types, demonstrating proficiency in vector control techniques.
CO 3	Evaluate the performance and efficiency of generators, identifying suitable applications for different types of acyclic machines.
CO 4	Assess the feasibility and integration of alternative energy sources, such as fuel cells, photovoltaic systems, and wind turbine generators, into existing power grids.
CO 5	Apply advanced control strategies to optimize energy conversion processes and enhance system stability.
CO 6	Demonstrate practical skills in configuring, operating, and troubleshooting specialized machines and generators through laboratory experiments and projects.
CO 7	Discuss and predict the impact of emerging technologies on the future landscape of energy conversion and power systems.
CO8	Communicate effectively through technical reports and presentations, conveying complex energy conversion concepts and solutions to both technical and non-technical audiences.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X	X							
CO 2	X	X							
CO 3	X	X							
CO 4	X	X						X	
CO 5	X	X			X				
CO 6			X	X	X				
CO 7	X					X	X		
CO8				X					

Recommended Books

1. "Electric Machinery Fundamentals" by Stephen J. Chapman
2. "Electrical machine" by B.L. Thereja

Course Title: Geographical Communication	Year/Semester: 4/1	Course Status: Theory (Major, optional)
Course Code: EEE 469	Credit: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 321 (Communication I)		

Rationale

This course will give a basic idea about global communication techniques.

Course Objectives are:

1. Understand how communication both structures and is structured by geography.
2. Understand the uneven geographical development of the Internet and other communication technologies.
3. Recognize the significance of the location of physical telecommunications infrastructure in the construction of cyberspaces.
4. Understand the ways that communications technologies may be undermining or enhancing the creation of community.

Course Contents:

Critically analyze the content of online communications.

Apply principles of good web design (including principles of accessibility for people with disabilities) to become a content creator as well as a content consumer.

Be able to identify the ways that online and offline worlds interconnect.

Understand the interrelationships among the disciplines of communication and geography.

Understand how their own relationships with others are affected by telecommunications technologies.

Understand how technological skills may be used to benefit their own and other's communities.

Develop skills in managing complex projects and in working as a part of a team. be able to identify both printed and online sources of information that they can use in the future to understand the changing geography of communication.

Develop web design skills that may be useful for gaining emPOyment upon graduation.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Critically analyze the content of online communications
CO 2	Understand the interrelationships among the disciplines of communication and geography
CO 3	Develop web design skills that may be useful for gaining emPOyment upon graduation.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2		**X**							
CO 3		**X**							

Course Title: Real Time Computer System	Year/Semester: 4/1	Course Status: Theory (Major, optional)
Course Code: EEE 481	Credit: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite:		

Rationale

In this course student will have a general idea how to build and work with real time systems

Course Objectives are:

- To get an idea about classification of real time process;
- Understand Real time scheduling; Real time programming; Implementation; Operating systems; Real time I/O.
- Get an idea about real time design methodologies. Modeling for real time systems. Reliable and Safe design for critical applications.

Course Contents:

Introduction to real time system; Classification of real time process; Real time scheduling; Real time programming; Implementation; Operating systems; Real time I/O. Real Time design methodologies. Modeling for real time systems. Reliable and Safe design for critical applications.

Review of Microprocessor fundamentals and programmable input/output devices and systems for PC. Application examples: digital controls, robotics, on line systems, communication with real world signals and automatic control using feedback, feed-forward and adaptive control, control algorithm implementation.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Classify of real time process;
CO 2	Learn Real time scheduling.
CO 3	Understand Real Time design methodologies.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**	**X**							
CO 2		**X**							
CO 3			**X**						

Elective IV

Course Title: Power System Protection	Year/Semester: 4/2	Course Status: Theory (Major, compulsory)
Course Code: EEE 433	Credits: 3.0	Contact hours: 3 hours Lecture per Week

Rationale:

This course deals with theoretical and practical knowledge on power system protection. It provides an overview of the principles and schemes for protecting power lines, transformers, buses and generators the students will become familiar with the components, basic operating principles, main applications, and limitations of protective relays and protection schemes. The students will also learn strategies to design reliable protection systems. As prerequisites of this course, the students are expected to be familiar with power system analysis.

Course Objectives are

- To develop an understanding of the most common types of switchgear and protection system.
- To introduce common types of protection scheme.
- To develop an understanding of the most common types of protection.
- To help develop necessary skills to apply the theory to a range of practical examples
- To describe the settings of feeder and transformer protection schemes, and selection of current and voltage instrument transformers for those protection schemes.
- To explain the impact of electrical overstress on the design and operation of power systems and electronic equipment and relays that can detect various faults.

Course Contents:

Introduction to power system protection: Purpose of power system protection, requirements of a good protection scheme.

Criteria for detecting faults: Over current, differential current, difference of phase angles, over and under voltages, power direction, symmetrical components of current and voltages, impedance, frequency and temperature.

Instrument transformers: Current Transformer and Potential Transformer.

Protective Relays: Electromechanical, electronic and digital Relays, basic modules, over current, differential, distance and directional, Trip circuits.

Unit protection schemes: Generator, transformer, motor, bus bar, transmission and distribution lines.

Switchgear: Switch, Miniature circuit breakers and fuses.

Circuit breakers: Principle of arc extinction, selection criteria and ratings of circuit breakers, types - air, oil, SF6 and vacuum.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Describe and categorize different protective equipment or power systems.
CO 2	Explain the concepts of power system protections, instrument transformers, fundamentals of relaying, overcurrent protection and coordination, directional overcurrent protection, differential protection, distance protection, distributed generation protection.
CO 3	Identify the economic and environmental challenges to designing a well-protected power system and provide solutions to the problems that maintains the moral and ethical standards from an engineering and societal perspective
CO 4	Implement the appropriate safety equipment for design of electrical power system with enhancing the efficiency of the transmission and distribution system with environment friendly technology.
CO 5	Distinguish sensing mechanism of different types of relays and working principle of various circuit breakers and fuses.
CO 6	Compare bus bar protection systems and use them accordingly
CO 7	Recognize the need to continuously follow the advancements in protection technology and incorporating them in the present system to improve efficiency.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
CO 1	**X**										
CO 2	**X**										
CO 3	**X**	**X**									
CO 4		**X**									
CO 5		**X**		**X**	**X**						
CO 6		**X**			**X**						
CO7		**X**		**X**	**X**						

Recommended Books

1. Principle of Power System by V.K Mehta & Rohit Mehta
2. Switchgear Protection and Power System by Sunil S. Rao
3. Power System Protection by Paul M. Anderson
4. Practical Power System Protection by Leslie Hewitson.

<table>
<tr><td>Course Title: Power System Protection Lab</td><td colspan="2">Year/Semester: 4/2</td><td>Course Status: Lab (Major, compulsory)</td></tr>
<tr><td>Course Code: EEE 434</td><td>Credits: 1.5</td><td colspan="2">Contact hours: 3 hours of Lab per Week</td></tr>
<tr><td colspan="4">Pre-requisite: EEE 337 (Power Systems II)</td></tr>
</table>

Rationale:

This course provides experimental and project-oriented verification of principles of industrial system design and power system protection. An understanding of the fundamental principles of power system protection remains very essential for engineering students. Theoretical knowledge is incomplete without hands on experiments using the module with all different kinds of relays and simulative tripping options. This course is designed to complement the theoretical course EEE 445.

Course objectives are:

1. To develop an understanding of the most common types of protection.
2. To help develop the skills to apply the theory to a range of practical examples
3. To explain the settings of feeder and transformer protection schemes, and selection of current and voltage instrument transformers for those protection schemes.
4. Foster the analytical and critical knowledge to simulate faulty scenarios with laboratory modules and to observe and calculate tripping time.

Course Contents:

1. Study of Maximum current three phase relay (overload and short-circuit)
2. Study of Maximum or minimum single-phase current relay
3. Study of Maximum and minimum three phase voltage relay
4. Study of Maximum or minimum single-phase voltage relay
5. Study of Phase sequence and voltage asymmetry relay
6. Study of Current directional relay
7. Study of Primary winding asymmetric transformers.
8. Study of Earth leakage protection relay.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Select the methods to choose suitable current transformer, voltage transformer and circuit breakers etc. for fulfilling power system protection.
CO 2	Identify and compare different protective devices and analyze their performance.
CO 3	Develop experimental techniques for setting and testing relays and document the obtained data properly.
CO 4	Develop individual opinion and communicate effectively across the members of the team
CO 5	Comply as a part of the team to achieve specified and measurable results while performing the experiments.
CO 6	Evaluate and explain the operation of protective devices from an experimental perspective.
CO 7	Maintain ethics while collecting and documenting experimental data.

Mapping of Course Learning Outcomes to Program Learning Outcomes-

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
CO 1	**X**	**X**									
CO 2	**X**	**X**									
CO 3			**X**		**X**						
CO 4	**X**					**X**				**X**	
CO 5							**X**				
CO 6								**X**	**X**		**X**
CO 7	**X**									**X**	

Recommended Books

5. Principle of Power System by V.K Mehta & Rohit Mehta
6. Switchgear Protection and Power System by Sunil S. Rao
7. Power System Protection by Paul M. Anderson
8. Practical Power System Protection by Leslie Hewitson
9. **Lab Manual:** Will be supplied by course teacher in the beginning of the course and also available in website.

Course Title: High Voltage Engineering	Year/Semester: 4/1		Course Status: Theory (Major, optional)
Course Code: EEE 435	Credits: 3.0	Contact hours: 3 hours lecture per week	
Pre-requisite: EEE 337 (Power System II)			

Rationale: This course provides advanced knowledge associated with high voltage engineering methods, techniques and equipment. It discusses consequent design principles for high-voltage equipment; of the generation of high direct, alternating and impulse voltages for testing high-voltage equipment; and of methods for monitoring and assessing the condition of high-voltage equipment. The behavior of dielectrics, the electrical insulating materials, subjected to high voltage of any kind, ac, dc and impulse also discussed at the end of the course.

Course Objective:

- Introduction to high voltage engineering,
- Basics of electrical breakdown,
- High voltage generation,
- High voltage test systems,
- Measurement and analysis techniques as applied to power system apparatus

Course Content:

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

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Describe fundamental concepts of high voltage AC, DC, and impulse generation.
CO 2	Differentiate between high voltage rectifier and voltage multiplier.
CO 3	Explain the fundamental concept of electric breakdown in liquids, gases, and solids.
CO 4	Apply analytical and numerical techniques for electric field calculations in high voltage systems.
CO 5	Apply the techniques employed in high voltage measurements.
CO 6	Compare non-destructive test techniques in high voltage engineering.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X								
CO 3	X								
CO 4	X	X			X				
CO 5		X							
CO 6		X	X						

Recommended Books

1. High Voltage Engineering by Matthew M.S. Naidu
2. High Voltage Engineering Fundamentals by E. Kuffel, W S Zaengl, and J. Kuffel

Course Title: High Voltage Engineering Lab	Year/Semester: 4/2		Course Status: Lab (Compulsory, Major)
Course Code: EEE 436	Credits: 1.5	Contact hours: 3 hours of Lab per Week	
Pre-requisite:			

Rationale:

This course provides had-on experience on testing dielectric strength and breakdown of gases, liquids, and solids, electric field design problems in power system equipment. It presents the mechanisms of high voltage phenomena in a controlled testing environment. This course covers safety aspects and practices in the lab, high voltage measurement techniques, flashover along insulators, insulation material breakdown and electric field effects.

Objectives of the course:

- Acquainted with high voltage and high voltage measuring instruments.
- Knowledge of the high voltage (HV) power equipment subjected with spark over voltage.
- Testing capacitance and insulation properties of high-power rating insulator.
- Generation and design of high voltage AC and DC transmission system.

Course Content:

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

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Measure DSM Peak Voltage and AC Leakage Current instantaneously.
CO 2	Compare the measured values with the standard values of different measurement.
CO 3	Test dielectric properties of transformer oil.
CO 4	Know safety precautions to be taken in the HV lab and standard layout design.
CO 5	Generate extra high direct current voltage.
CO 6	Design high voltage AC transmission line.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	**X**								
CO 2	**X**	**X**							
CO 3	**X**				**X**				
CO 4	**X**					**X**			**X**
CO 5	**X**	**X**							
CO 6	**X**	**X**	**X**	**X**					**X**

Recommended Books

1. High Voltage Engineering (Paperback) by M.S. Naidu
2. Dielectric Phenomena In High Voltage Engineering by F. W. Peek

Elective V

<table>
<tr><td colspan="2">Course Title: Power System Reliability</td><td colspan="2">Year/Semester: 4/2</td><td>Course Status: theory</td></tr>
<tr><td>Course Code: EEE 451</td><td colspan="2">Credit: 3</td><td colspan="2">Contact hours: 3 hours Lecture per week</td></tr>
<tr><td colspan="5">Pre-requisite: EEE 131, EEE 132, EEE 223, EEE 224, EEE 233, EEE 234</td></tr>
</table>

Rationale

Energy Conversion III is an advanced course designed to provide students with a comprehensive understanding of special machines, generators, and various energy conversion technologies. The course explores a wide range of topics, including specialized motor types, generators, alternative energy sources, and advanced control techniques. Through theoretical knowledge and practical applications, students will develop a deep insight into the principles of energy conversion and its real-world applications.

Course Objectives are:

1. Probability Fundamentals: Review and apply fundamental probability concepts, including probability distribution functions (binomial, Poisson, and normal) relevant to power system reliability analysis.
2. Reliability Measures: Understand and compute key reliability measures such as failure rate, mean time to failure, and outage probabilities for power system components and networks
3. System Configurations and Redundancy: Analyze series and parallel configurations of power system components and explore the principles of redundancy for enhancing system reliability.
4. Markov Process: Gain insights into Markov processes and their application in modeling the reliability of dynamic power system components and states.

5. Probabilistic Models: Develop probabilistic models for generation and load behaviors, considering uncertainties and variations in power system operation.
6. Reliability Indices: Compute and interpret reliability indices such as loss of load probability, loss of energy probability, frequency, and duration, assessing the system's performance during contingencies.
7. Reliability Evaluation Techniques: Apply reliability evaluation techniques to assess the reliability of a single area power system, including load flow analysis, fault analysis, and contingency analysis

Course Contents:

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

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Apply probability concepts to analyze uncertainties in power system operation and quantify reliability-related parameters.
CO 2	Compute and interpret reliability measures, such as failure rate, mean time to failure, and outage probabilities, for individual power system components.
CO 3	Analyze and compare series and parallel configurations of power system components and assess the impact of redundancy on system reliability.
CO 4	Understand and apply Markov processes to model the dynamic behavior and reliability of power system components.
CO 5	Develop probabilistic models for generation and load patterns, considering variability and fluctuations in power system operation.
CO 6	Compute reliability indices, including loss of load probability, loss of energy probability, and frequency-duration characteristics, to evaluate power system performance.
CO 7	Apply reliability evaluation techniques to analyze the reliability of a single area power system under different operating conditions and contingencies.
CO 8	Demonstrate an understanding of the importance of power system reliability in ensuring a stable and secure electrical grid.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X								
CO 3	X								
CO 4	X							X	
CO 5	X				X				
CO 6	X				X				
CO 7	X		X						
CO8		X					X		

Recommended Books

1. "Reliability Engineering" by L.S. Srinath
2. "Reliability Evaluation of Engineering Systems: Concepts and Techniques" by Roy Billinton and Ronald N. Allan

Course Title: Optoelectronics	Year/Semester: 4/2	Course Status: Theory (Major, optional)
Course Code: EEE 453	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: EEE 221 (Electronics I)		

Rationale

This course is an introduction to the properties of light and implementation of these properties for the fabrication and design of optoelectronic devices using the concept of homo-junction and hetero-junction already taught in Solid State Devices and Compound Semiconductor and Hetero-junction Devices courses. The working principle of LEDs, LASERs, Photo-diodes, Solar cell and modulators will be discussed in details.

Course Objectives are

- To explain the fundamental theory and properties of light.
- To facilitate necessary knowledge to analyze the function of band-gap for optical devices and different type of transitions along with the formation of strain and its significance.
- To acquaint students with the working principle and design parameter of Photonic Crystals.
- To develop skills for designing devices like LEDs, LASERs and solar cell.
- To understand the polarization of light and study different types of modulator.

Course Contents:

Optical properties in semiconductor: Direct and indirect band-gap materials, radiative and non-radiative recombination, optical absorption, photo-generated excess carriers, minority carrier life time, luminescence and quantum efficiency in radiation.
Properties of light: Particle and wave nature of light, polarization, interference, diffraction and blackbody radiation.
Light emitting diode (LED): Principles, materials for visible and infrared LED, internal and external efficiency, loss mechanism, structure and coupling to optical fibers.
Stimulated emission and light amplification: Spontaneous and stimulated emission, Einstein relations, population inversion, absorption of radiation, optical feedback and threshold conditions.
Semiconductor Lasers: Population inversion in degenerate semiconductors, laser cavity, operating wavelength, threshold current density, power output, hetero-junction lasers, optical and electrical confinement. Introduction to quantum well lasers.
Photo-detectors: Photoconductors, junction photo-detectors, PIN detectors, avalanche photodiodes and phototransistors.
Solar cells: Solar energy and spectrum, silicon and Schottky solar cells, P-V curve and output power calculation.
Modulation of light: Phase and amplitude modulation, electro-optic effect, acousto-optic effect and magneto-optic devices. Introduction to integrated optics.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Explain basic concepts and properties of light.
CO 2	Describe the working principle of optoelectronic devices like LEDs, LASERs and photo-detectors.
CO 3	Apply properties of light in semiconductor for modeling solar cells.
CO 4	Design and analyze Photonic Crystals.
CO 5	Design sustainable and environment friendly technology.
CO 6	Describe the working principles of different types of modulators and be able to use for specific purposes.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	**X**								
CO 2	**X**								
CO 3	**X**	**X**							
CO 4				**X**	**X**				
CO 5				**X**	**X**				
CO 6				**X**	**X**				

Recommended Books

1. Optoelectronics and Photonics: Principles and Practices by S.O. Kasap
2. Semiconductor Optoelectronic Devices by Pallab Bhattacharya
3. Optoelectronics: an introduction by John Wilson and John Hawkes
4. Physics of Semiconductor Devices by Simon M. Sze and Kwok K. Ng

Course Title: Semiconductor Device Theory	Year/Semester: 4/1	Course Status: Theory (Major, optional)
Course Code: EEE 459	Credits: 3	Contact hours: 3 hours Lecture per Week
Pre-requisite: Materials		

Rationale:

This course provides students with a fundamental understanding of the principles, operation, and behavior of semiconductor devices.

Course Objectives are

1. To provide students with a solid understanding of semiconductor physics, including energy bands, carrier statistics, carrier transport, and the interaction of light with semiconductors.
2. To comprehend the operating principles of key semiconductor devices, such as diodes, bipolar junction transistors (BJTs), field-effect transistors (FETs), and optoelectronic devices.
3. To analyze the behavior of semiconductor devices using mathematical models and analytical tools.
4. To introduce students to the fabrication techniques used in the manufacturing of semiconductor devices.
5. To enhance students' problem-solving and analytical skills.

Course Contents:

Lattice vibration: Simple harmonic model, dispersion relation, acoustic and optical phonons. Band structure: Isotropic and anisotropic crystals, band diagrams and effective masses of different semiconductors and alloys. Scattering theory: Review of classical theory, Fermi-Golden rule, scattering rates of different processes, scattering mechanisms in different semiconductors, mobility. Different carrier transport models: Drift-diffusion theory, ambipolar transport, hydrodynamic model, Boltzmann transport equations, quantum mechanical model, simple applications.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Demonstrate a deep understanding of semiconductor physics, including energy bands, carrier transport, and the behavior of electrons and holes in semiconductor materials.
CO 2	Design and optimize semiconductor device structures based on desired specifications and performance requirements.
CO 3	Understand and evaluate the impact of device scaling on performance, power consumption, and integration density.
CO 4	Demonstrate proficiency in using fabrication techniques and processes for creating semiconductor structures, including doping, lithography, etching, and deposition.

CO 5	Apply measurement techniques and instruments to characterize and test semiconductor devices, assessing parameters such as current, voltage, and frequency response.
CO 6	Demonstrate effective communication skills, both oral and written, in conveying technical concepts and findings related to semiconductor devices to diverse audiences.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X	X							
CO 2	X	X							
CO 3	X	X							
CO 4				X	X				
CO 5	X			X	X				
CO 6			X			X			X

Recommended Books

1. "Semiconductor Device Fundamentals" by Robert F. Pierret
2. "Semiconductor Devices: Physics and Technology" by Simon M. Sze and Kwok K. Ng
3. "Semiconductor Device Physics and Design" by Umesh Mishra and Jasprit Singh
4. "Principles of Semiconductor Devices" by Sima Dimitrijev

Course Title: Biomedical Instrumentation	Year/Semester: 4/2	Course Status: Theory (Major, optional)
Course Code: EEE 471	Credit: 3.0	Contact hours: 3 hours Lecture per week
Pre-requisite: EEE 221 (Electronics I), EEE 231 (Electronics II)		

Rationale

Biomedical Engineering is one the most growing field in modern world. EEE engineers can aid and alleviate to understand and interpret various signals coming from human body. This course will be a bridge between Engineers and Medical personnel.

Course Objectives are:

- To assist students in familiarizing with the basic physiology of human body and the mechanism of how various signals are created in human body.
- To facilitate necessary knowledge to work with various transducers which can decode signals of human body.
- To provide basic knowledge to compensate noise and error in medical devices.

Course Contents:

Human body: Cells and physiological systems. Bioelectricity: genesis and characteristics. Measurement of bio-signals: Ethical issues, transducers, amplifiers and filters. Electrocardiogram: electrocardiography, phonocardiograph, vector cardiograph, analysis and interpretation of cardiac signals, cardiac pacemakers and defibrillator. Blood pressure: systolic, diastolic mean pressure, electronic manometer, detector circuits and practical problems in pressure monitoring. Blood flow measurement: Plethysmography and electromagnetic flow meter. Measurement and interpretation: electroencephalogram, cerebral angiograph and conical X-ray. Brain scans. Electromyogram (EMG).

Tomography: Positron emission tomography and computer tomography. Magnetic resonance imaging. Ultra-sonogram. Patient monitoring system and medical telemetry. Effect of electromagnetic fields on human body.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CO 1	Know the Physiology of human body along with generation bio electricity.
CO 2	Ethical code of conduct of a Biomedical Engineer.
CO 3	Measuring various bio signals using transducers.
CO 4	Familiarize with modern medical devices.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**
CO 1	X								
CO 2						X	X	X	X
CO 3	X								
CO 4	X							X	X

Recommended Books

1. Medical Instrumentation, Application and Design by John G Webster
2. Introduction to Biomedical Equipment Technology by Joseph J Carr
3. Principles of Medical Electronics and Biomedical Instrumentation by C Raja Rao

Elective VI

Course Title**:** Control System II	Year/Semester: 4/2	Course Status: Theory (Major, optional)
Course Code: EEE	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: EEE 333 (Control System I)		

Rationale
This course gives more advanced idea for control system I course and more to the application-based study.

Course Objectives are
- State equations of digital systems
- Understand controllability and observability
- Understand various frequency and time domain analysis.

Course Contents:
Compensation using pole placement technique. State equations of digital systems with sample and hold, state equation of digital systems, digital simulation and approximation. Solution of discrete state equations: by z-transform, state equation and transfer function, state diagrams, state plane analysis. Stability of digital control systems. Digital simulation and digital redesign. Time domain analysis. Frequency domain analysis. Controllability and observability. Optimal linear digital regulator design. Digital state observer. Microprocessor control. Introduction to neural network and fuzzy control, adaptive control. Hu Control, nonlinear control.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	State equations of digital systems
CO 2	Understand controllability and observability.
CO 3	Understand various frequency and time domain analysis.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	**X**								
CO 2	**X**								
CO 3	**X**	**X**							

Course Title**:** Control System II	Year/Semester: 4/2	Course Status: Lab (Major, optional)
Course Code: EEE 474	Credits: 3.0	Contact hours: 3 hours lecture per week
Pre-requisite: EEE 333 (Control System I)		

Rationale
This course gives more advanced idea for control system I course and more to the application based study.

Course Objectives are
- State equations of digital systems
- Understand controllability and observability
- Understand various frequency and time domain analysis.

Course Contents:
- Compensation using pole placement technique.
- State equations of digital systems with sample and hold, state equation of digital systems, digital simulation and approximation.
- Solution of discrete state equations: by z-transform, state equation and transfer function, state diagrams,
- state plane analysis.
- Stability of digital control systems.
- Digital simulation and digital redesign.
- Time domain analysis. Frequency domain analysis.
- Controllability and observability.
- Optimal linear digital regulator design.
- Digital state observer.
- Microprocessor control.
- Introduction to neural network and fuzzy control, adaptive control. Hu Control, nonlinear control.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	State equations of digital systems
CO 2	Understand controllability and observability.
CO 3	Understand various frequency and time domain analysis.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	**X**								
CO 2	**X**						X		
CO 3	**X**	**X**							

Course Title: Optical Fiber Communication		Year/Semester: 4/2	Course Status: Theory (Major, optional)
Course Code: EEE 475	Credits: 3.0	Contact hours: 3 hours lecture per week	
Pre-requisite: PHY 101E (Physics I), EEE 321 (Communication I)_			

Rationale
This course gives basic idea about communication based on optics

Course Objectives:

- To introduce the principles of optical fiber communication.
- To develop skills in designing and analyzing simple optical fiber communication systems.
- To provide an overview of optical amplifiers and wavelength-division multiplexing (WDM).

Course Contents:
Introduction. Light propagation through optical fiber: Ray optics theory and mode theory. Optical fiber: Types and characteristics, transmission characteristics, fiber joints and fiber couplers. Light sources: Light emitting diodes and laser diodes. Detectors: PIN photo-detector and avalanche photo-detectors. Receiver analysis: Direct detection and coherent detection, noise and limitations. Transmission limitations: Chromatic dispersion, nonlinear refraction, four wave mixing and laser phase noises. Optical amplifier: Laser and fiber amplifiers, applications and limitations. Multi-channel optical system: Frequency division multiplexing, wavelength division multiplexing and co-channel interference.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	To introduce the principles of optical fiber communication.
CO 2	To develop skills in designing and analyzing simple optical fiber communication systems.
CO 3	To provide an overview of optical amplifiers and wavelength-division multiplexing (WDM).

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X				X				
CO 2	X								
CO 3	X	X							

Course Title: Optical Fiber Communication		Year/Semester: 4/2	Course Status: Lab (Major, optional)
Course Code: EEE 476	Credits: 1.5	Contact hours: 3 hours lecture per week	
Pre-requisite: PHY 101E (Physics I), EEE 321 (Communication I)_			

Rationale
This course gives basic idea about communication based on optics.

Course Objectives are

- To provide hands-on experience with optical fiber communication components and systems.
- To develop practical skills in assembling and testing optical fiber communication systems.
- To enhance students' understanding of optical fiber communication theory through laboratory experiments and measurements.

Course Contents:
This course consists of two parts. In the first part, students will perform experiments to verify practically the theories and concepts learned in EEE 475. In the second part, students will design simple systems using the principles learned in EEE 475.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	To provide hands-on experience with optical fiber communication components and systems.
CO 2	To develop practical skills in assembling and testing optical fiber communication systems.
CO 3	To enhance students' understanding of optical fiber communication theory through laboratory experiments and measurements.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2	X				X				
CO 3	X	X							

Course Title**:** VLSI	Year/Semester: 4/2	Course Status: Theory (Optional)
Course Code: EEE 491	Credits: 1.5	Contact hours: 3 hours lecture per week
Pre-requisite: EEE 221 (Electronics I), EEE 231 (Electronics II),		

Rationale
This course gives basic idea about the subject based on Very Large-Scale Integration.

Course Objectives are

- Understand the fundamental principles of integrated circuit design and fabrication, including semiconductor physics, transistor operation, and basic building blocks of digital and analog circuits at the VLSI level.
- Explore various design methodologies used in VLSI chip design, including RTL (Register-Transfer Level) design, logic synthesis, and physical design. Learn to use industry-standard Electronic Design Automation (EDA) tools for designing and simulating VLSI circuits.
- Study advanced VLSI design techniques such as power optimization, timing Closure, and design for manufacturability (DFM). Gain insights into complex topics like Clock distribution, interconnect design, and signal integrity in high-density integrated circuits.
- Apply theoretical knowledge to real-world scenarios by undertaking hands-on projects. Design, simulate, and layout VLSI circuits using industry tools, considering factors like power consumption, performance, and area efficiency. Develop problem-solving skills for common VLSI design challenges.
- Explore emerging trends and technologies in the field of VLSI, such as System-on-Chip (SoC) design, three-dimensional integrated circuits (3DICs), and hardware acceleration using Field-Programmable Gate Arrays (FPGAs) or Application-Specific Integrated Circuits (ASICs).

Course Contents:

VLSI technology: Top down design approach, technology trends and design styles. Review of MOS transistor theory: Threshold voltage, body effect, I-V equations and characteristics, latch-up problems, NMOS inverter, CMOS inverter, pass-transistor and transmission gates. CMOS circuit characteristics and performance estimation: Resistance, capacitance, rise and fall times, delay, gate transistor sizing and power consumption. CMOS circuit and logic design: Layout design rules and physical design of simple logic gates. CMOS subsystem design: Adders, multiplier and memory system, arithmetic logic unit. Programmable logic arrays. I/O systems. VLSI testing.

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Understanding MOS Transistor Operation and CMOS Logic Design
CO 2	Designing and Analyzing CMOS Circuits and Subsystems
CO 3	Applying Layout Design Rules and VLSI Testing Techniques

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	**X**								
CO 2	**X**				**X**				
CO 3	**X**	**X**							

Course Title**:** VLSI Lab	Year/Semester: 4/2	Course Status: Theory (Optional)
Course Code: EEE 492	Credits: 1.5	Contact hours: 3 hours lecture per week
Pre-requisite: EEE 221 (Electronics I), EEE 231 (Electronics II),		

Rationale
This course is the lab based practical work based on EEE 491

Course Objectives are

- Apply theoretical knowledge to real-world scenarios by undertaking hands-on projects. Design, simulate, and layout VLSI circuits using industry tools, considering factors like power consumption, performance, and area efficiency. Develop problem-solving skills for common VLSI design challenges.
- Explore emerging trends and technologies in the field of VLSI, such as System-on-Chip (SoC) design, three-dimensional integrated circuits (3DICs), and hardware acceleration using Field-Programmable Gate Arrays (FPGAs) or Application-Specific Integrated Circuits (ASICs).

Course Contents:

1. Transistor Characteristics and Logic Styles Lab
2. CMOS Circuit Design and Sizing Lab
3. Layout Design and Physical Design Lab
4. Subsystem Design Lab
5. Programmable Logic Array (PLA) Lab
6. I/O System Design Lab
7. VLSI Testing and Fault Detection Lab

Course Learning Outcomes:
After the successful completion of the course, the student will be able to-

CO 1	Understanding MOS Transistor Operation and CMOS Logic Design
CO 2	Designing and Analyzing CMOS Circuits and Subsystems
CO 3	Applying Layout Design Rules and VLSI Testing Techniques

Mapping of Course Learning Outcomes to Program Learning Outcomes

PO/ CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	**X**								
CO 2	**X**				**X**				
CO 3	**X**	**X**							

Reference Books:

1. "CMOS VLSI Design: A Circuits and Systems Perspective" by Neil H. E. Weste and David Money Harris.
2. "Digital Integrated Circuits: A Design Perspective" by Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolić.
3. "VLSI Design" by K. Lal Kishore and V. S. V. Prabhakar.
4. "Principles of CMOS VLSI Design: A Systems Perspective" by Neil H. E. Weste, Kamran Eshraghian.
5. "Modern VLSI Design: IP-Based Design" by Wayne Wolf.
6. "Introduction to VLSI Circuits and Systems" by John P. Uyemura.
7. "CMOS Digital Integrated Circuits: Analysis and Design" by Sung-Mo Kang and Yusuf Leblebici.