Regulations 2021
Curriculum and Syllabi
(Updated upto April 2023, as per 20th Academic Council)

B.Tech.
(Electrical and Electronics Engineering)

B.S. Abdur Rahman ™
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

REGULATIONS 2021

CURRICULUM AND SYLLABI

(Updated upto April 2023, as per 20th Academic Council)

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

B.S.Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

VISION

To achieve excellence in the programs offered by the Department of Electrical and Electronics Engineering through quality teaching, holistic learning and innovative research.

MISSION

- To offer Under Graduate, Post Graduate & Research programs of industrial and societal relevance.
- To provide knowledge and skill in the design and realization of electrical and electronic circuits and systems.
- To impart necessary managerial and soft skills to face the industrial challenges.
- To pursue academic and collaborative research with industry and research institutions in India and abroad.
- To disseminate research outcomes through publications, seminars, and workshops.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.TECH. (ELECTRICAL AND ELECTRONICS ENGINEERING)

PROGRAMME EDUCATIONAL OBJECTIVES

On successful completion of the programme, the graduates will

PEO 1 solve real world problems related to electrical and electronics engineering in industry through strong foundation in mathematics, science and engineering.

PEO 2 design, implement, and evaluate electrical and electronics systems, addressing contemporary challenges and considering societal and environmental aspects.

PEO 3 exhibit effective communication, teamwork, and leadership skills, enabling them to become entrepreneur and to work collaboratively in multidisciplinary environments.

PEO 4 pursue higher education to choose career path in teaching and research.

PEO 5 uphold ethical and professional values, promoting sustainable practices and demonstrating social responsibility in their engineering endeavours

PROGRAMME OUTCOMES

On successful completion of the programme, the graduates will

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.

9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

1. Design, Simulate and Analyse the Electrical and Magnetic Systems in the areas of Electrical and Electronics Engineering and arrive at appropriate solutions.

2. Competent to work professionally in an Industrial Environment.

REGULATIONS - 2021

B.TECH. DEGREE PROGRAMMES

(Under Choice Based Credit System)

(Amendments Approved by the 19th Academic Council – September 2022)

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme.

ii) **"Branch"** means specialization or discipline of B.Tech. Degree Programme like Civil Engineering, Mechanical Engineering, etc.,

iii) **"Course"** means theory / practical / laboratory integrated theory / seminar / internship / project and any other subject that is normally studied in a semester like English, Mathematics, Environmental Science, Engineering Graphics, Electronic Devices etc.,

iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.

v) **“Academic Council”** means the Academic Council, which is the apex body on all academic matters of this Institute.

vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.

vii) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of of the Institution who is responsible for activities related to student welfare and discipline in the campus.

viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.

ix) **“Dean of the School”** means the Dean of the School of the department concerned.

x) **“Head of the Department”** means the Head of the Department concerned.

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight semester B. Tech. degree programme shall be required to have passed the

Higher Secondary Examination of the 10+2 curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

2.1b) The student shall have studied at least any three of the following courses: Physics, Mathematics, Chemistry, Computer Science, Electronics, Information Technology, Biology, Informatics Practices, Biotechnology, Technical Vocational Subjects, Agriculture, Engineering Graphics, Business Studies, Entrepreneurship at 10+2 level. In case if the student has not studied any or all the courses viz., mathematics, physics and chemistry, he / she shall undergo bridge course(s) in the concerned course(s) at 10+2 level knowledge.

2.2 Notwithstanding the qualifying examination, the candidate might have passed at 10+2, the candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in the courses considered eligible for admission on the standards prescribed for 10+2 academic stream.

2.3 Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry category shall be required to have passed minimum Three years / Two years (Lateral Entry) Diploma examination in any branch of Engineering / Technology or passed B.Sc. Degree from a recognized University as defined by UGC and passed 10+2 examination with Mathematics as a subject or Passed three year Diploma of Vocation Stream (D.Voc) in the same or allied sector or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.4 The Institution shall offer suitable bridge courses in Mathematics, Physics, Engineering drawing, etc., for the students of diverse backgrounds.

2.5 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution in adherence to the guidelines of regulatory authorities from time to time.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. Degree programmes in various branches of Engineering and Technology, each distributed over eight semesters, with two semesters per academic year.

1. Aeronautical Engineering
2. Artificial Intelligence and Data Science
3. Automobile Engineering
4. Biotechnology
5. Civil Engineering
6. Computer Science and Engineering
7. Computer Science and Engineering (Cyber Security)
8. Computer Science and Engineering (Internet of Things)
9. Electrical and Electronics Engineering
10. Electronics and Communication Engineering
11. Electronics and Instrumentation Engineering
12. Information Technology
13. Mechanical Engineering
14. Polymer Engineering

4.0 STRUCTURE OF THE PROGRAMME

4.1 Every programme has a curriculum with syllabi consisting of theory and practical courses such as,

i) Basic Science Courses - BSC
ii) Humanities and Social Sciences including Management Courses - HSC
iii) Engineering Science Courses - ESC
iv) Professional Core Courses - PCC
v) Professional Elective Courses - PEC
vi) Open Elective Courses - OEC
vii) Laboratory Courses – LC
viii) Laboratory Integrated Theory Courses – LITC
ix) Mandatory Courses- MC
x) Project - PROJ (Project work, seminar and internship in industry or at appropriate workplace)

4.1.1 Mandatory Induction Programme for First year Students

The first year students upon admission shall undergo a mandatory three week induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local areas, familiarization with departments / schools and centres, etc.,

4.1.2 Personality and Character Development

All students shall enroll, on admission, in any of the following personality and character development programmes:

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO)
- Youth Red Cross (YRC)
- Rotaract
- Crescent Indian Society Training Development (ISTD – C)
- Crescent Creative Strokes
- Crescent Technocrats club

The training activities / events / camp shall normally be organized during the weekends / vacation period.

4.1.3 Online Courses for Credit Transfer

Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean (Academic Affairs) during his / her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

4.1.4 Value Added Courses

The students are permitted to pursue department approved online courses (excluding courses registered for credit transfer) or courses offered / approved by the department as value added courses.

The details of the value added course viz., syllabus, schedule of classes and the course faculty shall be sent to the Dean (Academic

Affairs) for approval. The students may also undergo the valued added courses offered by other departments with the consent of the Head of the Department offering the course.

These value added courses shall be specified in the consolidated mark sheet as additional courses pursued by the student over and above the curriculum during the period of study.

4.1.5 Industry Internship

The students shall undergo training for a period as specified in the curriculum during the summer vacation in any industry relevant to the field study.

The students are also permitted to undergo internship at research organizations / eminent academic institutions for the period prescribed in the curriculum during the summer vacation, in lieu of Industrial training.

In any case, the student shall obtain necessary approval from the Head of the Department / Dean of School and the training has to be taken up at a stretch.

4.1.6 Industrial Visit

The student shall undergo at least one industrial visit every year from the second year of the programme. The Heads of Departments / Deans of Schools shall ensure the same.

4.2 Each course is normally assigned certain number of credits:

- one credit per lecture period per week
- one credit per tutorial period per week
- one credit for two to three periods and two credits for four periods of laboratory or practical sessions per week
- one credit for two periods of seminar / project work per week
- one credit for two weeks of industrial training or 80 hours per semester.

4.3 Each semester curriculum shall normally have a blend of lecture courses, laboratory courses, laboratory integrated theory courses, etc.

4.5 The medium of instruction, examinations and project report shall be in

English, except for courses in languages other than English.

5.0 DURATION OF THE PROGRAMME

5.1 A student is expected to complete the B.Tech. programme in eight semesters (six semesters in the case of lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry students).

5.2 Each semester shall consist of a minimum of 90 working days including the days of examinations.

5.3 The maximum duration for completion of the programme as mentioned in clause 5.1 shall also include period of break of study vide clause 7.1 so that the student may be eligible for the award of the degree.

6.0 REGISTRATION AND ENROLLMENT

6.1 The students of first semester shall register and enroll for courses at the time of admission by paying the prescribed fees. For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

6.2 Change of a Course

A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

6.3 Withdrawal from a Course

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

7.0 BREAK OF STUDY FROM PROGRAMME

7.1 A student may be allowed / enforced to take a break of study for two semesters from the programme with the approval of Dean (Academic Affairs) for the following reasons:

7.1.1 Medical or other valid grounds

7.1.2 Award of ‘I’ grade in all the courses in a semester due to lack of attendance

7.1.3 Debarred due to any act of indiscipline

7.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1).

7.3 A student who has availed a break of study in the current semester (odd/even) can rejoin only in the subsequent corresponding (odd/even) semester in the next academic year on approval from the Dean (Academic affairs).

7.4 During the break of study, the student shall not be allowed to attend any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 Class Advisor

A faculty member shall be nominated by the Head of the Department as class advisor for the class throughout the period of study except first year.

The class advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

However, for the first and second semester, the class advisors (first year class advisors) are nominated by the first year coordinator.

8.2 Faculty Advisor

To help the students in planning their courses of study and for general counseling, the Head of the Department of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

9.0 COURSE COMMITTEE

9.1 Each common theory course offered to more than one group of students shall have a "Course Committee" comprising all the course faculty teaching the common course with one of them nominated as a course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending on whether all the course faculty teaching the common course belong to a single department or from several departments. The course committee shall ensure preparation of a common question paper and scheme of evaluation for the tests and semester end examination.

10.0 CLASS COMMITTEE

A class committee is constituted branch wise and semester wise by the Head of the Department / Dean of the School shall normally comprise of faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman.

10.1 The composition of class committees for first and second semester is as follows:

i) The first year coordinator shall be the chairman of the class committee
ii) Faculty members of all individual courses of first / second semester
iii) Six student representatives (male and female) of each class nominated by the first year coordinator
iv) The class advisor and faculty advisors of the class

10.2 The composition of the class committee for each branch from 3rd to 8th semester is as follows:

i) One senior faculty member preferably not handling courses for the concerned semester appointed as chairman by the Head of the Department
ii) All the faculty members handling courses of the semester
iii) Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors
iv) All faculty advisors and the class advisors
v) Head of the Department

10.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the components of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

10.4 During these two meetings, the student members shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi, etc.

10.5 The third meeting of the class committee, excluding the student members, shall meet after the semester end examinations to analyse the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the course faculty concerned.

11.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER

11.1 A student can enroll for a maximum of 32 credits during a semester including Redo / Predo courses.

11.2 The minimum credits earned by the student to move to 7th semester shall not be less than 60 credits (40 credits for lateral entry students).

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

12.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 6	1.5 hours	25%
Assessment 2	7 to 12	1.5 hours	25%
Semester End Examination	Full course	3 hours	50%

12.2 Theory Course

Appearing for semester end theory examination for each course is mandatory and a student shall secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

12.3 Laboratory Course

Every practical course shall have 60% weightage for continuous assessments and 40% for semester end examination. However, a student shall have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.4 Laboratory Integrated Theory Courses

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory components shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical components shall be through continuous assessment.

12.5 The components of continuous assessment for theory / practical / laboratory integrated theory courses shall be finalized in the first class committee meeting.

12.6 Industry Internship

In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research / academic organisation. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.

12.7 Project Work

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School will carry out three periodic reviews. Based on the project report submitted by the students, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by the Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the viva voce examination.

12.8 Assessment of seminars and comprehension shall be carried out by a committee of faculty members constituted by the Head of the Department.

12.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall become invalid.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. There shall be no arrear or improvement examination for lab components.

13.0 SUBSTITUTE EXAMINATIONS

13.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Head of the Department / Dean of the School for that purpose. There is no substitute examination for semester end examinations.

13.2 A student shall apply for a substitute exam in the prescribed form to the Head of the Department / Dean of the School within a week from the date of assessment test. However, the substitute examination will be conducted only after the last instructional day of the semester.

14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

14.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded “I” grade in that course.

14.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in the concerned course to the class advisor. The class advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

14.3 If a student secures attendance between 65% and less than 75% in any course in a semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the institution approved events, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course. In all such cases, the students shall submit the required documents immediately after joining the classes to the class advisor, which shall be approved by the Head of the Department / Dean of the School. The Vice Chancellor, based on the recommendation of the Dean (Academic Affairs) may approve the condonation of attendance.

14.4 A student who has obtained an “I” grade in all the courses in a semester is not permitted to move to the next higher semester. Such students shall repeat all the courses of the semester in the subsequent academic year.

14.5 The student awarded “I” grade, shall enroll and repeat the course when it is offered next. In case of “I” grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of the Head of the

Department / Dean of the School.

14.6 A student who is awarded “U” grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains “U” grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.

14.7 If a student with “U” grade, who prefers to redo any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier “U” grade and continuous assessment marks shall continue.

15.0 REDO COURSES

15.1 A student can register for a maximum of three redo courses per semester without affecting the regular semester classes, whenever such courses are offered by the concerned department, based on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

15.2 The number of contact hours and the assessment procedure for any redo course shall be the same as regular courses, except there is no provision for any substitute examination and withdrawal from a redo course.

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

16.1 All assessments of a course shall be made on absolute marks basis. The class committee without the student members shall meet to analyse the performance of students in all assessments of a course and award letter grades following the relative grading system. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points

S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
I	-

"W" - denotes withdrawal from the course

"I" - denotes inadequate attendance in the course and prevention from appearance of semester end examination

"U" - denotes unsuccessful performance in the course.

16.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student for improvement of grade.

16.3 Upon awarding grades, the results shall be endorsed by the chairman of the class committee and Head of the Department / Dean of the School. The Controller of Examinations shall further approve and declare the results.

16.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to the Controller of Examinations. Subsequently, the Head of the Department / Dean of the School offered the course shall constitute a revaluation committee consisting of chairman of the class committee as convener, the faculty member of the course and a senior faculty member having expertise in that course as members. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

16.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from the first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If C_i, is the number of credits assigned for the i^{th} course and GP_i is the Grade Point in the i^{th} course,

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i}$$

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

“I” and "W" grades are excluded for calculating GPA.

"U", “I” and **"W"** grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks shall be as follows:

Percentage equivalent of marks = CGPA X 10

16.6 After successful completion of the programme, the degree shall be awarded to the students with the following classifications based on CGPA.

Classification	**CGPA**
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the prescribed period of 8 semesters for all students (except lateral entry students) and 6 semesters for lateral entry students
First Class	6.50 and above and completing the programme within a maximum of 10 semesters for all students (except lateral entry students) and 8 semesters

	for lateral entry students
Second Class	Others

16.6.1 Eligibility for First Class with Distinction

- A student should not have obtained ‘U’ or ‘I’ grade in any course during his/her study
- A student should have completed the UG programme within the minimum prescribed period of study (except clause 7.1.1)

16.6.2 Eligibility for First Class

- A student should have passed the examination in all the courses not more than two semesters beyond the minimum prescribed period of study (except clause 7.1.1)

16.6.3 The students who do not satisfy clause 16.6.1 and clause 16.6.2 shall be classified as second class.

16.6.4 The CGPA shall be rounded to two decimal places for the purpose of classification. The CGPA shall be considered up to three decimal places for the purpose of comparison of performance of students and ranking.

17.0 SUPPLEMENTARY EXAMINATION

Final year students and passed out students can apply for supplementary examination for a maximum of three courses thus providing an opportunity to complete their degree programme. Likewise, students with less credits in VI semester can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in the even semester.

18.0 DISCIPLINE

18.1 Every student is expected to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

18.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the Head of the Department / Dean of the School concerned shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action. This committee shall also address the grievances related to the conduct of online classes.

19.0 ELIGIBILITY FOR THE AWARD OF DEGREE

19.1 A student shall be declared to be eligible for the award of B.Tech. degree provided the student has:

i) Successfully earned the required number of total credits as specified in the curriculum of the programme of study within a maximum period of 14 semesters (12 semesters for lateral entry) from the date of admission, including break of study.

ii) Successfully completed the requirements of the enrolled professional development activity.

iii) No dues to the Institution, Library, Hostel, etc.

iv) No disciplinary action pending against him/her.

19.2 The award of the degree must have been approved by the Institution.

20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

20.1 The students admitted in the following B.Tech. programmes can graduate with a minor degree, which is optional, along with a major degree:

• Civil Engineering	• Mechanical Engineering
• Electronics and Communication Engineering	• Electrical and Electronics Engineering
• Automobile Engineering	• Aeronautical Engineering
• Polymer Engineering	• Biotechnology Engineering
• Electronics and Instrumentation Engineering	• Computer Science and Engineering
• Information Technology	• Artificial Intelligence and Data Science
• Computer Science and Engineering (IoT)	• Computer Science and Engineering(Cyber Security)

20.2 The eligibility for choosing the minor degree is given as below:

Sl. No.	**Minor Degree**	**Eligible Major Degree Programmes (from other Departments)**
1.	Artificial Intelligence and Machine Learning	Mechanical Engineering Aeronautical Engineering Polymer Engineering
2.	Block Chain	

3.	Cyber Security	Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering
4.	Data Science	
5.	Internet of Things (IoT)	
6.	Virtual and Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering
8.	Robotics	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering
9.	3D Printing	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering

		Information and Technology Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electronics and Communication Engineering
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electronics and Communication Engineering
12.	GIS and Remote Sensing	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering

		Automobile Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
13.	Computational Biology	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering

20.3 A student shall earn an additional 18 to 20 credits for the award of a minor degree.

20.4 A student shall be awarded a minor degree only when he / she completes the requirements for the award of major degree stipulated in the respective programme.

21.0 POWER TO MODIFY

Notwithstanding all that has been stated above, the Academic Council has the right to modify the above regulations from time to time.

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B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE ANDTECHNOLOGY

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM FRAME WORK, REGULATIONS 2021

(Choice Based Credit System)

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BSC	PHD 1182	Engineering Physics *	3	0	2	4
2.	BSC	CHD 1182	Chemistry for Electrical and Electronic Engineering *	3	0	2	4
3.	BSC	MAD 1181	Algebra and Differential Calculus	3	1	0	4
4.	ESC	GED 1101	Engineering Graphics *	2	0	2	3
5.	ESC	GED 1102	Engineering Design	2	0	0	2
6.	ESC	GED 1103	Manufacturing Practices Laboratory	0	0	2	1
7.	ESC	GED 1104	Programming for Problem Solving **	1	0	2	2
			Credits				**20#**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	END 1181	English for Engineers	3	0	0	3
2.	BSC		Physics Elective	2	0	0	2
3.	BSC	MAD 1283	Partial Differential Equations and Transforms	3	1	0	4
4.	ESC	GED 1201	Engineering Mechanics	3	1	0	4
5.	ESC	EED 1201	Electric and Magnetic Circuits	3	0	0	3
6.	PCC	EED 1202	Signals and Systems	3	0	0	3
7.	PCC	EED 1203	Electric Circuits Laboratory	0	0	2	1
8.	MC	GED 1206	Environmental Sciences	2	0	0	2
			Credits				**22**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC		Humanities Elective I	3	0	0	3
2.	BSC		Mathematics Elective	3	1	0	4
3.	PCC	EED 2101	Electronic Devices	3	0	0	3
4.	PCC	EED 2102	Electro Magnetic Theory	2	1	0	3
5.	PCC	EED 2103	Electromechanical Energy Conversion	3	0	0	3
6.	PCC	EED 2104	Transmission and Distribution	3	0	0	3
7.	PCC	EED 2105	Electronic Devices Laboratory	0	0	2	1
8.	PCC	EED 2106	Electromechanical Energy Conversion Laboratory	0	0	2	1
9.	HSC	GED 2101	Essential Skills and Aptitude for Engineers	0	0	2	1
			Credits				**22**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	EED 2201	AC Machines	3	0	0	3
2.	PCC	EED 2202	Digital Electronics	3	0	0	3
3.	PCC	EED 2203	Electrical Measurement and Instrumentation	3	0	0	3
4.	PCC	EED 2204	Power System Protection	3	0	0	3
5.	PCC	EED 2205	Python for Electrical Engineers *	2	0	2	3
6.	PCC	EED 2206	AC Machines Laboratory	0	0	2	1
7.	PCC	EED 2207	Digital Electronics Laboratory	0	0	2	1
8.	PCC	EED 2208	Electrical Measurement and Instrumentation Laboratory	0	0	2	1
9.	PEC		Professional Elective Course I	3	0	0	3
10.	HSC	GED 2201	Workplace Skills and Aptitude for Engineers	0	0	2	1
11.	MC	GED 2202	Indian Constitution and Human	2	0	0	0

Rights

Credits **22**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	EED 3101	Embedded System	3	0	0	3
2.	PCC	EED 3102	Power System Analysis	3	0	0	3
3.	PCC	EED 3103	Power Electronics	3	0	0	3
4.	PCC	EED 3104	VLSI Design*	2	0	2	3
5.	PCC	EED 3105	Embedded System Laboratory	0	0	2	1
6.	PCC	EED 3106	Power System Simulation Laboratory	0	0	2	1
7.	PCC	EED 3107	Power Electronics Laboratory	0	0	2	1
8.	PEC		Professional Elective – II	3	0	0	3
9.	PEC		Professional Elective - III	3	0	0	3
10.	HSC	GED 3101	Communication Skills for Career Success	0	0	2	1
11.	PROJ	EED 3108	Internship I ##	0	0	0	1
			Credits				**23**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	MSD 3281	Entrepreneurship	3	0	0	3
2.	HSC		Humanities Elective II	2	0	0	2
3.	HSC	GED 3201	Reasoning and Aptitude for Engineers	0	0	2	1
4.	OEC		Open Elective I	3	0	0	3
5.	PCC	EED 3201	Control Systems	3	0	0	3
6.	PCC	EED 3202	Electric Vehicle Technology	3	0	0	3
7.	PCC	EED 3203	Control Systems Laboratory	0	0	2	1
8.	PEC		Professional Elective – IV	3	0	0	3
9.	PCC	EED 3204	Self Learning	0	1	0	1
10.	PCC	EED 3206	Electric Mobility Laboratory	0	0	2	1
			Credits				**21**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	OEC		Open Elective II	3	0	0	3
2.	OEC		Open Elective III	3	0	0	3
3.	PCC	EED 4101	PLC SCADA and DCS *	3	0	2	4
4.	PEC		Professional Elective Course V	3	0	0	3
5.	PEC		Professional Elective Course VI	3	0	0	3
6.	PEC		Professional Elective Course VII	3	0	0	3
7.	PEC		Professional Elective Course VIII	3	0	0	3
8.	PROJ	EED 4102	Internship II ###				1
9.	HSC	GED 4101	Employability Skills $	0	0	2	1
			Credits				**23**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PROJ	EED 4201	Project Work				9
			Credits				**9**

Overall Total Credits – 162

*	Laboratory Integrated Theory course
**	Laboratory Course
#	Three Week Orientation Programme – Mandatory Non-Credit Course
##	15 days of Industrial training during the summer vacation of second year. The credit will be awarded in the 5th Semester.
###	15 days of Industrial training during the summer vacation of third year. The credit will be awarded in the 7th Semester.
$	Not a Mandatory Course - The student will take up this course during the Summer Holidays of III year as a comprehension of Soft Skills courses offered from semester III to VI. Upon successful completion, the course will be mentioned in grade sheet of VII semester.

PROFESSIONAL ELECTIVE COURSES

The professional elective courses will be offered in a semester only after satisfying the prerequisites.

POWER SYSTEM ENGINEERING

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	EEDX 01	Distribution System Engineering	3	0	0	3
2.	PEC	EEDX 02	Electric Energy Generation, Utilization and Conservation	3	0	0	3
3.	PEC	EEDX 03	Energy Conservation and Audit	3	0	0	3
4.	PEC	EEDX 04	Flexible AC Transmission Systems	3	0	0	3
5.	PEC	EEDX 06	Industrial Power System Analysis and Design	3	0	0	3
6.	PEC	EEDX 07	Power System Operation and Control	3	0	0	3
7.	PEC	EEDX 08	Power System Transients	3	0	0	3
8.	PEC	EEDX 10	Restructured Power System	3	0	0	3
9.	PEC	EEDX 11	High Voltage Engineering	3	0	0	3
10.	PEC	EEDX 12	Network Analysis and Synthesis	3	0	0	3
11.	PEC	EEDX 13	Gas Insulated Substation	3	0	0	3

POWER ELECTRONICS & DRIVES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	EEDX 21	Converters, Applications and Design	3	0	0	3
2.	PEC	EEDX 22	Electric Power Quality	3	0	0	3
3.	PEC	EEDX 23	Electrical Machine Design	3	0	0	3
4.	PEC	EEDX 24	Embedded Control of Electric Drives(removed)	3	0	0	3
5.	PEC	EEDX 25	HVDC Transmission	3	0	0	3
6.	PEC	EEDX 26	Power Electronics Application to Renewable Energy Systems	3	0	0	3

7.	PEC	EEDX 27	Solid state Drives	3	0	0	3
8.	PEC	EEDX 28	Special Electrical Machines	3	0	0	3
9.	PEC	EEDX 29	Wind Energy Conversion Systems	3	0	0	3

ELECTRONICS, COMMUNICATION AND INSTRUMENTATION ENGINEERING

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	ECDX 011	ARM architecture and Programming	3	0	0	3
2.	PEC	ECDX 081	Communication Engineering	3	0	0	3
3.	PEC	ECDX 082	Digital Signal Processing	3	0	0	3
4.	PEC	ECDX 086	Computer Communication Networks	3	0	0	3
5.	PEC	EIDX 91	Advanced Control System	3	0	0	3
6.	PEC	EIDX 92	Bio Instrumentation and Signal Analysis	3	0	0	3
7.	PEC	EIDX 93	Biomedical Signal Processing	3	0	0	3
8.	PEC	EIDX 94	Industrial Instrumentation	3	0	0	3
9.	PEC	EIDX 95	Sensors for Bio-Medical Application	3	0	0	3
10.	PEC	EIDX 96	Transducers	3	0	0	3

COMPUTER SCIENCE AND ENGINEERING

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	CSDX 81	Introduction to Cloud Computing	3	0	0	3
2.	PEC	CSDX 82	Computer Hardware and Interfacing	3	0	0	3
3.	PEC	CSDX 83	Computer Networks	3	0	0	3

4.	PEC	CSDX 84	Fundamentals of Data Structures	3	0	0	3
5.	PEC	CSDX 85	Java Programming	3	0	0	3

RECENT TECHNOLOGY IN ELECTRICAL ENGINEERING

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	EEDX 51	Artificial Intelligence for Electrical Engineers	3	0	0	3
2.	PEC	EEDX 52	Automotive Transmission and Communication	3	0	0	3
3.	PEC	EEDX 53	DC Micro grid	3	0	0	3
4.	PEC	EEDX 54	Energy Devices for Electric Vehicles	3	0	0	3
5.	PEC	EEDX 55	Grid Integration of Renewable Energy Systems	3	0	0	3
6.	PEC	EEDX 56	HEV / xEV Motor Drives and Controllers	3	0	0	3
7.	PEC	EEDX 57	Image and Video Processing	3	0	0	3
8.	PEC	EEDX 58	Industrial IoT	3	0	0	3
9.	PEC	EEDX 59	IoT for Electrical Engineers	3	0	0	3
10.	PEC	EEDX 60	Micro-grid Protection	3	0	0	3
11.	PEC	EEDX 61	Smart Grid	3	0	0	3
12.	PEC	EEDX 62	Solar Energy Technology	3	0	0	3
13.	PEC	EEDX 63	Machine Learning	3	0	0	3
14.	PEC	EEDX 64	Cost Economics Of Renewable Energy Systems	3	0	0	3
15.	PEC	EEDX 65	Digital Electrical Control System For Modern Buildings	3	0	0	3

PHYSICS ELECTIVES – II SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	PHDX 01	Non Destructive Testing of Materials	2	0	0	2
2	PHDX 02	Materials Science for Engineering	2	0	0	2
3	PHDX 03	Biomaterials	2	0	0	2
4	PHDX 04	Optical Fibre Communication	2	0	0	2
5	PHDX 05	Semiconductor Physics for Information Technology	2	0	0	2
6	PHDX 06	Sensors and Actuators	2	0	0	2
7	PHDX 07	Fundamentals of Nanotechnology and its Applications	2	0	0	2

MATHEMATICS ELECTIVES – III SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	MADX 01	Transforms and Partial Differential Equations	3	1	0	4
2	MADX 02	Discrete Mathematics	3	1	0	4
3	MADX 03	Probablity and Statistics	3	1	0	4
4	MADX 04	Random Processes	3	1	0	4
5	MADX 05	Numerical Methods	3	1	0	4

HUMANITIES ELECTIVES – III SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	SSDX 01	Engineering Economics and Management	2	0	0	2

2	SSDX 02	Sociology of Science and Technology	2	0	0	2
3	SSDX 03	Industrial Economics and Management	2	0	0	2
4	SSDX 04	Dynamics of Indian Social Structure	2	0	0	2

HUMANITIES ELECTIVES – VI SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	SSDX 11	Economics of Sustainable Development	2	0	0	2
2	SSDX 12	Sociology of Industrial Relations.	2	0	0	2
3	SSDX 13	Professional Ethics and Human Values	2	0	0	2
4	SSDX 14	Gender, Technology and Development	2	0	0	2

OPEN ELECTIVE COURSES FOR
B.TECH. PROGRAMMES R 2021 - VI SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX 201	Application of Fluid Mechanics in Everyday Life	3	0	0	3	Aero
2	GEDX 202	Basics of Management and Organizational Behaviour	3	0	0	3	CSB
3	GEDX 203	Big Data Analytics	3	0	0	3	CA
4	GEDX 204	Biology for Engineers	3	0	0	3	SLS
5	GEDX 205	Consumer Electronics	3	0	0	3	ECE
6	GEDX 206	Creative Writing	2	1	0	3	English
7	GEDX 207	Cyber Forensics	3	0	0	3	CSE
8	GEDX 208	Cyber Security	3	0	0	3	IT
9	GEDX 209	Disaster Management	3	0	0	3	Civil
10	GEDX 210	English for Competitive Examination	2	1	0	3	English
11	GEDX 211	Enterprise Risk Management	3	0	0	3	CSB
12	GEDX 212	Fundamentals of Project Management	3	0	0	3	CSB
13	GEDX 213	Industrial Robotics	2	0	2	3	Mech.
14	GEDX 214	Internet of Things and its Applications	3	0	0	3	ECE
15	GEDX 215	Introduction to Health Care Analytics	3	0	0	3	CA
16	GEDX 216	IPR and Patent Laws	3	0	0	3	CSB
17	GEDX 217	Logistics and Supply Chain Management	3	0	0	3	CSB
18	GEDX 218	Nano Materials and Technology	2	0	2	3	Physics / Chemistry
19	GEDX 219	Numerical Computational Tools for Engineers	2	0	2	3	EIE
20	GEDX 220	Optimization Techniques	3	0	0	3	EEE
21	GEDX 221	Polymers for Emerging Technologies	3	0	0	3	Polymer

22	GEDX 222	Programming Language Principles	3	0	0	3	CSE
23	GEDX 223	Public Speaking and Rhetoric	2	1	0	3	English
24	GEDX 224	Python Programming	2	0	2	3	IT
25	GEDX 225	R Programming	3	0	0	3	CA
26	GEDX 226	Smart Sensors for Healthcare Applications	3	0	0	3	EIE
27	GEDX 227	Total Quality Management	3	0	0	3	Mech.
28	GEDX 228	Value Education	3	0	0	3	Commerce
29	GEDX 229	Waste Water Management	3	0	0	3	Civil
30	GEDX 230	Web Application Development	3	0	0	3	CA

OPEN ELECTIVE COURSES FOR B.TECH. PROGRAMMES R 2021 - VII SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX 101	Advanced Entrepreneurship	3	0	0	3	CSB
2	GEDX 102	Artificial Intelligence and Machine Learning Applications	3	0	0	3	CSE
3	GEDX 103	Automotive Technology	3	0	0	3	Automobile
4	GEDX 104	Behavioural Psychology	3	0	0	3	SSSH
5	GEDX 105	Building Repair Solutions	3	0	0	3	Civil
6	GEDX 106	Cloud Services and Management	3	0	0	3	CA
7	GEDX 107	Cost Management for Engineers	3	0	0	3	Commerce
8	GEDX 108	Cyber Law and Ethics	3	0	0	3	CSL
9	GEDX 109	Data Analytics and Visualization	3	0	0	3	CA
10	GEDX 110	Deep Learning Essentials	3	0	0	3	CSE
11	GEDX 111	Drone Technologies	2	0	2	3	Aero
12	GEDX 112	Electric Vehicle	3	0	0	3	EEE

13	GEDX 113	Emerging Technologies in Mobile Networks	3	0	0	3	ECE
14	GEDX 114	Fundamentals of Data Science and Machine Learning	3	0	0	3	IT
15	GEDX 115	Genetic Engineering	3	0	0	3	SLS
16	GEDX 116	Green Design and Sustainability	3	0	0	3	Civil
17	GEDX 117	Image Processing and its Applications	3	0	0	3	ECE
18	GEDX 118	Industrial Automation and Control	3	0	0	3	EIE
19	GEDX 119	Industrial Safety	3	0	0	3	Mech.
20	GEDX 120	Industry 4.0	3	0	0	3	Mech.
21	GEDX 121	Introduction to Artificial Intelligence	3	0	0	3	IT
22	GEDX 122	Introduction to Artificial Intelligence and Evolutionary Computing	3	0	0	3	EEE
23	GEDX 123	Motor Vehicle Act and Loss Assessment	3	0	0	3	Automobile
24	GEDX 124	National Service Scheme	3	0	0	3	SSSH
25	GEDX 125	National Cadet Corps	3	0	0	3	SSSH
26	GEDX 126	Personal Finance and Investment	3	0	0	3	Commerce
27	GEDX 127	Soft Computing Techniques	3	0	0	3	CSE
28	GEDX 128	Value Analysis and Engineering	3	0	0	3	Mech.
29	GEDX 129	Vehicle Maintenance	3	0	0	3	Automobile

SEMESTER I

		L	T	P	C
PHD 1182	**ENGINEERING PHYSICS** *(Common to EEE, ECE, EIE,IT,CSE, IoT, CS and AI &DS)*	**3**	**0**	**2**	**4**
SDG: 4					

COURSE OBJECTIVES:

COB1: To equip the students on the knowledge of electromagnetic waves.

COB2: To make the students in understanding the importance of mechanics.

COB3: To introduce the basics of oscillations, optics and lasers.

COB4: To acquire basic knowledge about the principle and theory of solids.

COB5: To understand the importance of physics behind semiconductor devices.

MODULE I ELECTROMAGNETIC WAVES 9

Gauss's law – Faraday's law - Ampere's law–Properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Reflection and transmission of electromagnetic waves from a non-conducting medium.

MODULE II QUANTUM MECHANICS 9

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh-Jean's law– Matter waves–Physical significance of wave function – Schrodinger wave equation – Time independent and time-dependent wave equation – Applications: Particle in one-dimensional box –Introduction to quantum computing.

MODULE III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - Anti-reflection coating - Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet-Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: Nd:YAG laser He-Ne laser and semiconductor laser - Applications : Laser Materials Processing - Holography.

MODULE IV INTRODUCTION TO SOLIDS 9

Free electron theory of metals- Expression for electrical conductivity of metal-Fermi level-Fermi distribution function-Effect of Fermi function with temperature-Density of energy states-carrier concentration in metals-Effect of temperature on Fermi energy- Energy distribution of electrons- Work function of a metal-Electron in a periodic potential (Kronig and Penny model)-Brillouin Zones-Fermi surface-Effective mass of electron and hole-Energy bands in solids.

MODULE V PHYSICS OF SEMICONDUCTORS 9

Elemental and compound semiconductors –Direct and Indirect band gap semiconductors- Drift and diffusion current – Intrinsic semiconductors: Intrinsic carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature – Mobility and electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductor (derivation) – Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect.

PRACTICALS

List of Experiments

1. Determination of thickness of a thin wire / sheet using Air Wedge method.
2. Determination of wavelength of laser light using semiconductor laser diffraction.
3. Determination of angle of divergence of a laser beam using semiconductor diode laser and He-Ne laser.
4. Resistivity measurement of a semiconductor using four point probe method.
5. Determination of band gap of a semiconductor diode.
6. Determination of Hall coefficient of a given semiconductor material.
7. Determination of frequency of a tuning fork using Melde's string arrangement in transverse and longitudinal modes.
8. Determination of particle size of lycopodium powder using semiconductor laser.

L – 45; P – 30; Total Hours – 75

TEXT BOOKS:

1. P K. Palanisamy, Engineering Physics Vol I and II Scitech Publications (India) Pvt Ltd, 2018.
2. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.

REFERENCES:

1. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015.
2. Serway R.A. and Jewett, J.W., Physics for Scientists and Engineers with Modern Physics, Brooks/cole Publishing Co., 2010.
3. Tipler P.A. and Mosca, G.P., Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.
4. Markert J.T., Ohanian. H. and Ohanian, M., Physics for Engineers and Scientists, W.W. Norton & Co., 2007.
5. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.
6. Linear Integrated Circuits by D. Roy Choudhury and Shail Jain - New Age International (P) Ltd.(2003).
7. Integrated Electronics by J.Millman and C.Halkias, Tata McGraw Hill, New Delhi (2001).

COURSE OUTCOMES:

CO1: Express the knowledge of electromagnetic waves.

CO2: Comprehend the importance &principles of quantum mechanics and apply it to understand ideas of quantum computing.

CO3: Grasp ideas related to oscillations, interference phenomenon, apply it to understandoptical based devices and classify the different laser systems used forvarious applications.

CO4: Conceptualize the electron theory of metals and band structure of solids.

CO5: Understand the principles of physics behind semiconductors, Hall effectand apply the same to identify type of any semiconductor sample, evaluateno of charge carriers.

Board of Studies (BoS) :
BOS of Physics held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	M	L	L	L	M	M	-	-	-
CO2	H	M	M	L	L	M	L	L	L	L	L	M	-	-	-
CO3	H	M	M	L	L	L	L	L	L	L	L	M	-	-	-
CO4	H	M	M	L	M	M	M	L	L	L	M	M	-	-	-
CO5	H	M	M	L	M	M	M	L	L	L	M	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

		L	T	P	C
CHD 1182	**CHEMISTRY FOR ELECTRICAL AND ELECTRONIC ENGINEERING**	**3**	**0**	**2**	**4**

SDG: 9

COURSE OBJECTIVES:

To make the students conversant with

COB1: preparation, properties and applications of polymers and moulding techniques.

COB2: synthesis, properties and applications of nanomaterials

COB3: classification and description of different types of batteries and their applications.

COB4: concepts of photochemistry related to photophysical processes, chemical reactions and its applications.

COB5: types of corrosion and its prevention.

MODULE I POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS 10

Classification: source, heat, composition – glass transition temperature – preparation, properties and applications of polyethene (LDPE, HDPE), poly(vinyl chloride), PMMA, polycarbonate, teflon, ABS, bakelite, urea-formaldehyde, epoxy resin - conducting polymers: polyaniline, polyacetylene and poly(phenylene vinylene), rubber- vulcanised rubber, ebonite, EPDM, polymer blends and alloys - moulding techniques: injection moulding, compression moulding.

MODULE II NANOMATERIALS 10

Introduction – classification based on dimension with examples – properties of nanomaterials (surface to volume ratio and size quantisation effect) - synthesis of nanomaterials (Top-down and Bottom-up)– role of capping & reducing agents - CVD (CNT), laser ablation (Ag, Ag_2O), electrodeposition (semiconductor materials), precipitation (Ag, Au), thermolysis: solvothermal (CuO, CeO_2) and hydrothermal (TiO_2, ZnO, carbon dots), microwave method (metal oxide), biogenic method – nanocomposite.

MODULE III BATTERIES 8

Electrochemical and electrolytic cell – batteries: types (primary, secondary and flow cell) – primary batteries: dry cell, alkaline battery – secondary batteries: nickel cadmium cell – lead acid storage cell - lithium battery: primary and secondary type - PN junction solar cell, thin film solar cell.

MODULE IV PHOTOCHEMISTRY 9

Introduction: absorption and emission – laws of photochemistry: Grotthus-Draper law, Stark Einstein law – quantum efficiency – determination of quantum yield (problems) – Jablonski diagram: photo physical processes – IC, ISC, fluorescence and phosphorescence –(electronic states and transitions) – quenching – chemiluminescence – bioluminescence – photosensitization: principle and applications(photosynthesis and artificial photosynthesis) – photoelectrolysis.

MODULE V CORROSION AND ITS PREVENTION 8

Types of corrosion – dry and wet corrosion – galvanic corrosion – differential aeration corrosion – Prevention of corrosion: choice of materials, electroplating, electrolesss plating of PCB, coatings : paints: constituents and function – hot dipping – galvanizing, tinning – powder coating – anodising – special coatings: water repellent coatings, fire-retardant coatings, temperature indicating coatings.

PRACTICALS

1. Free radical polymerization of PMMA.
2. Preparation of phenol-formaldehyde.
3. Preparation of urea-formaldehyde.
4. Synthesis of epoxy resin.
5. Determination of molecular weight and degree of polymerisation of polyvinyl alcohol using viscometer
6. Electrochemical synthesis of graphene oxide
7. Synthesis of nano-ZnO by precipitation
8. Demonstration of Laser ablation techniques for nanomaterials
9. Construction of dry cell and alkaline battery
10. Measurement of EMF for different batteries.
11. Electroplating of copper
12. Determination of corrosion of mild steel in acidic, neutral and basic medium.

L – 45; P – 30; Total Hours – 75

TEXT BOOKS:

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai

and Sons, New Delhi. 2016.

REFERENCES:

1. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1986.
2. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
3. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge, 2005.
4. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

COURSE OUTCOMES:

The students will be able to

CO1: summarise the preparation, properties and applications of plastics used in electrical and electronic applications

CO2: synthesize different types of nanomaterials based on its size and applications.

CO3: illustrate construction and working of various types of batteries with the aid of a diagram.

CO4: state laws of photochemistry and elaborate the various types of photophysical processes and concepts of photochemistry.

CO5: explain the different types of corrosion and elaborate the methods of various coating techniques.

Board of Studies (BoS) :
11th BoS of Chemistry held on 17.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1		H		M					L						
CO2		H		M					L						
CO3		H													
CO4		M													
CO5		M	M			L	L								

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Industry, Innovation & Infrastructure

Statement: The synthesis and use of polymers and nanomaterials supports the industrial growth and innovation activities of the nation. The aspects of corrosion and its prevention will lead to corrosion free environment in the industry and infrastructure.

		L	T	P	C
MAD 1181	**ALGEBRA AND DIFFERENTIAL CALCULUS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To introduce matrix algebra techniques for engineers to apply in practical problems

COB2: To find the roots of polynomial equations using different techniques

COB3: To demonstrate the concepts of limits, continuity and application of differential calculus.

COB4: To familiarize the students with the functions of several variables

COB5: To develop the use of differential equations necessary for engineering applications

MODULE I MATRICES 9+3

Characteristic Equation- Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation

MODULE II THEORY OF EQUATIONS 9+3

Introduction - Surds and irrational roots – simple problems – Equations whose roots are in A.P,G.P and in H.P – Relations between the roots and coefficients – symmetric functions – Formation of equations – Decreasing and Increasing the roots – transformation of equation – Reciprocal equations

MODULE III DIFFERENTIAL CALCULUS 9+3

Limits of functions - one sided limits – Continuity - Curvature – Cartesian and polar coordinates – center and radius of curvature – Circle of curvature – Involutes and evolutes – Envelopes

MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

Laws of limits –Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobian - Taylor’s series expansion – Optima of two variables – Lagrange’s multiplier method

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 9+3

Linear equations of second order with constant and variable coefficients – Simultaneous first order linear equations with constant coefficients – homogeneous equations of Euler's type – method of undetermined coefficients- method of variation of parameters

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2010.
2. Grewal B.S., "Higher Engineering Mathematics" 44th edition, Khanna Publishers, New Delhi, 2017.
3. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2011

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Jain, R.K. & Iyengar, S. R. K., "Advanced Engineering Mathematics", Narosa Publishers, 5th edition, 2016.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
4. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
5. James Stewart ," Calculus" 7th edition, Brooks/Cole Cengage learning, UK

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: use the matrix algebra methods for finding eigenvalues, eigenvectors and diagonalization

CO2: solve equations using the relations between roots and coefficients

CO3: apply differential calculus in various engineering problems

CO4: able to use differential calculus on several variable functions

CO5: solve various types of differential equations that arise in many applications

Board of Studies (BoS) :

12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M		-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M		-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H		-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	M		-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-

SDG 4 :Ensure inclusive and equitable quality education and promote lifelong opportunities for all

Learning of various mathematical techniques like matrices and calculus will lead to knowledge of applications in Engineering problems

GED 1101 **ENGINEERING GRAPHICS**

L	T	P	C
2	0	2	3

SDG: 9

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of engineering drawing, and familiarize with conic sections, special curves and orthographic projection of points and straight lines

COB2: To get practical exposure on projection of planes and solids

COB3: To be familiar with sectioning of solids, and development of surfaces

COB4: To conversant with 3D isometric projection, and perspective projection of simple solids

COB5: To introduce computerized drafting using CADD for drawing the orthographic views of simple solids

MODULE I BASICS, ENGINEERING CURVES AND ORTHOGRAPHIC PROJECTION OF POINTS AND STRAIGHT LINES **L: 7 P: 7**

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.

Conic sections: ellipse, parabola, hyperbola. Special curves: cycloid, epicycloid, hypocycloid and involutes.

Orthographic projection – first angle, second angle, third angle and fourth angle projections. Orthographic projection of points in all quadrants. Projection of straight lines in first quadrant – true length and true inclinations – traces of straight line.

MODULE II PROJECTION OF PLANES AND SOLIDS **L: 7 P: 7**

Projection of plane lamina in first quadrant and its traces

Projection of solids in first quadrant: Axis inclined to one reference plane only- prism, pyramid, cone, and cylinder – change of position method

MODULE III SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **L:5 P:5**

Section of solids: prism, pyramid, cone and cylinder– sectional view – true shape of section- cutting simple position solids - plane inclined to one reference plane only.

Development of surface of truncated solids: prism, pyramid, cone and cylinder – frustum of cone, pyramid and simple sheet metal parts.

MODULE IV THREE DIMENSIONAL PROJECTIONS L:4
P: 4

Isometric projection: Isometric scale – isometric axes- Isometric projection and view of prism, pyramid, cylinder, cone and frustums.
Perspective projection: station point – vanishing point – Perspective projection and views of prism, pyramid by Visual ray method.

MODULE V ORTHOGRAPHIC PROJECTION USING CADD L:7
P:7

Introduction to CADD - Basic commands for sketching - Editing sketches - creating texts and tables - Basic dimensioning and editing dimensions - Sketching orthographic views of simple solids and machine parts as per first angle projection - Plotting drawings.

L – 30; P – 30; Total Hours – 60

TEXT BOOKS:

1. N.D. Bhatt, “Engineering Drawing”,Charotar Publishing house, 53rd Edtion, 2014.
2. Venugopal. K, and V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Ltd., Publication, Chennai, Edition 15, 2017.

REFERENCES:

1. K.V. Natarajan, “A text book of Engineering Graphics”, Dhanalakshmi publishers, Chennai, 31st Edition, 2018.
2. Agrawal B. & Agrawal C. M., “Engineering Graphics”, TMH Publication, 2012.
3. Jeyapoovan, T., “Engineering Graphics using AutoCAD”, Vikas Publishing House Pvt. Ltd., New Delhi, 2015.
4. AutoCAD Software Theory and User Manuals
5. Engineering graphics You tube Lecture videos link: https://www.youtube.com/user/BSAUNIV/videos

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: identify the specifications and standards of technical drawing and draw conic sections, special curves and orthographic projection of points and straight lines
CO2: apply the concept of orthographic projection to draw the orthographic views of plane figures and simple solids
CO3:draw the sections of solids and development of solid surfaces

CO4:apply the concept of isometric and perspective projection to draw the 3-D views of simple solids
CO5: draw the orthographic views of simple objects using drafting software

Board of Studies (BoS):
18th BoS of MECH held on 21.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO2	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO3	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO4	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO5	M	L	L	-	M	-	-	-	-	L	-	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The various industrial standards of technical drawing and the application of orthographic projections to draw simple solids helps to innovate a new design for sustainable industrialization

		L	T	P	C
GED 1102	**ENGINEERING DESIGN**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

SDG: 9

COURSE OBJECTIVES:

COB1: To learn the basic concepts of design in engineering

COB2: To study the basic design thinking principles in problem solving

COB3: To encourage the students to develop a prototype using design concepts

COB4: To introduce the role of innovation in engineering

MODULE I INTRODUCTION TO DESIGN 08

Introduction to Engineering design – Design thinking – Problem identification - Design of Product, Process, System and Software – Case studies on Product, Process, Systems and Software design.

MODULE II DESIGN THINKING PROCESS 08

Empathy – Ideate - Need analysis - Voice of customers - product specification - concept generation - Bench marking - Quality function deployment - Concept evaluation - Case studies

MODULE III PROTOTYPE DESIGN 07

Product form and function – High level design – Design detailing - Sketch models – Prototypes - 3D printing - Case studies.

MODULE IV INNOVATION 07

Creativity and innovation – Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – Intellectual property rights - case studies on innovative products.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Clive L. Dym, Patrick Little, and Elizabeth J. Orwin, “Engineering Design: A Project Based Introduction”, 4th Edition, Wiley, 2014.
2. Eppinger, S. and Ulrich, K., “Product design and development”, McGraw-Hill Higher Education, 2015.

REFERENCES:

1. Nigel Cross, “Design Thinking”, Berg Publishers, 2011.
2. Tom Kelley, “The Art of Innovation”, Profile Books Ltd, London, 2016.
3. Tim Brown, “Change by Design”, HarperCollins e-books, 2009.
4. Cliff Matthews, “Case Studies in Engineering Design”, John Wiley & Sons Pvt. Ltd, New York, 1998.

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: explain the basic concepts of design in engineering products / process / Service

CO2: analyse the problems and perform design thinking process

CO3: correlate the basic principles of design thinking to solve engineering problems and develop prototypes

CO4: apply innovative approaches to engineering problems and provide design solutions

Board of Studies (BoS):

18th BoS of MECH held on 21.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	-	H	-	M	-	-	-	-	L	-	L	-	-
CO4	-	-	M	-	-	-	-	-	-	L	-	L	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The holistic understanding of basic knowledge in Engineering design and its process in the development of prototypes results in satisfying industrial challenges.

GED 1103	MANUFACTURING PRACTICES LABORATORY	L	T	P	C
		0	0	2	1

SDG: 9

COURSE OBJECTIVES:

COB1: To learn the basics of pipe connections used in household and industrial systems

COB2: To educate the usage of welding equipment's and machining methods

COB3: To impart knowledge onsandmould preparation for simple components

COB4: To explorevarious tools, instruments and methods used in electrical wiring

COB5: To impart knowledge onDesign, assembly and testing of electronic circuits

PRACTICALS

List of Experiments:

CIVIL ENGINEERING PRACTICE

1. Study of plumbing in general household and industrial systems: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
2. Making a small window frame with Lap and Mortise & Tenon Joints by sawing planing and cutting.
3. Introduction to power tools

MECHANICAL ENGINEERING PRACTICE

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints using Arc Welding - Gas cutting (Demo)
2. Machining of a component using simple turning and drilling practices.
3. Foundry operations such as sand mold preparation for simple component.
4. Plastic Component Manufacturing (Demo on Injection / Blow moulding)

ELECTRICAL ENGINEERING PRACTICE

1. Comparison of incandescent, fluorescent, CFL and LED lamps.
2. Domestic, staircase and go down wiring.

3. Measurement of earth resistance.
4. Study of protection devices (small relay, fuse, MCB, HRC, MCCB, ECCB).
5. Familiarization of household electrical gadgets (Iron Box, Wet Grinder).
6. Study of inverter fed UPS/Emergency lamp

ELECTRONICS ENGINEERING PRACTICE

1. Identifications and symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Design and testing of electronic circuits using active and passive electronic components

P – 30; Total Hours – 30

TEXT BOOK:

1. S.Gowri and T.Jeyapoovan, “Engineering Practices Lab Manual – Civil, Mechanical, Electrical, Electronics included”, Vikas Publishing, 5th Edition, 2019.

REFERENCES:

1. SubhransuSekhar Dash &K.Vijayakumar, “Electrical Engineering Practice Lab Manual”, Vijay Nicole Imprints Private Ltd., First Edition, 2013.
2. Raghbir Singh Khandpur, “Printed Circuit Boards: Design, Fabrication, and Assembly”, Tata McGraw-Hill Education, 2005.

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: demonstrate Plumbing requirements of domestic buildings.

CO2: use welding equipment’s to join the structures and to carry out machining operations

CO3: perform the task of making sand mould for simple components

CO4: execute simple electrical wiring and comprehend the construction and working of household appliances.

CO5: assemble and test simple electronic circuits used in day-to-day life

Board of Studies (BoS):
18th BoS of MECH held on 21.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	M	M	-	-	-	-	M	L	L	-	-	M	H
CO2	H	M	M	-	-	-	-	M	L	L	-	-	M	H
CO3	M	M	M	-	-	-	-	M	L	L	-	-	M	H
CO4	L	L	L	-	-	-	-	M	L	L	-	-	M	H
CO5	L	L	L	-	-	-	-	M	L	L	-	-	M	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The holistic understanding of welding, moulding, machining, wiring and electronic circuit increases the access of small-scale industrial and other enterprises in developing countries.

GED 1104	**PROGRAMMING FOR PROBLEM SOLVING**	**L**	**T**	**P**	**C**
SDG: 8		**1**	**0**	**2**	**2**

COURSE OBJECTIVES:

COB1: To explore the hardware and software components of the computer

COB2: To learn the structured and procedural programming concepts using C.

COB3: To study the constructs of decision making in branching and iteration statements

COB4: To learn Functions for effective reusability and readability of the code.

COB5: To understand pointer and file operation concepts.

MODULE I — INTRODUCTION TO C PROGRAMMING — 05

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, system software, compilers, creating, compiling and executing a program, Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming - Structure of C - C Tokens – Data Types – Declaration of Variables and Storage class – Operators – Expressions - Type Conversion.

MODULE II — DECISION MAKING AND ARRAY — 05

Decision Making and Branching: Simple if Statements, The if..else statements, Nesting of if..else statements, else…if Ladder, switch Statements, goto Statements, Looping: while, do…while, for Statements, Array: One-Dimensional, Two-Dimensional and Multi-Dimensional operations.

MODULE III — USER-DEFINED FUNCTIONS AND FILE OPERATIONS — 05

Definition of Functions - Function Types – Nesting of Functions – Recursion – Structures and Unions – Pointers - File handing operations.

L – 15; P – 30; Total Hours – 45

PRACTICALS

LIST OF PROGRAMS IN C:

1. Computer organization –Hardware in a typical computer Identification – Booting error messages and what it means
2. Structure of a basic program - Hello world program
3. Data types and Type conversions
4. IInput / Output: Formatted functions – Unformatted functions – Library functions
5. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
6. Conditional Statements: If – if else- nested if else- goto- switch case – nested switch case
7. Iteration Statements: for loops – nested for loops – while loop – do-while loop – break and continue statement
8. I/O operations of one- and two-dimensional arrays
9. Bubble Sort and Linear Search using arrays.
10. Functions and its types, Recursion Function
11. Pointers File Operations

TEXT BOOKS:

1. Richard L. Stegman, “Focus on Fundamentals of Programming with C”, Ninth Edition, ISBN -170077395X, 9781700773951, 2019.
2. E.Balagurusamy, “Programming in ANSI C”, McGraw Hill Education, Eighth Edition, ISBN-13: 978-93-5316-513-0, ISBN-10: 93-5316-513-X, 2019.

REFERENCES:

1. Brian W. Kernighan and Dennis M. Ritchie, “ The C Programming Language”, Prentice Hall, ISBN 0-13-110362-8, 2015.
2. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012.
3. Paul J. Deitel, Deitel& Associates, “C How to Program”, Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: identify the hardware components and describe the software components of computer.

CO2: bring out the importance of structural and procedural programming

CO3: write C coding using conditional and iteration statements

CO4: develop programs using Functions, Pointers and Files

CO5: implement program to build a real time application.

Board of Studies (BoS) :

18th BoS of CSE held on 26.07.2021

Academic Council:

17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	M	L	H	-	L	-	-	M	-	-	-	-	-
CO2	H	M	M	-	-	H	M	-	M	-	-	-	-	-
CO3	H	M	H	-	-	H	-	-	H	-	-	-	-	-
CO4	H	H	H	H	M	H	-	-	H	-	-	-	-	-
CO5	H	H	H	H	H	H	H	H	H	L	H	H	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: The students can have productive employment and decent work by learning this computer fundamentals and programming course.

SEMESTER II

		L	T	P	C
END 1181	**ENGLISH FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To train students to use appropriate vocabulary in academic and technical contexts

COB2: To facilitate students to speak effectively while exchanging ideas and making presentations

COB3: To develop students' listening skill for comprehending and analysing information

COB4: To develop their reading skill through sub skills like skimming, scanning and critical reading of a text

COB5: To sharpen their academic writing skills

COB6: To expose them to the correct usage of language and help them to apply that knowledge appropriately

MODULE I HUMAN RESOURCES 10

L: Listening to short texts – short formal & informal conversations.

S: Introducing one self – exchanging personal info.

R: Process of reading purposes, Reading comprehension, improving comprehension skills, Reading activities – short comprehension passages, practice in skimming & scanning.

W: Scientific & Technical Writing, Editing skills, Activities – completing sentences, developing hints - Paragraph Writing

Voc. development: Prefixes, Suffixes

Lang. development: Articles, Countable and Uncountable nouns, Present tense, Wh – Questions, Yes or No questions.

MODULE II TRANSPORT 10

L: Listening to long scientific talks

S: Sharing personal information – greeting, leave taking.

R: Comprehension passages with multiple choice questions / Wh–questions/ openended questions - Reading longer technical texts & completing exercises based on them.

W: Use of reference words & discourse markers on a text, jumbled sentences, describing a process – flow chart, use of sequence words.

Voc. development: Guessing meanings of words in context, vocabulary used in formal letters, e-mails & reports.

Lang. development: Preposition of Time, Place & Date, Past tense, Conjunctions, Impersonal passive voice, Question tags, Numerical Adjectives.

MODULE III ENERGY 9

L: Listening to talk on the topic & completing tasks.

S: Asking about routine actions & expressing opinions.

R: Locating Specific Information

W: Letter seeking permission for Industrial Visit / symposium – Letter of invitation

Voc. development: Sequence words, misspelt words.

Lang. development: Adverbs, Degrees of comparison, Future tense, Homophones

MODULE IV OUR LIVING ENVIRONMENT 8

L: Listening to scientific texts & making notes – Effective ways of making notes.

S: Speaking about one's friend.

R: Reading texts & magazines for detailed comprehension. (Students can be asked to read any book of their choice to encourage reading habit)

W: Argumentative writing.

Voc. Development: Synonyms, antonyms, phrasal verbs.

Lang. development: If clauses, Subject - Verb Agreement

MODULE V TECHNOLOGY 8

L: Listening to talks (General & Scientific).

S: Short group conversations.

R: Reading and understanding technical articles, Short narratives & articles from Newspaper including conversations.

W: Short essays, Dialogue writing.

Voc. Development: Idioms & Phrases.

Lang. development: Modal verbs.

L - 45; Total Hours - 45

TEXT BOOKS:

1. Board of Editors. Using English A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1) Perry, Carol Rosenblum (2011). The Fine Art of Technical Writing, Create Space Independent Publishing Platform, New Delhi.
2) Dutt, P.K. Rajeevan G. andPrakash, C.L.N. (2007). A course in Communication Skills, Cambridge Univesity Press, India.
3) Sen, Leena (2004). Communication Skills, Prentice Hall, New Delhi.
4) Matt Firth, Chris Sowton et.al (2012). Academic English an Integrated Skills Course for EAP, Cambridge University Press, Cambridge.
5) Bailey,Stephen 2011. Academic Writing: A practical guide for students, New York, Rutledge.
6) Redston, Chris & Gillies (2005). Cunningham Face2Face (Pre-intermediate Student's Book&Workbook) Cambridge University Press, New Delhi.
7) Dutt P. Kiranmai and RajeevanGeeta (2013). Basic Communication Skills, Foundation Books.

COURSE OUTCOMES:

CO1: Read articles of a general kind in magazines and newspapers

CO2:Participate effectively in conversations, introduce themselves and their friends and express opinions in English

CO3: Comprehend conversations and short talks delivered in English

CO4: Write short essays of a general kind and letters and emails in English

CO5: Express through speaking and writing using appropriate vocabulary and grammar

Board of Studies (BoS) :	**Academic Council:**
13th BoS of Department of English held on 17.6.2021	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	-	-	-	-	-	-	H	-	-
CO3	-	-	-	-	-	-	-	-	-	M	-	-
CO4	-	-	-	-	-	-	-	-	-	H	-	-
CO5	-	-	-	-	-	-	-	-	-	M	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG No. 4: Give Quality Education to all the Engineers

Statement: In future, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

		L	T	P	C
MAD 1283	**PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS**	**3**	**1**	**0**	**4**

SDG: 4

COURSE OBJECTIVES:

COB1: To formulate and solve partial differential equation of first, second and higher orders

COB2: To introduce basics and engineering applications of Fourier series

COB3: To develop Fourier transform techniques

COB4: To introduce techniques and engineering applications of Laplace Transforms

COB5: To acquaint with Z -Transform techniques for discrete time systems

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients

MODULE II FOURIER SERIES 9+3

Fourier Series and Dirichlet's conditions - General Fourier series – Even and Odd functions - Half range Fourier series - Parseval's identity - Harmonic Analysis

MODULE III FOURIER TRANSFORMS 9+3

Fourier integral theorem (without proof) - Fourier transform pair - Fourier Inverse Transform – Properties - Convolution theorem - Parseval's identity

MODULE IV LAPLACE TRANSFORM 9+3

Introduction to Laplace transform - Existence of Laplace Transform - Properties of Laplace Transforms - Initial & Final Value Theorems - Inverse Laplace Transform - Convolution Theorem – Circuits to signal square wave: Integral equations with unrepeated complex factors – Damped forced vibrations: repeated complex factors – Resonance - Solution of differential equations

MODULE V Z – TRANSFORM 9+3

Introduction and Definition of Z-transform - Properties of Z- Transform - Convolution Theorem of Z-Transform - Inverse Z–transform - Convolution Theorem of Inverse Z-Transform - Formation of difference equations - Solving Difference Equations using Z-Transform

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

1. Kreyszig .E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2011.
2. Grewal B.S., "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017.
3. Ramana, B.V, "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2010.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics", 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: form and solve the partial differential equations

CO2: derive a Fourier series of a given periodic function by evaluating Fourier coefficients

CO3: apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms

CO4: solve ordinary differential equations using Laplace transforms

CO5: solve difference equations using Z-transform

Board of Studies (BoS) :

12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Learning of various mathematical techniques like Partial differential equations and transform techniques will help to solve complicated engineering problems

GED 1201 **ENGINEERING MECHANICS**

L	T	P	C
3	1	0	4

SDG: 9

COURSE OBJECTIVES:

COB1: To impart knowledge about the basic laws of mechanics, resolution of forces, equilibrium of particles in 2D and 3D force systems.

COB2: To learn about supports, reactions and equilibrium of rigid bodies

COB3: To educate surface properties such as centroid and moment of inertia

COB4: To impart knowledge on friction and its applications

COB5: To study the laws of motion, impulse, momentum and elastic bodies

MODULE I VECTOR APPROACH AND EQUILIBRIUM OF PARTICLE **L: 11 T: 3**

Introduction - Vectors – Vectorial representation of forces and moments – Vector Algebra and its Physical relevance in Mechanics – Laws of Mechanics – Parallelogram and triangular Law of forces- Coplanar Forces Principle of transmissibility, Resolution and Composition of forces- Forces in plane and space - Lame's theorem - Equilibrium of a particle in 2D plane - Equilibrium of a particle in 3D space - Equivalent systems of forces – Single equivalent force

MODULE II EQUILIBRIUM OF RIGID BODY **L: 7 T: 3**

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples – Scalar components of a moment –Varignon's theorem - Equilibrium of Rigid bodies in two dimensions –Examples

MODULE III PROPERTIES OF SURFACES **L:10 T:3**

Determination of Areas – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section using standard formula – second and product moments of plane area – Physical relevance - Standard sections: Rectangle, triangle, circle- composite sections, Hollow section using standard formula –

Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia

MODULE IV FRICTION **L:9**
T:3

Introduction to friction- types of friction- Laws of Coloumb friction- Frictional force – simple contact friction –Block friction– Rolling resistance –ladder friction and wedge friction

MODULE V LAWS OF MOTION **L:8**
T:3

Review of laws of motion – Newton's second law – D'Alembert's principle and its applications in plane motion; Work Energy Equation of particles– Impulse and Momentum – Impact of elastic bodies.

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers", McGraw Hill Education, 10th Edition, 2017.
2. R.K. Bansal., "A Text Book of Engineering Mechanics", Laxmi Publications, 6th Edition, 2015.

REFERENCES:

1. Russell C Hibbeler, "Engineering Mechanics: Statics & Dynamics", 14th Edition, Pearson, 2015.
2. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education India, 2005.
3. R.S. Khurmi., "A Text Book of Engineering Mechanics", S. Chand Publishing, 22nd Edition, 2018.

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: resolve composite forces, apply concept of equilibrium to particles and solve problems

CO2: apply the concept of equilibrium to rigid bodies and solve problems

CO3: determine the properties of surfaces

CO4: analyse and evaluate the frictional forces between the bodies

CO5: apply the laws of motion in solving dynamics problems

Board of Studies (BoS):
18^{th} BOS held on 21.06.2021

Academic Council:
17^{th} AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	M	-	-	-
CO3	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CO4	-	M	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	L	-	-	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The understanding of force systems and its components leads to construction of robust engineeringsystems.

		L	T	P	C
EED 1201	**ELECTRIC AND MAGNETIC CIRCUITS**	**L**	**T**	**P**	**C**
SDG: 3, 8, 11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To expose the students to the solution methods in dc and ac circuits

COB2: To impart knowledge about network theorems and solution methods using theorems.

COB3: To impart knowledge about transients in electrical circuits.

COB4: To analyze resonance and three phase circuits.

COB5: To expose the students to magnetic circuits and coupled circuits.

MODULE I DC AND AC CIRCUITS 11

The concept of voltage and current-Electric circuit elements: R, L, C – Independent and dependent sources - Ohm's law- Kirchhoff's law- series and parallel resistive circuits – Voltage and current division. Source Transformation – Independent and dependant sources - Mesh and nodal analysis in DC & AC circuits –Super mesh and super nodes – Resonance in RLC series and parallel circuits. Phasor analysis of single-phase AC circuits.

MODULE II NETWORK THEOREMS 10

Superposition theorem, Compensation theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Tellegen's theorem, Millman's theorem, Reciprocity theorem, application of network theorems in solving DC and AC circuits; Dual networks.

MODULE III TRANSIENT ANALYSIS 9

Transient response of RL, RC and RLC circuits using Laplace transform with DC and AC excitations considering zero and non-zero initial conditions.

MODULE IV MAGNETIC CIRCUITS 6

Magnetic circuits: Definition of magnetic quantities i.e., permeability, flux, flux density, field intensity , reluctance , coercivity and their units and relationships - series and parallel magnetic circuits- magnetic circuit concept and analogies - magnetic circuit computations - Hysteresis and Eddy current loss.

MODULE V COUPLED AND THREE PHASE CIRCUITS 9

Magnetically coupled circuits : self and mutual inductances, Dot rule for coupled circuits, coupled circuits analysis and applications - Three phase circuits: generation of 3 - phase voltages - star and delta connection - relation between phase and line quantities - balanced and unbalanced 3 - phase loads - power measurement by 2 - wattmeter method- Application of two wattmeter method of power measurement.

L – 45; Total Hours – 45

TEXT BOOK:

1. William Hayt and Jack Kemmerly and Jamie Phillips and Steven Durbin, Engineering Circuit Analysis ,9th Edition, McGraw Hill, 2019.

REFERENCES:

1. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill, 2007.
2. Roy Choudury D, Networks and Systems, New Age International, 2nd edition, 2010.
3. Joseph A.Edminster, Mahmood Nahvi, ‘Electric Circuits’, Schaum’s Series, Tata McGraw Hill publishing Co. Ltd., New Delhi, 5th Edition 2011, ISBN-13: 978-0-07-163372-7, ISBN: 0-07-163372-3
4. James A. Svoboda Richard C. Dorf, ‘Introduction to Electric Circuits’, John Wiley & Sons Inc, Indian Edition, January 2018
5. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2015.

COURSE OUTCOMES:

At the end of this course, the student will be able to:

CO1: reduce circuits into equivalent circuits by applying different solution methods

CO2: reduce circuits into equivalent circuits by applying network theorems.

CO3: apply Laplace transform to perform transient analysis.

CO4: implement the concept of magnetic circuits

CO5: perform the calculations on coupled circuits and three phase circuits and implement in practical circuits.

Board of Studies (BoS) :	**Academic Council:**
15th meeting of BoS of EEE held on	17^{th} AC held on 15.07.2021

25.06.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	L	-	-	-	-	-	-	-	L	H	M
CO2	H	H	H	L	-	-	-	-	-	-	-	L	H	M
CO3	H	H	H	L	-	-	-	-	-	-	-	L	H	M
CO4	H	M	H	L	-	-	-	-	-	-	-	L	H	M
CO5	H	M	H	L	-	-	-	-	-	-	-	L	H	M

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG 3: Good health and well being.

Statement: Understanding of the fundamentals of DC and AC circuits can help in designing systems to promote good health and well being.

SDG 8: Descent work and economic

Statement: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 11: Sustainable cities and communities.

Statement: Use of network solution techniques learnt through this course can play a major role in establishing Sustainable cities and communities.

		L	T	P	C
EED 1202	**SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 3, 7, 8, 9,11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the students to the concept of signals and linear time-invariant systems

COB2: To build basics on Fourier series for the analysis of periodic signals and its applications.

COB3: To impart the knowledge on Fourier transform for aperiodic signals and its application for sampling the signals.

COB4: To provide the knowledge on Laplace transform and its applications for analyzing linear time-invariant continuous time systems.

COB5: To expose the students to the mathematical tool z-Transform for signal processing and system analysis applications.

MODULE I INTRODUCTION TO SIGNALS AND SYSTEMS 11

Signals: classification (analog and digital, energy and power, even and odd, periodic and aperiodic, deterministic and random, stationary and non-stationary) - standard signals (unit step, unit impulse, ramp, exponential, sinusoids) - transformations of the independent variable. Systems: system classification (continuous and discrete, causal and non-causal, stable and unstable, stable/unstable oscillatory, linear and non-linear, time-invariant and variant, invertible etc.) - continuous and discrete time LTI systems - Impulse response of an LTI system - convolution integral, graphical convolution - LTI system properties - interconnection of LTI systems - Differential and Difference Equation representation of LTI systems.

MODULE II FOURIER SERIES 9

Response of LTI systems to complex exponentials - Fourier Series representation of CT periodic signals – convergence of CT Fourier Series - properties of CT Fourier Series - Fourier Series representation of DT periodic signals - properties of DT Fourier Series – Fourier series and LTI Systems – concept of filtering.

MODULE III FOURIER TRANSFORM 10

Continuous - Time Fourier Transform for aperiodic and periodic signals - properties of Fourier Transform - frequency Response of CT-LTI systems

characterized by differential equations. Discrete Time Fourier Transform (DTFT) of aperiodic and periodic signals - Properties of DT Fourier Transform - frequency response of DT-LTI systems characterized by difference equations
Representation of a continuous-time signal by Its samples - Shannon's Sampling Theorem - reconstruction of a signal from its samples using interpolation - effect of under sampling - Aliasing.

MODULE IV LAPLACE TRANSFORM 8

Unilateral and Bilateral Laplace transform – s-plane and region of convergence (ROC) - properties of Laplace transforms - poles and zeros - inverse Laplace transformation – the concept of transfer function – causality and stability – LTI systems and solution of differential equations.

MODULE V Z- TRANSFORM 7

Z-Transform, z-Plane and ROC - properties of z-Transform - poles and zeros - inverse z-Transform - Transfer Function of DT-LTI Systems - causality and stability – LTI systems and solution of difference equations.

L – 45; Total Hours – 45

TEXT BOOK:

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, "Signals & Systems", 2nd Edition, Pearson Education, 2014.

REFERENCES:

1. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, John Wiley & Sons Pvt Ltd., 2004.
2. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing - Principles, Algorithms and Applications", 3rd Edition, Prentice Hall of India, 2000
3. Hwei P. Hsu, "Signals And Systems", 2nd Edition,Schaum's Outlines, McGraw Hill, 1995.
4. M. J. Roberts, "Signals and Systems Analysis using Transform method and MATLAB", 1st Edition,Tata McGraw Hill, 2003.
5. K. Lindner, "Signals and Systems", 2nd Edition, McGraw Hill International, 1999.
6. Chi-Tsong Chen, "Signals and Systems", 3rd Edition, Oxford University Press, 2004.
7. Roger E. Ziemer, William H. Tranter, D.R. Fannin, "Signals & Systems:

Continuous and Discrete", 4th Edition, Prentice Hall, 1998.
8. Ashok Amhardar, "Analog and Digital Signal Processing", 2nd Edition, Thomson, 2002.

COURSE OUTCOMES:

At the end of this course, the student will be able to:

CO1: classify, identify and mathematically represent different types of signals and systems.

CO2: do a harmonic analysis on periodic signals using Fourier series.

CO3: use Fourier transforms to analyze the periodic and aperiodic signals and apply the principle for sampling the signals.

CO4: use Laplace transforms to analyze continuous time systems.

CO5: apply z- transform to analyze discrete time systems.

Board of Studies (BoS) :

15th meeting of BoS of EEE held on 25.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	M	M	M	-	-	-	-	-	-	-	L	H	M
CO2	H	H	M	M	-	-	-	-	-	-	-	L	H	M
CO3	H	H	M	M	-	-	-	-	-	-	-	L	H	M
CO4	H	H	M	M	-	-	-	-	-	-	-	L	H	M
CO5	H	H	M	M	-	-	-	-	-	-	-	L	H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3: Good health and well being.

Statement: Understanding of the fundamentals of signals and systems can help in designing systems to promote good health and well being.

SDG 7: Affordable and Clean Energy

Statement: Knowledge on signals and systems can help in the analysis of affordable and clean energy systems.

SDG 8: Descent work and economic growth

Statement: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced communication infrastructure.

SDG 11: Sustainable cities and communities.

Statement: Use of signal processing techniques learnt through this case can play a major role in establishing Sustainable cities and communities.

EED 1203	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

SDG: 3, 8,12

COURSE OBJECTIVES:

COB1: To impart hands on experience in verification of Theorems

COB2: To perform transient analysis

COB3: To verify theorems using MATLAB / PSpice

COB4: To analyze coupled circuits.

COB5: To implement power measurement methods for three phase circuits..

List of Experiments

1. Verification of KCL and KVL
2. Verification of Thevenin's and Norton's Theorem using hardware and digital simulation.
3. Verification of Superposition Theorem using hardware and digital simulation.
4. Verification of Maximum Power Transfer Theorem using hardware and digital simulation.
5. Verification of Reciprocity and Millman's theorems using hardware and digital simulation.
6. Time domain response of RL , RC and RLC Transient Circuits
7. Series RLC Resonance Circuits(Frequency response& Resonant frequency)
8. Parallel RLC Resonance Circuits(Frequency response & Resonant frequency)
9. Frequency Response of single tuned and double tuned coupled circuits.
10. Measurement of active power and reactive power for star and delta connected balanced loads.
11. Measurement of 3 Phase power by two- wattmeter method for unbalanced loads.

P – 30; Total Hours – 30

COURSE OUTCOMES:

At the end of this course, the student will be able to:

CO1: Conduct basic laboratory experiments involving electrical circuits using laboratory test equipment such as power supplies, signal generators, oscilloscopes, multimeters etc.

CO2: Implement and verify network theorems

CO3: Implement three phase power measurement method using two wattmeter method

CO4: Relate physical observations and measurements involving magnetic circuits to theoretical principles.

CO5:To simulate various electric circuits using PSpice and MaTLab simulation

Board of Studies (BoS) :
15th meeting of BoS of EEE held on 25.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	L	M	L	L	H	-	-	-	-	-	-	-	L	M
CO2	H	M	L	L	H	-	-	-	-	-	-	-	L	M
CO3	H	M	L	M	L	-	-	-	-	-	-	-	L	M
CO4	-	H	M	H	M	-	-	-	-	-	-	-	M	H
CO5	H	M	L	M	L	-	-	-	-	-	-	-	L	M

SDG 3: Good health and well being.
Statement: Understanding of the fundamentals of electric and magnetic circuits can help in designing systems to promote good health and well being.

SDG 8: Descent work and economic growth
Statement: The learners of this course can get descent work and earn financial benefits and they can work in electrical engineering filed.

SDG 12: Responsible consumption and production.
Statement: Use of right and energy efficient components in electric and magnetic circuits results in reasonable consumption and production.

GED 1206	**ENVIRONMENTAL SCIENCES**	**L**	**T**	**P**	**C**
SDG: All	**(for Undergraduate B.Tech. Courses)**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

To make the student conversant with the

COB1: various natural resources, availability, utilisation and its current scenario.

COB2: diverse ecosystems and its function, importance of biodiversity, its values, threats and conservation.

COB3: types of pollutants and its impacts on the environment and the effects of natural disasters.

COB4: impacts of human population, human health, diseases and immunisation for a sustainable lifestyle.

MODULE I NATURAL RESOURCES 8

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems - (a) Land resources: Land degradation soil erosion and desertification - (b) Forest resources: Use and over-exploitation, deforestation (c) Water resources: Use and over-utilisation of surface and ground water, conflicts over water, dams: benefits and problems, effects on forest and tribal people - (d) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, mining (e) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture (f) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources.

MODULE II ECOSYSTEMS AND BIODIVERSITY 8

Concept of an ecosystem - Food chains, food webs, Energy flow in the ecosystem - ecological pyramids - Ecological succession - Characteristic features, structure and function of (a) Terrestrial Ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem (b) Aquatic fresh water ecosystems: Ponds and lakes, rivers and streams (c) Aquatic salt water ecosystems: oceans and estuaries

Biodiversity and its conservation - Types: genetic, species and ecosystem diversity - Values of biodiversity - India as a mega-diversity nation - Invasive, endangered, endemic and extinct species - Hot sports of biodiversity and Red Data book - Threats to biodiversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

MODULE III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 8

Sources, cause, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear pollution (h) ill-effects of fireworks and upkeep of clean environment, types of fire and fire extinguishers- Solid waste Management: types, collection, processing and disposal of urban waste, industrial waste, e-waste and biomedical wastes - Disaster management: flood, drought, cyclone, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

Human Population - Population growth, Population explosion, population pyramid among nations - Family Welfare Programme - Human Rights - Value Education - Environment and human health: air-borne, water borne, infectious diseases, contagious diseases and immunisation (all types of vaccines from birth), risks due to chemicals in food and water, endocrine disrupting chemicals, cancer and environment - Sustainable development - Resettlement and rehabilitation of people - Environment Legislative laws- Women and Child Welfare, Public awareness.

Case studies related to current situation.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Erach Bharucha, “Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education for University Grants Commission”, Orient Blackswan Pvt. Ltd., Hyderabad, India, 2013.
2. Benny Joseph, “Environmental Studies”, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, “Environmental Science and Engineering”, Sri Krishna Publications, Tamil Nadu, India, 2018.
4. Raman Sivakumar, “Introduction to Environmental Science and Engineering”, McGraw Hill Education, India, 2009.
5. Venugopala Rao P, “Principles of Environmental Science and Engineering”, Prentice Hall India Learning Private Limited; India, 2006.
6. Anubha Kaushik and Kaushik C.P., “Environmental Science and

Engineering", New Age International Pvt. Ltd., New Delhi, India, 2009.

REFERENCES:

1. Masters G.M., "Introduction to Environmental Engineering and Science", Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W., "Environmental Science and Engineering", Prentice Hall International Inc., New Jersy, 1996.
3. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co. Boston, USA, 2016.
4. "Waste to Resources: A Waste Management Handbook", The Energy and Resources Institute, 2014.
5. https://www.teriin.org/article/e-waste-management-india-challenges-and-opportunities.
6. https://green.harvard.edu/tools-resources/how/6-ways-minimize-your-e-waste.
7. https://www.aiims.edu/en/departments-and-centers/central-facilities/265-biomedical/7346-bio-medical-waste-management.html.
8. https://tspcb.cgg.gov.in/Shared%20Documents/Guidelines%20for%20Management%20of%20Healthcare%20Waste%20Waste%20Management%20Rules,%202016%20by%20Health%20Care%20Facilities.pdf.

COURSE OUTCOMES:

The student will be able to

CO1: analyse the current scenario of various natural resources and their depletion and suggest remedies to curb the exploitation.

CO2: identify food chains and web and its function in the environment, assess the impacts on the biodiversity and propose solutions to conserve it.

CO3: analyse the types and impacts of pollutants in the environment and propose suitable methods to alleviate the pollutants and the natural disasters.

CO4: assess on the impact of human population and the health related issues and immunisation practices and sustainable developments for a healthy life.

Board of Studies (BoS) :	**Academic Council:**
11th BoS of Chem held on 17.06.2021	17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	L	M	-	-	L	M	-	-	-	-	-	-	-	-
CO2	-	-	-	M	H	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	M	M	-	-	L	-	-	-	-
CO4	-	-	-	-	-	M	M	M	-	-	-	L	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SDG All: No Poverty, Zero Hunger, Good Health and Well-Being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable & Clean Energy, Decent Work and Economic Growth, Industry, Innovation & Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice and Strong Institutions, Partnerships for the Goals.

Statement: This course discuss about the environment, all the natural resources available, sharing of resources, effective utilisation, effects of over utilisation, health and environmental issues pertained to that, global warming and related issues, climates, disasters, impact assessments, population, human rights, societal welfare, laws to conserve the environment and sustainability.

SEMESTER III

EED 2101 SDG: 3, 9	ELECTRONIC DEVICES	L 3	T 0	P 0	C 3

COURSE OBJECTIVES:

COB1: To familiarize the student with basic semiconductor devices with the principle of operation, characteristics and their application in real time.

COB2: To study the principle of operation and characteristics of BJT with different biasing techniques used to operate the transistors.

COB3: To study the principle of operation and characteristics of JFET and MOSFET.

COB4: To familiarize the concept of operational amplifier and its various application circuits.

COB5: To understand the concept and working principle of different feedback amplifiers and oscillators.

MODULE I SEMICONDUCTOR DIODE AND TRANSISTOR 10

PN junction- current equation, junction capacitance, breakdown characteristics, V-I characteristics, PN junction diode ratings. Clippers and, clampers circuits- LED, LCD, Photo diode - Physical behaviour of a BJT – Ebers – Moll model - Modes of transistor operation – Common Base, Common Emitter and Common Collector configurations, Input and output characteristics, Early effect, Thermal runaway, Transistor as a switch and an amplifier, AC and DC load lines - Need for stability of Q Point - Biasing, photo transistors.

MODULE II FIELD EFFECT TRANSISTOR (FET) 9

JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET as a switch, Voltage variable resistor and an amplifier. MOSFET- Constructional details- Operation of Enhancement and Depletion type MOSFET, V-I characteristics, Transfer characteristics, MOSFET as a switch, resistor and amplifier, generalized small signal model.

MODULE III OPAMP FUNDAMENTALS AND CHARACTERISTICS 8

Operational amplifier: block diagram representation, Transfer characteristics of a typical Op Amp circuit, ideal Op Amp characteristics -Non-ideal characteristics- DC characteristics – Input bias current-Input offset voltage- Input offset current- Thermal drift- AC characteristics- Frequency response- Frequency compensation-

Slew rate, Internal circuit operation of operational amplifier - differential amplifier.

MODULE IV OP AMP AND ITS APPLICATIONS 9

Mathematical operations using operational amplifier - inverting amplifier, non inverting amplifier, summer, subtractor, integrator, differentiator, zero crossing detector - Instrumentation amplifier - comparator - Schmitt Trigger, Astable and Monostable Multivibrator, Active Filters: I and II order low pass filter.

MODULE V FEEDBACK AMPLIFIERS AND OSCILLATOR USING OPAMP 9

Amplifier classification - Feedback concept - Characteristics - effect of feedback on input and output characteristics. Oscillator- Principle, Stability of feedback circuits using Barkhausen criteria, RC oscillator- Wien bridge oscillator and Phase shift oscillator, LC oscillator - Hartley oscillator, Colpitts oscillator, Crystal oscillator.

L - 45 ; TOTAL HOURS : 45

TEXT BOOKS:

1. Nashelsky, Louis, and Boylestad, Robert L.. Electronic Devices and Circuit Theory. N.p., Eleventh Edition, Pearson Education, 2015.
2. S. Salivahanan and N Suresh Kumar Electronic Devices and Circuits, 4th Edition, Tata McGraw Hill, 2017.
3. A. P. Godse U. A. Bakshi, Electron Devices & Circuits, Technical publications, 2018.

REFERENCES:

1. Thomas L Floyd, “Electronic Devices (Conventional Current Version) “, 10th Edition, Pearson, 2018.
2. Gupta.J.B. “Electronic Devices and Circuits”, 3rd Edition, S.K. Kataria& Sons, New Delhi, 2010.
3. Millman J., C.C. Halkias, Sathyabratha Jit, “Electronic Devices and Circuits”,Tata McGraw-Hill Publishing company limited, 2nd Edition, 2007.
4. R. Gayakwad, Op-Amps and Linear Integrated Circuits, 4th ed., Pearson Education, Delhi, 2000.
5. R. Coughlin and F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, 6th ed., Pearson Education, Delhi, 2003.
6. D. R. Choudhury and S. Jain, Linear Integrated Circuits, New Age International, New Delhi, 2002.

COURSE OUTCOMES:

At the end of this course, the student will be able to:

CO1: Apply the fundamentals of PN junction to design practical circuits.

CO2: Apply the concepts of BJT with biasing concepts to design practical circuits.

CO3: Analyse the working of FET and its applications.

CO4: Characterize opamp behaviour in practical circuits and synthesize opamp circuits to perform various mathematical operations.

CO5: Design feedback amplifiers and oscillators using opamps.

Board of Studies (BoS) :
16[h] BoS of EEE held on 13/12/2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	H	H	H	-	-	-	-	-	-	H	M	H
CO2	H	H	H	H	H	-	-	-	-	-	-	H	M	H
CO3	H	H	H	H	H	-	-	-	-	-	-	H	M	H
CO4	H	H	H	H	H	-	-	-	-	-	-	H	M	M
CO5	H	H	H	H	H	-	-	-	-	-	-	H	M	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3 : Good health and wellbeing.

Statement: Understanding of the fundamentals of electron devices can help in designing systems to promote good health and well being.

SDG 9 : Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all. Statement : The complete understanding of electron devices and components lead to sustainable industrialization and promote economic development.

		L	T	P	C
EED 2102	**ELECTRO MAGNETIC THEORY**	**L**	**T**	**P**	**C**
SDG: 3, 5, 8		**2**	**1**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the basic mathematical concepts related to electromagnetic vector fields.

COB2: To provide knowledge on the concepts of electrostatics, electric potential, energy density and their application.

COB3: To provide knowledge on the concepts of magnetostatics, potential, Flux density and their application.

COB4: To impart knowledge on the concepts of Faraday's law, induced EMF and Maxwell's equations.

COB5: To deliver knowledge on the concepts of electromagnetic wave and Poynting vector.

MODULE I CO-ORDINATE SYSTEM AND VECTOR CALCULUS 7

Cartesian Coordinate, Circular Cylindrical Coordinate, Spherical Coordinate Systems, Line, Surface, and Volume Integrals, Del Operator, Gradient of a Scalar, Divergence of a Vector and Divergence Theorem, Curl of a Vector and Stokes's Theorem, Laplacian of a Scalar, Classification of Vector Fields.

MODULE II ELECTROSTATIC FIELDS 10

Coulomb's Law and Field Intensity, Electric Fields due to Continuous Charge Distributions, Electric Flux Density, Gauss's Law, Applications of Gauss's Law, Electric Potential, Relationship between E and V, Electric Dipole, Flux Lines and Energy Density, Capacitance, Boundary conditions, Poisson's and Laplace's equations.

MODULE III MAGNETOSTATIC FIELDS 10

Biot-Savart's Law, Ampere's Circuit Law, Magnetic Flux Density, Magnetic Scalar and Vector Potentials , Magnetic field due to straight conductors, circular loop, Forces due to Magnetic Fields, Magnetic Torque and Moment, Magnetic Dipole, Magnetization in Materials, Classification of Magnetic Materials, Magnetic Boundary Conditions, Inductances, Magnetic Energy, Applications.

MODULE IV ELECTRO MAGNETIC INDUCTION 9

Faraday's Law, Transformer and Motional EMFs, Displacement Current, Maxwell's

Equations (differential and integral form), Time Varying Fields.

MODULE V ELECTROMAGNETIC WAVE PROPAGATION 9

Electromagnetic Waves, Plane Waves in Lossless Dielectrics, Plane Waves in Free Space, Plane Waves in Good Conductors, Poynting theorem, Poynting Vector, Reflection of a Plane Wave at Normal Incidence, Reflection of a Plane Wave at Oblique Incidence.

L – 30 ; T – 15 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Matthew N.O. Sadiku & S.V.Kulkarni, “Principles of Electromagnetics”, Oxford University Press, Asian Edition, 2015.
2. William Hayt, “Engineering Electromagnetics”, McGraw Hill, New York,2006.
3. Kraus and Fleish, “Electromagnetics with Applications”, McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCES:

1. Zahn Markus, Electromagnetic Field Theory: A Problem-Solving Approach. Malabar, FL: Krieger Publishing Company, 2003.
2. John D. Kraus, “Electromagnetics”, McGraw Hill, 2017
3. Joseph A.Edminister, M.S.E, “Schaum’s Outline of Theory and Properties of Electromagnetic”, McGraw Hill Book ,2010.
4. S.P.Ghosh, Lipika Datta, ‘Electromagnetic Field Theory’, First Edition, McGraw Hill Education (India) Private Limited, 2012.
5. K A Gangadhar, ‘Electromagnetic Field Theory’, Khanna Publishers; Eighth Reprint : 2015.
6. https:\\nptel.ac.in/courses/108104087.

COURSE OUTCOMES: At the end of this course, the student will be able to:

CO1: Relate the concepts of vector calculus and coordinate systems in the study of electromagnetic.

CO2: Apply the fundamental laws of electrostatics and to solve electrostatic boundary value problems.

CO3: Explain the fundamental laws and concepts of magnetostatic fields.

CO4: Apply the concepts of Maxwell's equations in electromagnetic field theory.

CO5: Correlate the concepts of wave propagation in various media.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	M	-	H	-	-	-	-	-	-	-	-	H	-
CO2	H	M	L	H	-	-	-	-	-	-	-	-	H	-
CO3	H	M	L	H	-	-	-	-	-	-	-	-	H	-
CO4	H	M	-	H	-	-	-	-	-	-	-	-	H	-
CO5	H	M	-	H	-	-	-	-	-	-	-	-	H	-

Board of Studies (BoS) :
16^{h} BoS of EEE held on 13/12/2021

Academic Council:
18th Academic Council held on 24.02.2022

Note: L - Low Correlation M -Medium Correlation H - High Correlation

SDG 3: Good health and well being.
Statement: Understanding of the fundamentals of electrical and electronics systems can help in designing systems to promote good health and well being.

SDG 5: Gender equality
Statement: Acquiring the interdisciplinary knowledge help overcome the gender barriers in work place.

SDG 8: Decent work and economic growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

		L	T	P	C
EED 2103 **SDG: 7,8**	**ELECTROMECHANICAL ENERGY CONVERSION**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To relate the concepts of electromechanical energy conversion principles to working of electrical machines.

COB2: To impart knowledge on working and classification of DC machines

COB3: To determine the characteristics and methods of speed control of motors.

COB4: To estimate the various losses taking place in DC machines and to study the different testing methods to arrive at their performance.

COB5: To familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.

MODULE I ELECTROMECHANICAL ENERGY CONVERSION SYSTEMS 8

Principles of Electromechanical Energy Conversion-Conservative force field-Energy Balance Relationships in Electromechanical Systems-Conservation of Energy Concept of co-energy- Single Excited system- multiple-excited system.

MODULE II DC GENERATOR 9

Construction – Principle of Operation – classification– types of armature windings – EMF equation -OCC & Load characteristics – Power Flow diagram – Losses and efficiency- Armature reaction – Commutation

MODULE III DC MOTOR & BLDC MOTOR 10

Construction – Principle of operation – Torque – Types and characteristics – Power Flow diagram – Starters – Speed Control - Solid state DC drives (Qualitative treatment only). Brushless Concept – Construction and operation of Brushless DC motor (BLDCM) – Characteristics – Concept of control of BLDCM – Control Circuitry – Applications.

MODULE IV TRANSFORMER 9

Construction and principle of operation – EMF equation – Transformer on no load and load – Phasor diagram - Equivalent circuit - Voltage regulation – Losses &Efficiency - Auto Transformer - All day efficiency- 3-phase transformer connections- applications.

MODULE V TRANSFORMER TESTING &PARALLEL OPERATION 9

OC and SC tests — computation of Voltage regulation, losses & efficiency using OC and SC tests - polarity test – Sumpner's test - Parallel Operation of transformers.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. Edward Hughes, Electrical Technology, Tata McGraw Hill Publication, 2015.

REFERENCES:

1. Fitgerald, A.E., Charles Kingsely Jr. Stephen D.Umans, “Electric Machinery”, McGraw Hill Books Company,6th edition 2002.
2. Hill Stephen, Chapman.J, “Electric Machinery Fundamentals”, McGraw Hill Book Co., New Delhi, 4th edition 2005.
3. Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2010.
4. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009

COURSE OUTCOMES: At the end of this course, the student will possess knowledge and skills on the following:

CO1: apply the concepts of electromagnetism in electromechanical energy conversion systems.

CO2: analyze the performance and characteristics of DC Generators

CO3: compare performance characteristics of DC Motors for various applications and analyze the performance and characteristics of BLDC Motor.

CO4: analyze the performance characteristics of Transformers

CO5: compute voltage regulation, losses and efficiency of transformers by conducting appropriate test.

Board of Studies (BoS) :	**Academic Council:**
16h BoS of EEE held on 13/12/2021	18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	L	M	M	-	-	-	-	-	-	-	L	L
CO2	H	H	L	H	H	-	-	-	-	-	-	-	L	H
CO3	H	M	-	M	M	-	-	-	-	-	-	-	M	H
CO4	H	H	L	H	H	-	-	-	-	-	-	-	L	H
CO5	M	H	L	H	H	-	-	-	-	-	-	-	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 7 : Affordable and Clean Energy

Statement: Electrical Engineering contributes to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8 : Decent Work And Economic Growth

Statement: Decent Work And Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

EED 2104	**TRANSMISSION AND DISTRIBUTION**	**L**	**T**	**P**	**C**
SDG: 5,8,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To study the structure of electric power system, EHVAC, HVDC and FACTS devices

COB2: To develop expressions for the computation of transmission line parameters.

COB3: To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.

COB4: To analyze the voltage distribution in insulator strings so as to improve the efficiency.

COB5: To study about distribution systems, types of substations, bus bar arrangements and radial and ring main distribution system.

MODULE I INTRODUCTION 8

Structure of electric power system - Generation, transmission and distribution EHV AC and HVDC transmission - Comparison of economics of transmission, technical performance and reliability, application of HVDC transmission system. FACTS (qualitative treatment only) - TCSC, SVC, STATCOM, UPFC.

MODULE II TRANSMISSION LINE PARAMETERS 10

Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects -Typical configurations, conductor types and electrical parameters of EHV lines.

MODULE III MODELLING AND PERFORMANCE OF TRANSMISSION LINES 10

Performance of Transmission lines – short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance – transmission efficiency and voltage regulation, real and reactive power flow in lines – Formation of Corona – Critical Voltages – Effect on Line Performance.

MODULE IV INSULATORS AND UNDER GROUND CABLES 9

Insulators: Types - voltage distribution in insulator string - string efficiency - improvement of string efficiency -Underground cables: Types of cables – Construction of single core and 3 core Cables – Insulation Resistance – Potential Gradient – Capacitance of Single-core and 3 core cables – Grading of cables.

MODULE V SUBSTATION AND DISTRIBUTION SYSTEM 8

Types of substations; bus-bar arrangements; substation bus schemes: single bus scheme, double bus with double breaker, double bus with single breaker, main and transfer bus, ring bus, breaker-and-a-half with two main buses, Radial and ring-main distributors; interconnectors; AC distribution.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. Kothari I, D P, "Power System Engineering", Tata Mcgraw Hill, 2nd Edition,2017

REFERENCES:

1. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, 2008.
2. Luces Fualkenberry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2006.
3. John J. Grainger and Stevenson Jr. W.D., 'Power System Analysis', McGraw Hill International Edition, 2016.
4. Hadi Saadat, 'Power System Analysis', Tata Mc Graw Hill, 2010.
5. Stagg, G.W. and El-Abiad, A.H., 'Computer Methods in Power System Analysis', McGraw Hill International Book Company.
6. M.A. Pai, ‘Computer Methods in Power System Analysis’ McGraw Hill Education (India) Pvt. Ltd., 2006.

COURSE OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

CO1: Proper understanding of EHVAC, HVDC and FACTS devices.

CO2: Capable of determining the inductance and capacitance of transmission lines.

CO3: Ability to obtain the voltage regulation and efficiency for short, medium and long lines.

CO4: Ability to determine the string efficiency of insulators.

CO5: Better understanding of different types of substation and distribution systems.

Board of Studies (BoS) :
16h BoS of EEE held on 13/12/2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	L	L	L	L	-	-	-	-	-	-	-	L	L
CO2	H	M	L	L	L	-	-	-	-	-	-	-	M	L
CO3	H	M	L	L	L	-	-	-	-	-	-	-	M	L
CO4	H	H	M	L	L	-	-	-	-	-	-	-	M	L
CO5	H	L	L	L	L	-	-	-	-	-	-	-	L	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 5: Gender equality
Statement: Acquiring the interdisciplinary knowledge help to overcome the gender barriers in work place.

SDG 8: Decent work and economic growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas such as polymeric insulators etc.

SDG 9: Industry, innovation and infrastructure
Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

		L	T	P	C
EED 2105 **SDG: 3,8,9,12**	**ELECTRONIC DEVICES LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To acquire knowledge in the usage of simulation software for the various semiconductor devices and its application circuitry.
COB2: To provide hands on experience on various semiconductor devices and its application circuitry.
COB3: To analyze the characteristics of various semiconductor devices both in software and in hardware**.**
COB4: To provide simulation and hands-on experience on op amp application circuits.
COB5: To design, simulate and implement oscillator circuits.

PRACTICALS

List of Experiments

The following experiments will be carried out for verification in hardware after simulating in software's such as MATLAB, PSPICE, PSIM etc.,

1. VI characteristics of LED.
2. Input- Output Characteristics of BJT.
3. Characteristics of Common Emitter Amplifier.
4. Transfer and Drain Characteristics of JFET.
5. Transfer and Drain Characteristics of MOSFET.
6. Determination of gain for inverting and non-inverting amplifier
7. Implementation of Integrator and differentiator using OPAMP
8. Design and Implementation of LC oscillator circuit using OPAMP
9. Implementation of Astable Multivibrator Circuit using OPAMP.
10. Implementation of Monostable Multivibrator Circuit using OPAMP
11. Design and implementation of RC phase shift oscillator using OPAMP
12. Design and implementation of Wien's bridge oscillator using OPAMP

P – 15 ; TOTAL HOURS – 30

TEXTBOOK:

1. Laboratory Manual

REFERENCES:

1. Thomas L Floyd, “Electronic Devices (Conventional Current Version) “, 10th Edition, Pearson, 2018.
2. Gupta.J.B. “Electronic Devices and Circuits”, 3rd Edition, S.K. Kataria& Sons, New Delhi, 2010.
3. Millman J., C.C. Halkias, Sathyabratha Jit, “Electronic Devices and Circuits”,Tata McGraw-Hill Publishing company limited, 2nd Edition, 2007.

COURSE OUTCOMES:

CO1: Relate physical observations made through simulation and hands-on to theoretical principles.

CO2: Construct and verify the various characteristics of semiconductor devices both in software and hardware.

CO3: Construct application circuits of semiconductor devices.

CO4: Design, Simulate and implement various amplifier and oscillator circuits.

CO5: Design, Simulate and implement operational amplifier application circuits.

Board of Studies (BoS) :
16^h BoS of EEE held on 13/12/2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	H	M	L	L	-	-	-	-	-	-	-	-	L	L
CO2	H	H	M	L	-	-	-	-	L	-	-	-	L	M
CO3	H	H	M	M	-	-	-	-	L	-	-	-	L	M
CO4	H	H	H	H	-	-	-	-	M	-	L	L	H	H
CO5	H	H	H	H	-	-	-	-	M	-	L	L	H	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3 : Good health and wellbeing.
Statement : Understanding of the fundamentals of electron devices can help in designing systems to promote good health and well being.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9 : Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement : The complete understanding of electron devices and components lead to sustainable industrialization and promote economic development.

SDG 12: Responsible consumption and production.

Statement: Use of right and energy efficient electric and instrumentation components and devices results is reasonable consumption and production.

		L	T	P	C
EED 2106	**ELECTROMECHANICAL ENERGY CONVERSION LABORATORY**	**L**	**T**	**P**	**C**
SDG: 7,8		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To experimentally verify the performance and characteristics of DC generator.

COB2: To experimentally verify the performance and characteristics of DC Motor.

COB3: To experimentally verify the performance and characteristics of single phase transformer.

COB4: Know the necessity to predetermine the performance of DC machines.

COB5: To expose the students to the operation of transformers

PRACTICALS

List of Experiments:

1. OCC and Load characteristics of a separately excited DC generator.
2. OCC and Load characteristics of a self-excited DC shunt generator.
3. Load characteristics of a DC shunt motor.
4. Load characteristics of a DC series motor.
5. Load characteristics of a DC compound generator.
6. Speed control of DC shunt motor.
7. Swinburne’s test.
8. Hopkinson's test
9. Load test on a 1-phase transformer.
10. OC and SC tests on a 1-phase transformer.
11. Sumpner’s test.
12. 3-phase transformer connections.

P – 30 ; TOTAL HOURS –30

TEXT BOOK:

1. Laboratory Manual

REFERENCES:

1. Fitgerald, A.E., Charles Kingsely Jr. Stephen D.Umans, “Electric Machinery”, McGraw Hill Books Company,6th edition 2002.
2. . Hill Stephen, Chapman.J, “Electric Machinery Fundamentals”, McGraw Hill Book Co., New Delhi, 4th edition 2005.
3. Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, Tata

McGraw Hill Publishing Company Ltd, 2010.
4. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009

COURSE OUTCOMES: At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

CO1: Plot the OCC and load characteristics of DC generators.

CO2: Conduct load test on various types of DC motors.

CO3: Choose appropriate speed control methodology for DC motors

CO4: Predetermine the efficiency of DC machines by conducting indirect tests.

CO5: Predetermine the efficiency of transformers by conducting indirect tests.

Board of Studies (BoS) :
16[h] BoS of EEE held on 13/12/2021

Academic Council: 18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	L	-	-	-	-	-	-	-	L	H	L
CO2	H	H	H	H	-	-	-	-	-	-	-	L	H	M
CO3	M	M	M	M	-	-	-	-	-	-	-	L	H	M
CO4	M	M	M	M	-	-	-	-	-	-	-	L	H	M
CO5	M	M	M	M	-	-	-	-	-	-	-	L	H	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 7 : Affordable and Clean Energy

Statement: Electrical Engineering contributes to clean sustainable energy, by generating, storage, transport electricity, and help to produce climate neutral power to the world.

SDG 8 : Decent Work And Economic Growth

Statement: Decent Work And Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

		L	T	P	C
GED 2101 **SDG: 17**	**ESSENTIAL SKILLS AND APTITUDE FOR ENGINEERS**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1:To enable them to make effective business presentations

COB2:To train them to participate in group discussions

COB3: To enhance the problem-solving skills

COB4: To train students in solving analytical problems

MODULE I ORAL DISCOURSE 07

Importance of oral communication-verbal and non-verbal communication, Presentation Strategies- one minute presentation (using Audacity/vocaro) - Effective listening skills, listening for specific information

MODULE II VERBAL COMMUNICATION 08

Understanding negotiation, persuasion & marketing skills - Listening to short conversations & monologues - Group Discussion techniques - Role plays - Interview techniques

MODULE III BASIC NUMERACY 08

Simplification and Approximation – Competitive Examination Shortcut Techniques - Number Systems - Simple and Compound Interest-Progression

MODULE IV ANALYTICAL COMPETENCY 07

Blood Relations – Clocks and Calendars – Coding and Decoding – Analytical Reasoning(Linear Arrangement, Circular Arrangement, Cross Variable Relationship and Linear Relationship)– Directions .

L – 30; TOTAL HOURS 30

REFERENCES:

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
2. Swan, Michael (2005). Practical English Usage, Oxford University Press
3. Bhattacharya. Indrajit (2008). An Approach to Communication Skills, DhanpatRai& Co., (Pvt.) Ltd. New Delhi.
4. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company

Pvt. Limited, 2009

5. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
6. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
7. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
8. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
9. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

COURSE OUTCOMES:

CO1: Make effective business presentations

CO2: Speak English intelligibly, fluently and accurately in group discussions

CO3: To apply the various problem-solving techniques

CO4: Understand and solve aptitude problem

Board of Studies (BoS) :
13th BoS of the Department of English held on 17.6.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1										H					
CO 2									M	H					
CO 3					L	L									
CO 4		M		L											
CO 5															

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Statement: This course ensures capacity building and skills development requisite for implementing global partnership.

SEMESTER IV

EED 2201	AC MACHINES	L	T	P	C
SDG: 7, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To give exposure to the students about synchronous machines including their constructional details, principle of operation and performance analysis.

COB2: To learn the characteristics of induction machines and relate their use for various applications.

COB3: To enable the students to compute various parameters of 3 Phase induction machines by performing suitable experiments.

COB4: To enable the students to compute various parameters of single Phase induction machines by performing suitable experiments.

COB5: To enable the students to solve analytical problems on AC machines.

MODULE I SYNCHRONOUS GENERATOR 8

Construction – Principle of Operation – EMF equation – Synchronous impedance – Voltage Regulation-Application- Armature Reaction – Parallel operation – Synchronizing current and torque – Effect of change in excitation and mechanical input – Two reaction theory – Slip test.

MODULE II SYNCHRONOUS MOTOR 9

Principle of Operation – Starters – Power developed and torque – Power stages and efficiency – Motor on load with varying excitations and varying loads – V and inverted V curves- Application.

MODULE III THREE PHASE INDUCTION MOTOR 10

Construction – Types – Principle of operation –Slip-torque characteristics - Various torques - T_{st}, T_{max} etc., – Losses and efficiency –Starters and Speed Control Application.

MODULE IV PREDICTION OF PARAMETERS OF THREE PHASE INDUCTION MOTOR 9

No load and blocked rotor tests – Equivalent circuit – Circle diagram – Cogging torque and crawling- induction machines with deep bar and double cage rotors.

MODULE V SINGLE PHASE INDUCTION MOTOR 9

Constructional details of single phase induction motor - Double revolving field theory and operation - Equivalent circuit - No load and blocked rotor test - Performance analysis - Starting methods of single-phase induction motors.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

Edward Hughes, Electrical Technology, Tata McGraw Hill Publication, 2001.

REFERENCES:

1. Fitgerald, A.E., Charles Kingsely Jr. Stephen D.Umans, “Electric Machinery”, McGraw Hill Books Company,6th edition 2002.
2. Hill Stephen, Chapman.J, “Electric Machinery Fundamentals”, McGraw Hill Book Co., New Delhi, 4th edition 2005.
3. Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2010.
4. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009
5. H. Cotton, Electrical Technology, Tata McGraw Hill Publication, 1999.
6. Alexander S. Langsdorf, “Theory of Alternating current Machinery” SecondEdition, TATA McGRAW-HILL, 1983.
7. P.S.Bhimbra, Electrical Machinery, Khanna Publishers, 2014.

COURSE OUTCOMES: At the end of this course, the student will possess knowledge and skills on the following:

CO1: Identify different types of synchronous and induction machines

CO2: Analyse the performance of synchronous machines.

CO3: Perform basic calculation on synchronous and induction machines

CO4: Identify areas of application of synchronous and induction machines

CO5: Assess the performance of Induction motor using equivalent circuits.

Board of Studies (BoS) :

16^{h} BoS of EEE held on 13/12/2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	L	L	-	-	-	-	-	-	-	L	H
CO2	H	H	H	L	L	-	-	-	-	-	-	-	H	H
CO3	H	M	M	L	L	-	-	-	-	-	-	-	H	H
CO4	H	H	H	L	M	-	-	-	-	-	-	-	M	H
CO5	M	M	H	L	-	-	-	-	-	-	-	-	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 7 : Affordable and Clean Energy

Statement : Electrical Engineering contributes to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8 : Decent Work And Economic Growth

Statement : Decent Work And Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

		L	T	P	C
EED 2202	**DIGITAL ELECTRONICS**				
SDG: 8,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To acquaint the students with the methods for simplifying Boolean expressions.

COB2: To familiarize the students with the procedures for the analysis and design of combinational circuits

COB3: To familiarize the students with the procedures for the analysis and design of sequential circuits

COB4: To acquaint the students with the design of Finite state machine

COB5: To introduce the concept of memories and programmable logic devices

MODULE I BOOLEAN ALGEBRA AND LOGIC GATES 9

Number systems - Introduction to number system, conversions, Binary codes, logic gates, universal gates, Boolean algebra: Boolean algebra and theorems; Boolean identities, standard forms of logic expressions, Implementations of Logic Functions using logic gates, simplification of logic expressions- Karnaugh map and Quine-McClusky method Digital IC families -DTL, TTL, ECL, MOS, CMOS.

MODULE II COMBINATIONAL CIRCUITS 9

Analysis and design procedures of combinational circuit - Arithmetic circuits, Code converters -decoders, encoders, multiplexers, de-multiplexers, and their use in logic synthesis; Hazards in combinational circuits.

MODULE III SEQUENTIAL LOGIC CIRCUITS 9

Edge triggering – Level Triggering, Latches and Flip flops- SR, JK, T, D, - Master slave- Timing in sequential circuits– Conversion of flip flops, Design of Counters, Shift registers – Types- Sequential circuit design examples.

MODULE IV FINITE STATE MACHINES 11

Basic concepts and design, Moore and Mealy machines examples, State minimization/reduction, state assignment - Finite state machine design case studies-Asynchronous sequential circuits-Hazards, Hazards elimination.

MODULE V SEMICONDUCTOR MEMORIES 7

Memory organization, Classification, and characteristics of memories, Sequential memories, ROMs, R/W memories, Content Addressable memories, Charged-Coupled Device memory, PLA, PAL and Gate Array, CPLD and FPGA architectures.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. M. Morris Mano ,Michael D. Ciletti “Digital Design With an Introduction to the Verilog HDL”,5th Edition, Pearson Education, 2013
2. Harris D., Harris S., “Digital Design and Computer Architecture”, Elsevier Publications, 2nd 2007.

REFERENCES:

1. Charles H. Roth, "Fundamentals of Logic Design", 7th Edition, Global Engineering: Tim Anderson, 2014
2. Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.
3. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 4th Edition. New Delhi, 2010.
4. William Stallings, "Computer Organization and Architecture", 8th Edition, Pearson Education Asia, 2010.
5. Thomas L. Floyd, "Digital Fundamentals", 10th Edition Pearson Education, Inc, New Delhi, 2008
6. Donald D. Givone, "Digital Principles and Design", Tata McGraw Hill Publishing company limited, New Delhi, 2003.

COURSE OUTCOMES: At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

CO1: Apply the concepts and techniques associated with the number systems and to minimize the logical expressions

CO2: Analyze, design and implement combinational circuits

CO3: Analyze, design and implement sequential circuits

CO4: Design a finite state machine

CO5: Apply the concepts and techniques associated with memory devices and to develop digital logic circuits.

Board of Studies (BoS) :

16h BoS of EEE held on 13/12/2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	M	M	M	L	-	-	-	-	-	-	L	H	M
CO2	H	H	M	M	L	-	-	-	-	-	-	L	H	M
CO3	H	H	M	M	L	-	-	-	-	-	-	L	H	M
CO4	H	H	M	M	L	-	-	-	-	-	-	L	H	M
CO5	H	H	M	M	L	-	-	-	-	-	-	L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8 : Decent Work and Economic Growth

Statement: The complete understanding of digital logic circuits leads to have sustainable industrialization and promote economic development.

SDG 9 : Industry, Innovation & Infrastructure

Understanding the fundamentals of digital electronics leads to innovative digital application circuits which further enhances the industry and infrastructure

		L	T	P	C
EED 2203 **SDG: 3, 8 & 11**	**ELECTRICAL MEASUREMENT AND INSTRUMENTATION**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES: To impart knowledge on

- **COB1:** various instrument systems and their errors in them.
- **COB2:** principles of various active and passive transducers.
- **COB3:** various signal conditioning circuits.
- **COB4: i**nstruments for measuring various electrical quantities.
- **COB5:** overview of magnetic measurement techniques.

MODULE I INTRODUCTION 07

Functional elements of an Instrument - Static and Dynamic characteristics - Errors in measurement - statistical evaluation of measurement of data - Standards and Calibration.

MODULE II ANALOG INSTRUMENTS 08

DC & AC potentiometers - General Principle - calibration of ammeter, voltmeter and wattmeter using potentiometer. DC & AC Bridges: Wheatstone bridge – Kelvin's double bridge- Maxwell's bridge- Schering bridge and Wien's bridge. Principle and types of analog ammeters and voltmeters – Single and three phase watt meters and energy meters.

MODULE IV DIGITAL INSTRUMENTS AND DISPLAYS 10

Principle of digital ammeters and voltmeters- Basic principle of signal display – Digital Storage Oscilloscope. A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation - Instrument standards.

MODULE V TRANSDUCERS AND SIGNAL CONDITIONING CIRCUITS 10

Classification of transducers - selection of transducer - resistive, capacitive and inductive transducer - Piezo-electric transducer - optical and digital transducers. Transducers for measurement of displacement- velocity- flow- liquid level- force- pressure- strain and temperature - basic principles and working of LVDT, , piezoelectric transducer- load cell- strain gauges- RTD- Thermistors- thermocouple. Operational Amplifiers- Differential and Instrumentation amplifier -

filter circuits- V/f and f/V converters - multiplexing and demultiplexing - data acquisition system- need for data acquisitions.

MODULE V MAGNETIC MEASUREMENTS 10

Introduction - Measurement of flux and permeability - flux meter - hall effect Gauss meter - BH curve and permeability measurement - hysteresis measurement- ballistic galvanometer – principle- determination of BH curve - hysteresis loop - Lloyd Fisher square — measurement of iron losses.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", DhanpatRai& Sons Publications, New Delhi, 2012.
2. Morris, A.S,"Principle of Measurement and Instrumentation", Prentice Hall of India, 1999.
3. Northrop, Robert B. "Introduction to instrumentation and measurements", CRC press, 2018.

REFERENCES:

1. Bakshi, Uday A., and Late Ajay V. Bakshi. "Electronic measurements and instrumentation", Technical Publications, 2020.
2. Ghosh, Arun K. "Introduction to measurements and instrumentation", PHI Learning Pvt. Ltd., 2012.
3. Doebelin E.O., "Measurement Systems - Application and Design", McGraw Hill Publishing Company, 1990.

COURSE OUTCOMES: At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

CO1: Identify the functional blocks of various Instruments and their standards.

CO2: Select transducers based on their working principle.

CO3: Analyse the working of signal conditioning circuits.

CO4: Illustrate the working principle of electrical instruments.

CO5: Apply the concepts of magnetic measurement techniques.

Board of Studies (BoS) :
16h BoS of EEE held on 13/12/2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	M	M	H	M	-	-	-	-	-	-	L	M	H
CO2	M	H	H	H	M	-	-	-	-	-	-	L	M	M
CO3	M	H	H	H	M	-	-	-	-	-	-	L	M	M
CO4	L	M	H	H	M	-	-	-	-	-	-	L	M	H
CO5	L	M	M	H	M	-	-	-	-	-	-	L	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 3: Good health and well-being.
Statement: Understanding the fundamentals of sensors and transducers can help in designing systems to promote good health and well-being.

SDG 8: Decent work and economic growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 11: Sustainable cities and communities.
Statement: Use of measurement and calibration techniques learnt through this course can play a major role in establishing Sustainable cities and communities.

		L	T	P	C
EED 2204	**POWER SYSTEM PROTECTION**	**L**	**T**	**P**	**C**
SDG: 3,8,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To discuss the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.

COB2: To impart knowledge on over current protection schemes.

COB3: To understand the characteristics and functions of relays and protection schemes.

COB4: To understand the problems associated with circuit breaking.

COB5: To impart knowledge on functioning of circuit breakers and fuses.

MODULE I INTRODUCTION 9

Principles and need for protective schemes – nature and causes of faults – types of faults – Methods of Neutral grounding - essential qualities of protection- Zones of protection and protection scheme - CTs and PTs and their applications in protective schemes.

MODULE II OPERATING PRINCIPLES AND RELAY CHARACTERISTICS 9

Relay terminologies- definitions- Electromagnetic relays – over current, directional and non-directional, distance, negative sequence, differential and under frequency relays – relay co-ordination- Introduction to static relays, Pilot Relaying Schemes: Introduction, Wire Pilot Protection, Carrier Current Protection.

MODULE III OVERCURRENT PROTECTION 9

Introduction, Time – current Characteristics, Current Setting, Time Setting, Over current Protective Schemes, Reverse Power or Directional Relay, Protection of Parallel Feeders, Protection of Ring Mains, Earth Fault and Phase Fault Protection, Combined Earth Fault and Phase Fault Protective Scheme, Phase Fault Protective Scheme, Directional Earth Fault Relay, Static Over current Relays, Numerical Over current Relays. Distance Protection: Introduction, Impedance Relay, Reactance Relay, Mho Relay, Angle Impedance Relay.

MODULE IV APPARATUS PROTECTION 9

Main considerations in apparatus protection – transformer, generator and motor protection – protection of bus bars. Transmission line protection – zones of protection, Frame Leakage Protection. Capacitor Bank / Reactor protection.

MODULE V CIRCUIT BREAKERS AND FUSES 9

DC and AC circuit breaking – re-striking voltage and recovery voltage – rate of rise of recovery voltage – resistance switching – current chopping – interruption of capacitive current – Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers. Fuses: Introductions, Definitions, Fuse Characteristics, Types of Fuses, Applications of HRC Fuses, Selection of Fuses.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Ravindranath.B and Chander.N, "Power System Protection and Switchgear", New Age International (P) Publishers, 1977 (2005 Reprint).
2. Badri Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata McGraw Hill Publishing Company Limited, 2007

REFERENCES:

1. Chakrabarti.A.Soni.M.L Gupta, P.V. "A Text book on Power System Engineering", Dhanpat Co. Pvt. Ltd., 2008.
2. C.L.Wadhwa; "Electrical Power Systems", New Age International Pvt. Ltd., 2006.
3. Patra S.Basu S.K & Choudary.S, "Power System Protection", Oxford and IBH Publishing Co. Ltd.,1983.
4. Sunil S.Rao, "Switch Gear and Protection", Khanna Publishers, New Delhi, 1986.

COURSE OUTCOMES: At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

CO1: Gain proficiency on different Protective Equipment or Power Systems.

CO2: Analyse the fault level and accordingly design the protective devices in a power system for power frequency voltages and currents.

CO3: Apply appropriate overcurrent protection schemes for various power system configurations and fault scenarios

CO4: Identify the fault in various apparatus and propose appropriate protection scheme.

CO5: Apply various circuit breakers like Oil Circuit Breaker, Air Blast circuit Breakers, SF6 Circuit Breaker etc., in the appropriate places.

Board of Studies (BoS) :
16h BoS of EEE held on 13/12/2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	L	-	-	M	-	-	-	-	-	-	H	-	M
CO2	H	H	L	M	H	-	-	-	-	-	-	H	-	H
CO3	H	M	L	L	H	-	-	-	-	-	-	H	L	H
CO4	H	H	M	H	H	-	-	-	-	-	-	H	M	H
CO5	H	M	L	L	H	-	-	-	-	-	-	H	L	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3 : Good health and wellbeing.
Statement : Understanding of the fundamentals of electron devices can help in designing systems to promote good health and well being.

SDG 8: Decent work and economic growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9 : Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.
Statement : The complete understanding of power system protection will lead to sustainable industrialization and promote economic development.

SDG 12: Responsible consumption and production.
Statement: Use of right and energy efficient electric components and protective devices results is reasonable consumption and production.

		L	T	P	C
EED 2205	**PYTHON PROGRAMMING FOR ELECTRICAL ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 7, 8, 9 & 11		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1: To understand the fundamentals of python programming and Raspberry PI.

COB2: To develop python programs with conditional loops and to understand I/O components.

COB3: To define and declare functions and call them.

COB4: To explore file input and output operations and to provide practical experience with Raspberry PI for electrical applications.

MODULE I BASICS OF PYTHON AND RASPBERRY PI 8

Overview and fundamentals of python, executing simple programs, exploring python variables, operators and comprehend python blocks, Raspberry PI, Linux on Raspberry PI, Raspberry PI interfaces, terminals, remote desktop connections, Installation of Python in Raspberry PI, setting up the hardware and software for Raspberry PI, GPIO pins.

MODULE II DATA TYPES, PROGRAM FLOW CONTROLS AND REAL TIME I/O COMPONENTS 8

Basic data types, numeric data types, string and string operations, list data types and slicing, tuples and its types, conditional blocks, control statements, looping statements, break statements, for loop, while loop using strings and dictionaries, Sensors: Temperature, Humidity, Current, Voltage and Hall Sensors, Actuators: Electromechanical Relays, Motors with driver circuits.

MODULE III FUNCTIONS, PACKAGES AND MODULES 7

Organize functions using python code, import libraries and methods internally and externally, usage of external packages, powerful functions in python, understanding packages.

MODULE IV BULIDING BLOCKS OF PYTHON – METHODS 7

String and dictionary manipulations, list manipulation using in build methods, programming using string, list and inbuilt functions, Exception handling and programs, Read/Write sensor data’s from/to CSV using python programming, Case Study: Advanced Metering Infrastructure (AMI) and smart metering using

Raspberry PI.

L – 30; P – 30; TOTAL HOURS – 60

PRACTICALS

List of Experiments:

1. Implementation of simple python program by installing and exploring python IDE.
2. Programs to implement basic data types, tuples, strings, numeric data types and list data types.
3. Implement control statements and conditional blocks.
4. Implement looping statements – for, while and do-while.
5. Implement strings and dictionaries.
6. Programming using functions in python.
7. Import basic packages, libraries and execute programs in Raspberry PI.
8. Develop a python program to interface an LED with switch using Raspberry PI.
9. Develop a python program to measure voltage and current using Raspberry PI.
10. Develop a python program to control a DC fan based on the current temperature using Raspberry PI.

TEXT BOOKS:

1. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
2. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

REFERENCES:

1. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013.
2. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. https://www.geeksforgeeks.org/python-programming-language

COURSE OUTCOMES: Upon Completion of course the students will be able to:

CO1: write, execute python programs and setting up of raspberry pi environment for electrical applications.

CO2: develop simple python programs to solve problems and demonstrate a working knowledge of the necessary steps and methods used to interface a Raspberry PI to devices such as relays, meters, motor controls and sensors etc.

CO3: explore libraries in python and molder programs to functions and electrical measurement instruments.

CO4: develop data structures based on python programs and real-time automated systems.

Board of Studies (BoS) :
16h BoS of EEE held on 13/12/2021

Academic Council: 18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	L	-	-	-	-	-	-	-	L	H	M
CO2	H	H	H	L	-	-	-	-	-	-	-	L	H	M
CO3	H	H	H	L	-	-	-	-	-	-	-	L	H	M
CO4	H	M	H	L	-	-	-	-	-	-	-	L	H	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 7: Affordable and Clean Energy

Statement: Knowledge on python programming relevant to real-time applications can help in the analysis of affordable and clean energy systems.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced communication infrastructure.

SDG 11: Sustainable cities and communities.

Statement: Use of python programming for electrical engineers learnt through this course can play a major role in establishing Sustainable cities and communities.

EED 2206	**AC MACHINES LABORATORY**	**L**	**T**	**P**	**C**
SDG: 7,8		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To experimentally verify the performance and characteristics of Alternator, Synchronous motor, 3-phase induction motor.

COB2: To perform tests on the various types of electric motors and generators

COB3: To introduce students to the operating principles, methods of starting and area of applications of synchronous and induction machines

COB4: To perform speed control in various AC machines.

COB5: To synchronize AC machines and to regulate the voltage**.**

PRACTICALS

List of Experiments:

1. Regulation of alternators by EMF and MMF method.
2. Regulation of alternators by Potier Triangle method.
3. Load test on a 3-phase alternator.
4. Regulation of a salient pole alternator by Slip test.
5. Synchronization of alternators
6. V and inverted V curves of a synchronous motor.
7. Load test on a 3-phase squirrel cage induction motor.
8. No load and blocked rotor tests on a 3-phase induction motor
9. Load test on single phase induction motor.
10. Performance study of induction generator

P – 30 ; TOTAL HOURS –30

TEXT BOOK:

1. Laboratory Manual

REFERENCES:

1. Fitzgerald, A.E., Charles Kingsely Jr. Stephen D.Umans, “Electric Machinery”, McGraw Hill Books Company,6th edition 2002.
2. Stephen, Chapman.J, “Electric Machinery Fundamentals”, McGraw Hill Book Co., New Delhi, 4th edition 2005.
3. Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2010.
4. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI

Learning PVT LTD., New Delhi, 2009

COURSE OUTCOMES: At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

CO1: Estimate voltage regulation of alternators by EMF, MMF and Potier triangle methods

CO2: Evaluate the performance of synchronous machines by plotting their characteristic curves

CO3: Evaluate the performance of induction machines by plotting their characteristic curves.

CO4: Analyze the working of any electrical machine under loaded and unloaded conditions.

CO5: Predetermine the efficiency of the Synchronous and Induction machines.

Board of Studies (BoS) :
16h BoS of EEE held on 13/12/2021

Academic Council: 18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	L	-	-	-	-	L	-	-	L	H	L
CO2	H	H	H	H	-	-	-	-	L	-	-	L	H	M
CO3	M	M	M	M	-	-	-	-	L	-	-	L	H	M
CO4	M	M	M	M	-	-	-	-	L	-	-	L	H	M
CO5	M	M	M	M	-	-	-	-	L	-	-	L	H	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 7 : Affordable and Clean Energy

Statement : Electrical Engineering contributes to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8 : Decent Work And Economic Growth

Statement : Decent Work And Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

EED 2207	**DIGITAL ELECTRONICS LABORATORY**	**L**	**T**	**P**	**C**
SDG: 8,9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To verify the functionality of simple digital logic circuit

COB2: To design and implement Combinational circuits

COB3: To verify the functionalities of Flip-flops

COB4: To design and implement sequential circuits

COB5: To work in a team to design and implement various digital application circuitries

PRACTICALS

List of Experiments:

1. Implementation of arbitrary function using logic gates/ universal gates.
2. Design and implementation of combinational circuits using basic gates.
3. Design and implementation of multiplexers and Demultiplexers.
4. Design and implementation of encoder and decoder.
5. Design and implementation of Code converters.
6. Design and implementation of 4 bit binary Adder.
7. Design and implementation of Magnitude Comparator using logic gates.
8. Verification of R-S flip-flop, J-K flip-flop, T Flip-Flop and D Flip-Flop.
9. Design and implementation of synchronous counters.
10. Design and Implementation of shift registers using Flip- flops.

P – 30; TOTAL HOURS – 30

TEXT BOOK:

M. Morris Mano ,Michael D. Ciletti “Digital Design With an Introduction to the Verilog HDL”,5th Edition, Pearson Education, 2013.

REFERENCES:

1. Charles H. Roth, "Fundamentals of Logic Design", 7th Edition, Global Engineering: Tim Anderson, 2014.
2. Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009
3. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 4th Edition. New Delhi, 2010

COURSE OUTCOMES:

CO1: To analyze and design digital logic circuits by applying the knowledge of Boolean algebra

CO2: To design simple combinational circuits using logic gates

CO3: To design sequential circuits using logic gates

CO4: To identify, formulate and solve engineering problems in the area of digital logic circuit design and to meet desired needs within realistic constraints

CO5: To function on multi-disciplinary teams through digital circuit experiments.

Board of Studies (BoS) :
16h BoS of EEE held on 13/12/2021

Academic Council: 18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	M	L	-	-	-	H	-	-	L	H	M
CO2	H	H	M	M	L	-	-	-	H	-	-	L	H	M
CO3	H	H	M	M	L	-	-	-	H	-	-	L	H	M
CO4	H	H	M	M	L	-	-	-	H	-	-	L	H	M
CO5	H	H	M	M	L	-	-	-	H	-	-	L	H	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 8 : Decent Work and Economic Growth

Statement: The complete understanding of digital logic circuits leads to have sustainable industrialization and promote economic development.

SDG 9 : Industry, Innovation & Infrastructure

Understanding the fundamentals of digital electronics leads to innovative digital application circuits which further enhances the industry and infrastructure

		L	T	P	C
EED 2208	**ELECTRICAL MEASUREMENT AND**	**L**	**T**	**P**	**C**
SDG: 3, 8 & 11	**INSTRUMENTATION LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES: To impart Knowledge on

COB1: various sensors and transducers.

COB2: various bridge circuits.

COB3: calibration of energy meters and current transformers.

COB4: instruments for measuring the various electrical quantities.

COB5: overview of magnetic measurement techniques.

PRACTICALS

List of Experiments:

1. Study of displacement and pressure transducers.
2. Design of AC Bridges (Schering and Maxwell).
3. Design of DC Bridges (Wheatstone and Kelvin).
4. Design of Instrumentation Amplifiers.
5. Study of A/D and D/A converters.
6. Study of Transients.
7. Calibration of Single Phase Energy meter.
8. Calibration of Current Transformer.
9. Measurements of three phase Reactive Power and Power Factor.
10. Measurement of Iron Loss.

P – 30; TOTAL HOURS – 30

TEXT BOOKS:

1. A.K. Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”, DhanpatRai & Sons Publications, New Delhi, 2012.
2. Morris, A.S,"Principle of Measurement and Instrumentation", Prentice Hall of India, 1999.
3. Northrop, Robert B. “Introduction to instrumentation and measurements”, CRC press, 2018.

REFERENCES:

1. Bakshi, Uday A., and Late Ajay V. Bakshi. “Electronic measurements and instrumentation”, Technical Publications, 2020.
2. Ghosh, Arun K. “Introduction to measurements and instrumentation”, PHI Learning Pvt. Ltd., 2012.
3. Doebelin E.O., "Measurement Systems - Application and Design",

McGraw Hill Publishing Company, 1990.

COURSE OUTCOMES: At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

CO1: Analyse the various types of transducers and their characteristics

CO2: Design Inductive and capacitive bridge circuits.

CO3: Design Instrumentation amplifiers.

CO4: Calibrate the various instruments.

CO5: Measure the electrical quantities like power, power factor and the iron loss in a specimen.

Board of Studies (BoS) :
16h BoS of EEE held on 13/12/2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	H	H	M	-	-	-	L	-	-	M	H	H
CO2	M	H	M	M	H	-	-	-	M	-	-	-	H	H
CO3	M	H	M	M	H	-	-	-	M	-	-	L	H	H
CO4	M	H	M	M	M	-	-	-	M	-	-	-	H	H
CO5	M	H	M	M	M	-	-	-	L	-	-	-	H	H

Note:L- Low Correlation M -Medium Correlation H -High Correlation

SDG 3: Good health and well-being.
Statement: Understanding of the fundamentals of sensors and transducers can help in designing systems to promote good health and well-being.

SDG 8: Decent work and economic growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 11: Sustainable cities and communities.
Statement: Use of measurement and calibration techniques learnt through this course can play a major role in establishing Sustainable cities and communities.

GED 2201	**WORKPLACE SKILLS AND APTITUDE FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 8		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To expose them to reading for specific purposes, especially in professional contexts

COB2: To expose them to the process of different kinds of formal writing

COB3: To prepare the students to be successful in their career

COB4: To familiarize various problem-solving techniques in aptitude and puzzles.

MODULE I EXTENSIVE READING & WRITING 07

Reading for comprehension - inferring and note-making – Process of writing-paragraph development - elements of business writing: Email, memos.

MODULE II INTENSIVE READING & WRITING 08

Intensive reading and reviewing - Interpretation of charts, graphs - Résumé - Letter of enquiry, thanksgiving letters.

MODULE III QUANTITATIVE APTITUDE 08

Percentage - Ratio and Proportion - Profit and Loss – Averages, Allegations and Mixtures.

MODULE IV LOGICAL COMPETENCY 07

Syllogism – Blood Relations- Number, Alpha and Alpha numeric series - Puzzles – Cubes and Dice - Odd One Out-Coding and Decoding

L – 30; TOTAL HOURS - 30

REFERENCES:

1. Sharma, R.C. and Mohan, Krishna (2010). Business Correspondence and Report Writing. 4th edition. Tata McGraw Hill Education Private Limited, New Delhi
2. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009

4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

COURSE OUTCOMES:

CO1: Demonstrate reading skills with reference to business related texts

CO2: Draft professional documents by using the three stages of writing

CO3: Apply various short cut techniques for solving complicated aptitude problems

CO4: To understand various problems and patterns of different ways to solve it

Board of Studies (BoS) :

13th BoS of the Department of English held on 17.6.2021

Academic Council:

17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PS O1	PSO2	PS O3
CO1		L		H						H					
CO2			L							H					
CO3			L				M								
CO4		H		M											
CO5															

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement:Demonstrating, Drafting and applying various techniques for sustainable growth to employment.

GED 2202	**INDIAN CONSTITUTION AND HUMAN RIGHTS**	**L**	**T**	**P**	**C**
SDG: 16		**2**	**0**	**0**	**0**

COURSE OBJECTIVES:

COB1: To explicate the emergence and evolution of Indian Constitution.

COB2: To have an insight into the philosophy of fundamental rights and duties, and Directive Principles.

COB3: To differentiate the structure of executive, legislature and judiciary.

COB4: To understand human rights and its implication - local and international and redressal mechanism.

MODULE I INTRODUCTION AND BASIC INFORMATION ABOUT INDIAN CONSTITUTION 8

Meaning of the constitution law and constitutionalism - Historical Background of the Constituent Assembly - Government of India Act of 1935 and Indian Independence Act of 1947 - The Constituent Assembly of India - Enforcement of the Constitution - Indian Constitution and its Salient Features - The Preamble of the Constitution. Citizenship.

MODULE II FUNDAMENTAL RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES 7

Fundamental Rights and its Restriction and limitations in different complex situations - Directive Principles of State Policy (DPSP) & its present relevance in our society with examples- Fundamental Duties and its Scope and significance in nation building - Right to Information Act 2005.

MODULE III GOVERNANCE IN INDIA 8

The Union Executive – the President and the Vice-President – The Council of Ministers and the Prime Minister – Powers and functions. The Union legislature – The Parliament – The Lok Sabha and the Rajya Sabha, Composition, powers and functions – Government of the State - The Governor – the Council of Ministers and the Chief Minister – Powers and Functions-Elections-Electoral Process and Election Commission of India - Indian judicial system.

MODULE IV HUMAN RIGHTS AND INDIAN CONSTITUTION 7

Human rights – meaning and significance - Covenant on civil and political rights - Covenant on Economic, Social and Cultural rights - UN mechanism and agencies - The Protection of Human Rights Act, 1993 – watch on human rights and enforcement - Roles of National Human Rights Commission of India - Special Constitutional Provisions for SC & ST, OBC - Special Provision for Women, Children & Backward Classes.

L – 30; TOTAL HOURS – 30

TEXT BOOKS:

1. B.K. Sharma, Introduction to the Constitution of India, 6th ed., PHI Learning Private Limited, New Delhi 2011
2. Durga Das Basu "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19th / 20th Edn. 2008
3. M.P. Jain, Indian Constitutional Law, 7th ed., LexisNexis, Gurgaon. 2014.

REFERENCES:

1. Fadia B.L "Indian Government and Politics", Sahitya Bhavan Publications. 2010
2. Kashyap Subhash C "Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT. 2017
3. M.V.Pylee "An Introduction to Constitution of India", Vikas Publishing. 2002
4. Sharma Brij Kishore "Introduction to the Indian Constitution", 8th Edition, PHI Learning Pvt. Ltd. 2015
5. Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

COURSE OUTCOMES: At the end of the course, the students will be able to

CO1: describe the emergence and evolution of Indian Constitution.

CO2: realize the status and importance of fundamental rights, fundamental duties and directive principles of state policy and relation among them by understanding the articulation of its basic values under the Constitution of India.

CO3: compare the various structure of Indian government.

CO4: recognize the human rights, cultural, social and political rights and its relationship with Indian constitution. .

Board of Studies (BoS) :
4th BoS of SSSH held on 28.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			M			H	M	L	M		M	
CO2			H			M	H	M			H	
CO3			M			H	M	L			L	
CO4			H			H	H	M	M			H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Application of human, legal and political rights leading to empowerment in real-life situations for protection of fundamental freedoms and freedom from violence, abuse, trafficking and exploitation are at the core of human rights.

SEMESTER V

		L	T	P	C
EED 3101	**EMBEDDED SYSTEM**	**L**	**T**	**P**	**C**
SDG: 3, 8, 9 & 11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain knowledge on architecture of 8051 controller and its programming.

COB2: To study hardware architecture and programming using PIC microcontroller.

COB3: To learn Interfacing Interrupts and on-chip A/D converter to PIC microcontroller.

COB4: To familiarize the concept of time delays using Timer modules in PIC microcontroller.

COB5: To acquire knowledge different peripherals and their interfacing concepts with PIC microcontroller.

MODULE I INTRODUCTION TO 8051 CONTROLLERS 9

Introduction and history of microcontrollers, Overview of 8051 microcontrollers, Block diagram and Architecture, I/O ports, Memory organization, addressing modes and instruction set of 8051, timer/counter, serial communication in 8051, interfacing ADC / DAC with controller, simple programs.

MODULE II INTRODUCTION TO EMBEDDED SYSTEMS 9

Components of Embedded systems - Evolution in Microcontroller technology - Introduction to PIC family - Features of PIC16F877A - PIC Families - Harvard Architecture vs Von Neumann - PIC16F877A Architecture - Pin description and Oscillator Types - System Reset - Memory Organization - Input/output - Ports - Registers - Status Register - Option Register - Memory Organization - Port I/O configuration - Introduction to Software Tools - MikroC and Pickit2 programmer. Simple programmes in MikroC: Digital input/output and Delay loop Applications – Push Button interfacing, Flasher and Counter.

MODULE III INTERRUPTS AND ON-CHIP ANALOG TO DIGITAL CONVERTER 8

Interrupts in PIC 16F877A - INTCON Register - Option Register - Interrupt Sources - PIE and PIR registers - Enabling Interrupts - Peripheral Interrupts - Interrupt Service Routine (ISR). - On-Chip Analog-to-Digital Converter (ADC) block diagram - PIC16F877A ADC pins - ADC Configuration- ADC PORT configuration - ADC Channel Selection – ADC voltage reference selection – Resolution. - Interrupt control - ADC Registers: ADCON0 and ADCON1 - Sample Interrupt Codes in MikroC.

MODULE IV TIMER MODULES IN PIC 16F877A 9

TIMER0 module Block Diagram - Timer Calculation and TMR0 Register – Configuring the TIMER0 module using the INTCON and OPTION registers – TIMER1 module Block Diagram - Timer Calculation and TMR1H:TMR1L Register - Register Configuring the TIMER1 using T1CON, PIR1 and PIE1control registers – TIMER2 module Block Diagram - Timer Calculation and TMR2 Register - Register Configuring the TIMER2 using T2CON, PIR1 and PIE1 control registers - sample codes to generate time delay.

MODULE V CAPTURE/COMPARE/PWM MODULES AND SERIAL COMMUNICATION MODULES 10

CAPTURE and COMPARE modes operation block diagram - CCP1CON/CCP2CON Registers - TIMER1 mode selection - software interrupt - CCP pre-scaler - PWM mode- simplified PWM block diagram- PWM period - PWM duty cycle - setup for PWM operation – Generation of PWM in MikroC using the CCP module.

Serial communication: SPI Mode – Master/Slave mode – Inter-Integrated Circuit (I2C) Mode - Universal Synchronous Asynchronous Receiver Transmitter (USART) module- Master/Slave mode – Sample MikroC source codes: PIC to PIC Communication.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Mazidi, Muhammad Ali, Rolin D. McKinlay, and Danny Causey. "PIC microcontroller and embedded systems: using Assembly and C for PIC18", second edition, Pearson Education ,2021.
2. Han-Way Huang, Leo Chartrand, "PIC Microcontroller: An Introduction to Software & Hardware Interfacing", Delmar Cengage Learning, 2004.
3. MikroC- Compiler for PIC Microchip controllers- mikro Electronik, 2012.

REFERENCES:

1. Kamal, Raj. “Embedded Systems-SoC, IoT, AI and Real-Time Systems”,

McGraw-Hill Education, 2020.

2. Martin P. Bates, “PIC Microcontrollers –An Introduction”, Newnes, 2011.
3. John Main, “PIC Microcontroller C”, 2006-2007 Edition, 2007.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: program 8051 and PIC microcontrollers.

CO2: interface interrupt and on-chip A/D converter in PIC microcontroller for various applications.

CO3: interface PIC microcontroller with hardware for a given application.

CO4: develop small microcontroller based applications.

CO5: analyze a problem and formulate appropriate computing solution for microcontroller based applications.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	M	M	H	L	-	-	-	-	-	-	L	L	H
CO2	L	M	M	H	M	-	-	-	-	-	-	L	L	L
CO3	L	M	M	H	M	-	-	-	-	-	-	L	L	L
CO4	L	M	H	H	H	-	-	-	-	-	-	L	H	H
CO5	L	M	M	H	M	-	-	-	-	-	-	L	H	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 3: Good health and well-being.

Statement: Understanding of microcontrollers can help in designing systems to promote good health and well-being.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced communication infrastructure.

SDG 11: Sustainable cities and communities.

Statement: Use of various microcontrollers learnt through this course can play a major role in establishing sustainable cities and communities.

EED 3102	**POWER SYSTEM ANALYSIS**	**L**	**T**	**P**	**C**
SDG: 8, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To model the power system under steady state operating condition.

COB2: To understand and apply iterative techniques for power flow analysis.

COB3: To study the symmetrical fault analysis on power system.

COB4: To study the unsymmetrical fault analysis on power system.

COB5: To model and analyze stability problems in power system.

MODULE I POWER SYSTEM REPRESENTATION 10

Need for system planning and operational studies – Power scenario in India – Balanced three phase systems and per phase analysis, per phase models of generator, load, transmission line and transformers - equivalent circuit of transformers with off-nominal tap ratio - single line diagram – per unit system - impedance and reactance diagrams – Bus admittance matrix: formation of bus admittance matrix by inspection method (two rule method) - basic graph theory – node incidence matrix – formation of bus admittance matrix by singular transformation.

MODULE II POWER FLOW ANALYSIS 9

Power flow analysis: Problem definition - bus classification - derivation of power flow equation in rectangular and polar forms - Power flow solution by Gauss-Seidel, Newton-Raphson and FDPF methods - computation of slack bus power, transmission loss and line flows.

MODULE III SYMMETRICAL FAULT ANALYSIS 9

Need for short circuit study - symmetrical short circuit analysis by internal emf and Thevenin's equivalent circuit methods - short circuit current - Short Circuit MVA calculation - Thevenin's impedance and bus impedance matrix - bus impedance matrix building algorithm (without mutual impedance) - symmetrical short circuit analysis by bus impedance matrix - selection of circuit breakers.

MODULE IV UNSYMMETRICAL FAULT ANALYSIS 9

Symmetrical components - sequence impedances of synchronous machines, transformers, transmission lines and loads - formation of sequence networks for unsymmetrical fault analysis. Unsymmetrical fault analysis: LG, LL and LLG faults with and without fault impedance - effect of ground impedance.

MODULE V STABILITY ANALYSIS 8

Classification of power system stability – Rotor angle stability - swing equation for SMIB system - power angle equation and curve- steady state stability limit - transient stability: equal area criterion, critical clearing time and angle - numerical solution of swing equation by modified Euler's method.

L – 45 ; TOTAL HOURS – 45

TEXT BOOK:

1. John J. Grainger and Stevenson Jr. W.D., 'Power System Analysis', McGraw Hill International Edition, 2017.

REFERENCES:

1. Hadi Saadat, 'Power System Analysis', Third Edition, PSA Publishing LLC, 2011, ISBN 13: 9780984543861.
2. Stagg, G.W. and El-Abiad, A.H., 'Computer Methods in Power System Analysis', Medtech , 2019.
3. M. A. Pai and Dheeman Chatterjee, “Computer Techniques in Power System Analysis”, McGraw Hill Education; 3rd edition, 2017.
4. Olle I. Elgerd, 'Electric Energy and System Theory - An Introduction', McGraw Hill Education; 2nd edition, 2017.
5. Kothari, D.P and Nagrath, I.J., 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Education, New Delhi, 2003.
6. Kundur, 'Power System Stability and Control', McGraw Hill Education; 1st edition 2006.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: draw and interpret single line diagram of a given power system and to model an electrical power network using bus admittance matrix.

CO2: apply iterative techniques for power flow analysis.

CO3: perform symmetrical fault analysis in power systems and to calculate the breaker ratings.

CO4: perform unsymmetrical fault analysis in power systems.

CO5: analyze the given power system for small signal / transient stability and compute critical clearing angle and critical clearing time for simple systems.

Board of Studies (BoS) :
17th BOS of EEE held on 15.07.2022

Academic Council:
19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	L	L	M	L	-	-	-	-	-	-	M	L	H
CO2	H	H	M	M	H	-	-	-	-	-	-	H	H	H
CO3	H	H	H	H	M	-	-	-	-	-	-	H	H	H
CO4	H	H	M	H	L	-	-	-	-	-	-	H	H	H
CO5	H	M	L	H	H	-	-	-	-	-	-	H	H	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic growth.
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.
Statement : The complete understanding of this course lead to sustainable industrialization and promote economic development.

EED 3103	**POWER ELECTRONICS**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the basics of Power Electronics

COB2: To learn the operation of power semiconductor switches

COB3: To understand the working of various types of converters

COB4: To learn how to analyze the converters and design the components of them, under various load types

COB5: To learn about the control of various converters

MODULE I POWER DEVICES 7

Diodes, SCRs, BJT, MOSFET, IGBT, GTO, TRIAC - working, V-I and switching characteristics, selection and protection.

MODULE II AC - DC CONVERTER 10

Single phase controlled rectifiers- half wave, semi controlled, fully controlled rectifier- Three phase controlled rectifiers- half wave, semi controlled, fully controlled rectifier –Effect of source inductance-dual converter - applications.

MODULE III AC - AC CONVERTER 9

Principle of phase control, integral cycle control - single phase AC voltage controller –application – sequence control of AC voltage controller- two stage, multistage - Three phase AC voltage controller - matrix converter.

MODULE IV DC – DC CONVERTER 9

Non-Isolated DC-DC Converters - Buck , Boost, Buck-Boost - one quadrant, two quadrant and four quadrant chopper - speed control of DC motor -Isolated DC-DC converters - Fly back Converter, Forward Converter , Bridge Converters - and Cuk converters.

MODULE V DC - AC CONVERTER 10

Voltage source inverter - single phase and three phase – modulation techniques - voltage control – harmonics reduction - single phase current source inverter - Multilevel inverters: capacitor clamped inverter – cascaded H-Bridge inverter- uninterruptible power supplies.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Ned Mohan, Undeland and Robbin, "Power Electronics - converters, Application and design", John Wiley and sons. Inc, New York, Third Edition 2009.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, Third Edition 2011.

REFERENCES:

1. P.S.Bimbra, "Power Electronics", Khanna Publishers, 2005.
2. Sen P.C., "Modern Power Electronics", Wheeler Publishing Co, Third edition, New Delhi, 2008.
3. V. Subrahmanyam Power Electronics: Devices, Converters, Application, New Age Publications ,2018.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: relate basics of semiconductors to properties of power devices, and its characteristics

CO2: select suitable power semiconductor devices by assessing the requirements of application fields

CO3: implement the basic concepts of operation of various converters and its application

CO4: apply the control techniques of various converter circuits

CO5: relate the converter circuits for utility-related applications

Board of Studies (BoS):

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	M	L	L	H	L	-	-	-	-	-	-	L	H	M
CO2	M	L	M	H	L	-	-	-	-	-	-	L	H	M
CO3	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO4	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO5	H	H	M	L	L	-	-	-	-	-	-	L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Statement: This course enables the student to understand the basic characteristics of power devices, design of converter and inverter circuits.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.
Statement: Able to design and implement the power electronics devices in real time applications.

EED 3104	VLSI DESIGN	L	T	P	C
SDG: 4, 9		2	0	2	3

COURSE OBJECTIVES:

COB 1: To apply the concepts of modeling in digital system using Verilog HDL.

COB 2: To describe the fundamental principles of MOS and CMOS process technology.

COB 3: To understand the design procedures of digital logic circuits.

COB 4: To examine the basic building blocks of large-scale digital integrated circuits.

PREREQUISITE:

- Basics of Electron devices
- Fundamentals of Digital electronics

MODULE I — PROGRAMMING TECHNIQUES IN VERILOG HDL — 9

Basics of Verilog HDL, Design methodologies, Levels of abstraction, Lexical conventions, Data types, Test bench concept, Gate level model of circuits, Dataflow model of circuits, Behavioral model of combinational and sequential circuits, switch level model.

MODULE II — TRANSISTOR THEORY — 7

Introduction to MOS Transistors - NMOS & PMOS Characteristics, Current Equations, Complementary CMOS Inverter - DC Characteristics, Static Load MOS Inverters, Differential inverters.

MODULE III — BASICS OF DIGITAL CMOS DESIGN — 7

CMOS Logic Gate, Layout design and stick diagram, CMOS Logic Structures - full adder, multiplexers and demultiplexers, encoder and decoder, flip flops.

MODULE IV — BUILDING BLOCKS OF DIGITAL VLSI SYSTEMS — 7

Data Path Circuit, Adders – Types of fast adders, Multipliers – array multipliers, Shifters, Memory Elements, Programmable logic elements and AND-OR arrays, FPGA and CPLD.

PRACTICALS

List of Experiments

1. Study of simulation tools and synthesis tools
2. Simulation of basic logic gates using Xilinx Software and FPGA.
3. Design, simulate and synthesis of adders using Xilinx Software and FPGA.
4. Design, simulate and synthesis of Multiplexers & demultiplexers Xilinx Software and FPGA.
5. Design, simulate and synthesis of Encoders & Decoders using Xilinx Software and FPGA
6. Design, simulation and synthesis of flip flops using Xilinx Software and FPGA.
7. Design, simulation and synthesis of Counters using Xilinx Software and FPGA.

L – 30; P – 30; TOTAL HOURS – 60

TEXT BOOKS:

1. Suman Lata Tripathi , Sobhit Saxena, Govind S Patel and Sanjeet K. Sinha , “Digital VLSI Design and Simulation with Verilog”, John Wiley & Sons, 9 March 2022.
2. Samir Palnitkar, “Verilog HDL, A guide to digital design and synthesis”, PHI, 2010.
3. D. P. Kothari and J. S Dhillon, “Digital Circuits and Design”, Pearson Education, New Delhi, 2016.
4. Neil H. E Weste, David Harris, Ayan Banerjee, “CMOS VLSI Design – A Circuits and Systems Perspective”, 4th Ed, Pearson Education, Noida, India, 2014.
5. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, J.Wiley, 2nd Edition, New York, 2009.

REFERENCES:

1. Charles H.Roth and J.S.Dhillon, “Fundamentals of logic design”, Cengagei, 7th edition, 2019.
2. Stephen Brown, “Fundamentals of Digital Logic with Verilog Design”, Third Edition, Mc, Graw Hill, 2014.
3. CMOS Digital Integrated Circuits Analysis, Sung-Mo (Steve) Kang, 2011, TMH.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: apply the basic concepts and different levels of abstraction in Verilog HDL.

CO2: relate the characteristics of MOS transistors.

CO3: design and Illustrate CMOS based digital circuit designs, data path and arithmetic circuits for processor design.

CO4: write program using Verilog HDL for VLSI digital circuits.

Board of Studies (BoS) :
17th BOS of EEE held on 15.07.2022

Academic Council:
19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	H	M	M	L	-	-	-	H	-	-	L	H	M	H
CO2	H	H	M	M	L	-	-	-	H	-	-	L	H	M	H
CO3	H	H	M	M	L	-	-	-	H	-	-	L	H	M	H
CO4	H	H	M	M	L	-	-	-	H	-	-	L	H	M	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: This course enables the student to understand the basic characteristics of MOS devices, design of combinational and sequential circuits.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Able to apply the design concepts of VLSI system design in designing processor based design.

EED 3105	**EMBEDDED SYSTEM LABORATORY**	**L**	**T**	**P**	**C**
SDG: 3, 8 & 11		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To gain knowledge on software tools MikroC and PicKit2 programmer.

COB2: To acquire knowledge about in-built modules of PIC microcontroller

COB3: To study the simulation of drive control using PIC16F877A.

COB4: To learn the interfacing of different peripherals with microcontroller.

COB5: To study microcontroller based circuits for practical applications.

PRACTICALS

List of Experiments:

1. Programs on arithmetic operations: addition / subtraction using 8051.
2. Program to transfer data between specified memory location using 8051.
3. Introduction to Software Tools MikroC, PicKit2 programmer.
4. Blinking of LED using PIC Microcontroller – MikroC.
5. Square wave generation using PIC Microcontroller – MikroC.
6. Interfacing Push Button Switch with PIC Microcontroller.
7. Interfacing Relay with PIC Microcontroller.
8. Applying external interrupt to PIC Microcontroller.
9. Analog to Digital Conversion using in-built ADC Module.
10. Interfacing Matrix keypad with PIC Microcontroller.
11. Interfacing DC Motor with PIC Microcontroller using L293D.
12. Interfacing Stepper Motor with PIC Microcontroller.
13. Generating PWM with PIC Microcontroller using CCP Module.
14. PIC to PIC communication using UART.

P – 30; TOTAL HOURS – 30

TEXT BOOKS:

1. Mikro C- Compiler for PIC Microchip controllers- mikroElectronik, 2012.
2. Mazidi, Muhammad Ali, Rolin D. McKinlay, and Danny Causey. "PIC microcontroller and embedded systems: using Assembly and C for PIC18", Pearson edition 2021.
3. Han-Way Huang, Leo Chartrand, "PIC Microcontroller: An Introduction to Software & Hardware Interfacing", Delmar Cengage Learning, 2004.

REFERENCES:

1. Kamal, Raj. “Embedded Systems-SoC, IoT, AI and Real-Time Systems”, McGraw-Hill Education, 2020.
2. Martin P. Bates, “PIC Microcontrollers –An Introduction”, Newnes, 2011.
3. John Main, “PIC Microcontroller C”, 2006-2007 Edition, 2007.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: apply the Software Tools MikroC and PicKit2 programmer.

CO2: implement on-chip analog to digital converters to convert analog signals to digital signals.

CO3: simulate drive control using PIC16F877A.

CO4: interface PIC microcontroller with hardware for given application.

CO5: develop small microcontroller-based applications.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	-	-	-	H	-	-	-	-	-	-	-	-	-
CO2	M	H	H	H	H	-	-	-	L	-	-	-	-	-
CO3	M	H	H	H	H	-	-	-	L	-	-	-	-	H
CO4	M	H	H	H	H	-	-	-	L	-	-	L	-	H
CO5	M	H	H	H	H	-	-	-	L	-	-	L	-	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 3: Good health and well-being.

Statement: Understanding of the fundamentals of microcontrollers can help in designing systems to promote good health and well-being.

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 11: Sustainable cities and communities.

Statement: Use of automation techniques learnt through this course can play a major role in establishing sustainable cities and communities.

EED 3106	**POWER SYSTEM SIMULATION LABORATORY**	**L**	**T**	**P**	**C**
SDG: 8, 9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: Formation of bus admittance and impedance matrices and network solution.

COB2: Power flow solution of small systems using simple method, Gauss-Seidel Power Flow , NRPF and FDPF methods.

COB3: Transient stability simulation of multi machine power system

COB4: Load Frequency Control of single area and two-area systems

COB5: Unit Commitment and Economic Dispatch.

PRACTICALS

List of Experiments:

1. Computation of Parameters and Modeling of Transmission Lines
2. Formation of Network Matrices and Solution of Networks.
3. Power Flow Analysis I: Solution of Power Flow using Gauss-Seidel Method.
4. Power Flow Analysis II: Solution of Power Flow using Newton-Raphson and Fast-Decoupled Methods.
5. Short Circuit Analysis.
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System.
7. Transient Stability Analysis of Multi machine Power Systems.
8. Electromagnetic Transients in Power Systems.
9. Load - Frequency Dynamics of Single and Two-Area Power Systems.
10. Unit Commitment and Economic Dispatch in Power Systems.

P – 30; TOTAL HOURS – 30

TEXT BOOK:

John J. Grainger and Stevenson Jr. W.D., 'Power System Analysis', McGraw Hill International Edition, 2017.

REFERENCES:

1. Hadi Saadat, 'Power System Analysis', Tata Mc Graw Hill, 2002.
2. Stagg, G.W. and El-Abiad, A.H., 'Computer Methods in Power System Analysis', McGraw Hill International Book Company.
3. M.A. Pai, 'Computer Methods in Power System Analysis' McGraw Hill Education (India) Pvt. Ltd., 2006.
4. Olle I. Elgerd, 'Electric Energy and System Theory - An Introduction', Tata McGraw Hill Publishing Company, New Delhi. 2nd edition, 2017.
5. Lab Manual by the Course Teacher

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: determine the performance characteristics of a long transmission line and its reactive power requirement.

CO2: perform load flow studies using Gauss Seidal, Newton Raphson and fast decoupled method.

CO3: perform transient and small signal stability study.

CO4: perform load frequency dynamics of single area and two area power systems.

CO5: implement optimal scheduling using economic dispatch programme.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	H	M	-	-	-	-	-	-	-	H	H	H
CO2	H	H	H	L	-	-	-	-	-	-	-	L	H	M
CO3	H	H	H	L	-	-	-	-	-	-	-	L	H	M
CO4	H	H	H	H	-	-	-	-	-	-	-	L	H	M
CO5	H	M	H	L	-	-	-	-	-	-	-	L	H	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 8: Decent work and economic growth.

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement : The complete understanding of this course lead to sustainable industrialization and promote economic development.

		L	T	P	C
EED 3107	**POWER ELECTRONICS LABORATORY**	**L**	**T**	**P**	**C**
SDG: 4, 9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To acquire knowledge on the operation of several common power electronic devices.

COB2: To provide the students with hands-on experience in design and prototyping the driver circuit for power electronic devices.

COB3: To expose the students to the control techniques of power converters.

COB4: To provide the students with hands-on experience in design and prototyping the power electronic converters.

COB5: To expose the students with the design and implementation of power electronic application circuits.

PRACTICALS

List of Experiments:

1. V-I characteristics of SCR.
2. Fabrication of zero crossing detector circuit for SCR and TRIAC triggering.
3. Fabrication of SCR and TRIAC gate driving circuits using MOC 30XX series optically isolated Thyristor drivers.
4. Implementation of digital control of Half wave controlled rectifier.
5. Implementation of TRIAC based AC Lamp intensity control.
6. Fabrication of gate driving stage using half bridge gate driver IC with high speed opto-coupler.
7. Design and fabrication of Buck Converter.
8. Design and fabrication of Boost Converter.
9. Design and fabrication of Half bridge Inverter.
10. Simulation of Flyback Converter.
11. Simulation of H Bridge Inverter.

P – 30; TOTAL HOURS – 30

TEXT BOOK:

1. Lab Manual

REFERENCES:

1. Ned Mohan, Undeland and Robbin, "Power Electronics - converters, Application and design", John Wiley and sons.Inc, New York, Third Edition 2009.

2. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Prentice Hall India, New Delhi, Third Edition 2011.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: analyze the characteristics of power semiconductor devices and its gating circuits

CO2: correlate theoretical and practical analysis of power converters

CO3: implement power electronic application circuitry

CO4: identify, formulate and solve engineering problems in the area of power electronic circuit design and to meet desired needs within realistic constraints

CO5: work as multi-disciplinary teams while conducting power electronic experiments.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	H	H	-	-	L	L	H	M	H	H	M
CO2	H	H	H	H	H	-	-	L	L	H	L	M	H	M
CO3	H	H	H	H	H	-	-	L	L	H	L	H	H	H
CO4	H	H	H	H	H	-	-	L	L	H	L	H	H	H
CO5	M	M	M	M	M	-	-	L	L	M	L	H	M	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: This course enables the student to understand the basic characteristics of power devices, design of converter and inverter circuits.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Able to design and implement the power electronics devices in real time applications.

		L	T	P	C
GED 3101	**COMMUNICATION SKILLS FOR CAREER SUCCESS**	**L**	**T**	**P**	**C**
SDG: 4		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To develop students' proficiency in English at CEFR B2 level (Business Vantage)

COB2: To develop students' receptive skills (Listening and Reading) in a wide range of situations

COB3: To develop students' productive skills (Speaking and Writing) in a wide range of situations

COB4: To expose students to the nuances of the English language, grammar and usage.

MODULE I BRIEF EXCHANGES OF COMMUNICATION 08

Listening to telephonic conversations - gap filling exercises- short conversations – Promoting a product-Reading short passages and answering matching tasks- Writing short notes and messages. - Framing questions

MODULE II WORKPLACE COMMUNICATION 07

Listening to monologues - gap filling exercises - Mini presentations- role play- Reading longer texts – gap filling- Writing memo , emails and Fax - Writing reports on conferences, seminars

MODULE III INTERPERSONAL COMMUNICATION 08

Listening to conversations – Collaborative discussion using prompts - Reading comprehension-multiple choice-texts - Writing enquiry letters & replies to customers

MODULE IV NEGOTIATING AND PERSUADING 07

Listening to interviews - Group Discussions - Multiple choice and gap filling- writing work reports- cause and effect - Complaint letter and sales letter

P-30: TOTAL HOURS - 30

REFERENCES:

1. Guy Brook-Hart, 'Business Benchmark-Upper Intermediate, 2nd edition, Cambridge University Press, Shree Maitrey Printech Pvt. Ltd, Noida,

2016.

2. Leo Jones, ‘New International Business English’ Students book. Cambridge University Press, Cambridge, 2003.
3. Simon Sweeney, ‘Communicating in Business’ Teacher’s Book. Cambridge University Press, Cambridge, 2004.
4. Simon Sweeney, ‘Communicating in Business’ Student’s Book. Cambridge University Press, Cambridge, 2003.
5. Bill Mascull. ‘Business Vocabulary in Use’. Advanced. Cambridge University Press, Cambridge, 2004

COURSE OUTCOMES:

CO1: Use the LSRW skills effectively in business and general situations

CO2: Demonstrate receptive skills effectively in various formal and informal communication situations.

CO3: Demonstrate productive skills effectively in various formal and informal communication situations

CO4: Use appropriate grammar and vocabulary in any context.

Board of Studies (BoS) :

13th BoS of the Department of English held on 17.6.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O 3	PSO 4	PSO 5
CO1									M	H							H
CO2									M	H							H
CO3									M	H							H
CO4										H							M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

This course helps the students to enhance their communication skills, critical thinking, problem solving, conflict resolution, team building and public speaking. This course also helps them to achieve success in their professional and personal life.

SEMESTER VI

MSD 3281	**ENTREPRENEURSHIP**	**L**	**T**	**P**	**C**
SDG: All 1-17.		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the fit between individual and their entrepreneurial ambitions.

COB2: To identify the customers and find a problem worth solving.

COB3: To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas

COB4: To develop a solution for customers' problem and analyze the problem solution fit & product market fit.

COB5: To build and demonstrate a Minimum Viable Product (MVP) for startup

MODULE I — PROBLEM IDENTIFICATION AND OPPORTUNITY DISCOVERY — 9

Entrepreneurial Thinking, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study

MODULE II — CUSTOMER, SOLUTION AND BUSINESS MODEL — 10

Customers and Markets, Identification of Customer Segment, Niche Segment, Customers Jobs, Pain and Gain, Early Adopters, Value Proposition Canvas-Case Study, Basics of Business Model-Lean Canvas-Case Study.

MODULE III — VALIDATION AND FINANCIALS — 10

Blue Ocean Strategy, Solution Demo, Problem – Solution Fit, Minimum Viable Product- Product Market Fit, Prototype – Case Study. Cost, Revenues, Pricing, Profitability Checks, Bootstrapping, Initial Financing and Pitching.

MODULE IV — GO TO MARKET — 8

Positioning and Branding, Golden Circle model: Sinek's theory value proposition, Branding Elements, Market Penetration Strategy, Collaboration Tools and Techniques, Channels – Case Study

MODULE V MANAGING GROWTH AND FUNDING 8

Sales Planning, Customer Acquisition Strategy, Selling Skills, Identifying Funding Sources, Mapping Start-Up Cycle to Funding Options, Funding Plan, , Creating business valuation

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Entrepreneurship Rajeev Roy oxford, 2012.
2. https://web.nen.wfglobal.org/en/home - Wadhwani Foundation
3. W. Chan Kim , Renée A. Mauborgne**,** "Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant", Harvard Business Press, 2015.

REFERENCES:

1. Anil Lamba , "Romancing the Balance Sheet: For Anyone Who Owns, Runs Or Manages a Business", HarperCollins Publishers India, 2016.
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.
3. "Anatomy of Business Plan" – Linda Pinson, OMIM publication , Seventh Edition, 2008.
4. Running Lean: Iterate From Plan A To a Plan That Works, Ash Maurya, "O'Reilly Media, Inc.", 28-Feb-2012.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Build an entrepreneurial mindset and reach out the customer to identify the problem using design thinking process

CO2: Craft solution to the problem through value proposition canvas and develop a business model using lean canvas

CO3: Provide product solution demo and deliver a minimum viable product

CO4: Work as a team and create brand strategy marketing for product/service

CO5: Prepare, make an outstanding sale pitch for startup

GED 3201 **REASONING AND APTITUDE FOR ENGINEERS**

SDG: 4

L	T	P	C
0	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To develop students' critical reading skills

COB2: To foster their writing skills

COB3: To enlighten the various methods of solving quantitative problems

COB4: To make students ready for clearing placement and competitive examination

MODULE I OBJECTIVE ENGLISH 07

Reading Comprehension - Sentence Rearrangement - Cloze Test – Error Spotting

MODULE II VOCABULARY DEVELOPMENT 08

Vocabulary (Synonyms and Antonyms, one word Substitutes, Spellings, Idioms and Phrases, etc) - Fill in the blanks - Paragraph Completion

MODULE III GENERAL MENTAL ABILITY 08

Time speed and Distance –Problems on Trains – Boats and Streams - Permutation and Combination - Probability

MODULE IV 07

Data Interpretation (charts, graphs, tables, data sufficiency, etc.) – Time and work-Pipes and Cisterns-Venn Diagrams-Mensuration

P- 30, TOTAL HOURS 30

REFERENCES:

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK.
2. Swan, Michael (2005). Practical English Usage, Oxford University Press.
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017

5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Limited, 2010
6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019

COURSE OUTCOMES:

CO1: Demonstrate their reading ability

CO2: Exhibit their vocabulary and writing skills

CO3: Apply the problem-solving techniques

CO4: Gain confidence mentally and be successful in their career

Board of Studies (BoS) :
13th BoS of the Department of English held on 17.6.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										M		
CO2										H		
CO3										L		
CO4												M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Give Quality Education to all the Engineers

Statement: In future, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

		L	T	P	C
EED 3201	**CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 3,8,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the use of transfer function models for analysis of physical systems and introduce the control system components.

COB2: To gain adequate knowledge in the time response of systems and steady state error analysis.

COB3: To understand the necessity for frequency domain analysis using bode plot and polar plot.

COB4: To study the stability analysis and design of compensators.

COB5: To acquire knowledge on state variable representation and analysis of physical systems.

MODULE I SYSTEMS AND REPRESENTATION 9

Basic Elements in control system – Open loop and closed loop control systems – Transfer Function – Mechanical, Electrical and Electromechanical Systems – Electrical analogy of mechanical systems – Block diagram representation – Block diagram reduction – Signal flow graphs – Mason's Gain formula.

MODULE II TIME RESPONSE ANALYSIS 9

Transient and Steady State response – Test Signals – Time domain specifications – First and Second order system, Steady state error and error constants – P, PI, PID modes of feedback control.

MODULE III FREQUENCY RESPONSE ANALYSIS 9

Frequency domain specifications – Relation between time and frequency domain parameters – Analysis based on bode plot and polar plot – Gain and phase margin.

MODULE IV STABILITY AND COMPENSATOR DESIGN 9

Stability: Characteristics equation – Routh Hurwitz criterion – Nyquist stabilty criterion - Performance criteria – Compensator Design: Effect of Lag, lead and lag-lead compensation on frequency response- Design of Lag, lead and lag-lead compensator using bode plots.

MODULE V STATE VARIABLE ANALYSIS 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and Observability.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 4th Edition, 2012.
2. B. C. Kuo, “Automatic Control System”, Wiley, 2018.

REFERENCES:

1. K. Ogata, “Modern Control Engineering”, 5th Edition, Pearson Education, New Delhi, 2010.
2. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2018.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: analyze complex systems using mathematical models.

CO2: analyze the time response of first and second order systems.

CO3: perform frequency response analysis of physical systems and interpret the response.

CO4: perform stability analyses and design appropriate compensator for the given system to meet the desired specifications.

CO5: implement state space approach for the process and obtain the solution.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	H	M	L	-	-	L	-	-	-	L	H	-
CO2	H	M	H	M	L	-	-	L	-	-	-	M	H	-
CO3	M	M	M	L	L	-	-	L	-	-	-	M	M	-
CO4	M	M	M	L	L	-	-	L	-	-	-	M	M	-
CO5	H	L	H	H	L	-	-	L	-	-	-	L	-	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3: Good health and wellbeing.

Statement : Understanding of the fundamentals of this course can help in designing systems to promote good health and well being.

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.
Statement : The complete understanding of this course will lead to sustainable industrialization and promote economic development.

SDG 12: Responsible consumption and production.
Statement: Use of appropriate controller and its components results in reasonable consumption and production.

		L	T	P	C
EED 3202	**ELECTRIC VEHICLE TECHNOLOGY**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the concept of Electric Vehicles.

COB2: To familiarize the basic energy transfer processes that govern existing and proposed methods of power generation for Electric Vehicles.

COB3: To familiarize with the traditional and non-traditional sources for Electric Vehicles in terms of energy content, accessibility, required processing steps and projected remaining reserves.

COB4: To know about ultra-capacitors and flywheel technologies

COB5: To familiarise about the electric drive train in EVs

MODULE I INTRODUCTION 9

A Brief History - Types of Electric Vehicle in use today: Battery electric vehicles - The IC engine/electric hybrid vehicle - Fuelled electric vehicles – Electric vehicles using supply lines - Solar powered vehicles - Electric vehicles which use flywheels or super capacitors – Environmental impact.

MODULE II BATTERIES 9

Battery Parameters - Lead Acid Batteries - Nickel-based Batteries – Sodium based Batteries - Lithium Batteries - Metal Air Batteries - Battery Charging - Choice of Battery - Use of Batteries in Hybrid Vehicles - Battery Modeling – Hybridization of storage devices.

MODULE III FUEL CELLS AND ULTRA CAPACITOR 9

Hydrogen Fuel Cells - Connecting Cells in Series - Water and thermal management in the PEM Fuel Cell – Hydrogen supply & storage. Ultra Capacitor :Features, Basic Principle, Performance – Ultra capacitor technology – Ultrahigh Speed Flywheels: Operation & Principles - Power Capacity of Flywheel Systems - Flywheel Technologies

MODULE IV ELECTRIC VEHICLE MODELLING AND ANCILLARY SYSTEMS 9

Tractive Effort - Modeling Vehicle Acceleration - Modeling Electric Vehicle Range - Aerodynamic Considerations - Transmission Efficiency – Electric

Vehicle Chassis and Body Design - Heating and Cooling Systems - Design of the Controls - Power Steering - Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks - Brake System of EVs and HEVs - Antilock Brake System.

MODULE V DESIGN OF HYBRID ELECTRIC DRIVE TRAIN 9

Series Hybrid Electric Drive Train Design: Operating patterns - control strategies - sizing of major components - power rating of traction motor - power rating of engine/generator - design of PPS.

Parallel Hybrid Electric Drive Train Design: Control strategies - design of engine power capacity - design of electric motor drive capacity - transmission design - energy storage design.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd, 2003.
2. Iqbal Husain, “Electric and Hybrid Vehicles”, Design Fundamentals, CRC Press,3rd Edition, 2021.
3. M. Ehsani, Y. Gao, S. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles” , 3rd Edition, CRC Press, 2018.

REFERENCES:

1. Husain.I, "Electric and hybrid vehicles: Design fundamentals", CRC press, 2011.
2. Teresa Donateo “Hybrid Electric Vehicles”, Intech open publisher, 2017.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: identify and quantify the important energy transfer for batteries and fuel cell schemes.

CO2: design and develop basic schemes of electric vehicles and hybrid electric vehicle.

CO3: choose proper energy storage systems for vehicle applications.

CO4: identify the current industry activities by car makers, electricity ut suppliers (motors and batteries), including joint ventures, product announceme projects.

CO5: choose a suitable drive scheme for developing an ZEV.

Board of Studies (BoS) :
17th BOS of EEE held on
15.07.2022

Academic Council:
19th Academic council held on
29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	H	L	L	-	-	-	-	-	-	-	L	H	L
CO2	H	L	L	L	-	-	-	-	-	-	-	L	L	H
CO3	L	H	M	L	-	-	-	-	-	-	-	L	M	M
CO4	M	L	H	L	-	-	-	-	-	-	-	H	L	L
CO5	L	L	L	L	-	-	-	-	-	-	-	L	L	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG No. 9: Industry, innovation and infrastructure
The development of hybrid electric vehicles will meet out the desired needs within realistic constraints such as economic, environmental, manufacturability, and sustainability.

EED 3203	**CONTROL SYSTEMS LABORATORY**	**L**	**T**	**P**	**C**
SDG: 5,8,9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response.

COB2: To assess the system performance using time domain analysis and methods for improving it.

COB3: To study the various controllers and compensators to improve system performance.

COB4: To assess the system performance using frequency domain analysis and techniques for improving the performance.

PRACTICALS

List of Experiments:

1. Transfer function of Armature controlled DC Motor.
2. Transfer function of field controlled DC Motor.
3. Transfer function of separately excited DC Generator.
4. Transfer function of DC Servomotor.
5. Transfer function of AC Servomotor.
6. Time response analysis of a Type-1 system with the standard test inputs.
7. Stability analysis using Bode plot.
8. Stability analysis using Root locus/ Nyquist plot.
9. Lag, Lead and Lag-Lead compensator design.
10. Design of PID controller for a second order system.
11. Characteristics of Synchros.
12. Study of application of stepper motor.

P – 30; TOTAL HOURS – 30

TEXT BOOKS:

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.

REFERENCES:

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
2. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: determine the transfer function of D.C generator, D.C motor, D.C and A.C servomotors.

CO2: simulate the response of I and II order systems using MATLAB.

CO3: analyze the stability of different systems using Bode, Root locus, Nyquist plot etc.

CO4: design lag, lead and lag-lead compensators.

CO5: predict the performance of synchro, stepper motor etc.

Board of Studies (BoS):

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M		M	M	L	-	-	M	L	M	-	M	M	-
CO2	M	H	H	M	L	-	-	M	L	M	-	M	M	-
CO3	H	M	M	M	L	-	-	M	L	M	-	M	M	-
CO4	H	H	H	M	L	-	-	M	L	M	-	M	-	H
CO5	M	H		L	L	-	-		L	M	-	M	M	-

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 5: Gender equality

Statement: Acquiring the interdisciplinary knowledge help to overcome the gender barriers in work place.

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas such as control and instrumentation etc.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

EED3206	ELECTRIC MOBILITY LABORATORY	L	T	P	C
SDG: 8,9		0	0	2	1

OBJECTIVES:

COB 1:	To understand working of different power electronics device & converters used in electric vehicles.
COB 2:	To identify components of electric vehicles
COB 3:	To gain insight into the physical layout, connections, and arrangement of components within an electric vehicle.
COB 4:	To learn how to implement speed control strategies for brushless direct current motor, three phase induction motor, switched reluctance motor and permanent magnet synchronous motor using appropriate control techniques.
COB 5:	To know the importance of battery management systems in effectively managing energy storage.

PRACTICALS

List of Experiments:

1. Open loop and closed loop control of Buck & Boost converter.
2. VSI fed three phase induction motor for electric vehicle.
3. Performance characteristics of Permanent Magnet Synchronous Motor.
4. Speed control of Permanent Magnet Synchronous Motor drive for four wheeler test system.
5. Performance characteristics of Brushless Direct Current Motor.
6. Computation of Motor Rating for an Electric Vehicle Using Python
7. Speed control of Brushless Direct Current Motor drive for four wheeler test system.
8. Performance characteristics of Switched Reluctance Motor.
9. Speed control of Switched Reluctance Motor drive for four wheeler test system.
10. Performance analysis of electric scooter.
11. Demonstration of battery based 4WD and its battery management system.
12. Study of CAN Bus protocol for electric vehicles.
13. Driving Range Prediction of Electric Vehicle using C++.

TOTAL HOURS – 30

OUTCOMES:

At the end of the course, the student will be able to	
CO1:	analyse the characteristics of various power electronics devices and converters employed in electric vehicles.
CO2:	recognize and categorize the essential components integral to electric vehicles, including batteries, motors, controllers, and auxiliary systems.
CO3:	differentiate the functions and significance of each component within the broader context of an electric vehicle's operation.
CO4:	design the drive and control circuits for speed control of E-vehicle drives.
CO5:	optimize energy usage with battery management system of electric vehicle.
Board of Studies (BoS) : **19th BoS conducted on 29.08.2023**	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	M	L	-	L	-	H	-	-	L	H	M
CO2	H	H	M	M	L	-	L	-	H	-	-	L	H	M
CO3	H	H	M	M	L	-	L	-	H	-	-	L	H	M
CO4	H	H	M	M	L	-	L	-	H	-	-	L	H	M
CO5	H	H	M	M	L	-	L	-	H	-	-	L	H	M

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9 : Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement : The complete understanding of electric vehicle and its components lead to sustainable industrialization and promote economic development.

SEMESTER VII

EED 4101	**PLC, SCADA & DCS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To gain fundamental knowledge about the PLC networks.

COB2: To acquire knowledge about SCADA and its interface.

COB3: To familiarize with DCS and its architecture

COB4: To learn the architecture and local control unit of distributed control system.

COB5: To acquire information about industrial data network.

MODULE I PLC AND ITS PROGRAMMING 9

Evolutions of PLCs – Sequential and Programmable Controllers – Architecture – Comparative study of Industrial PLC's. Programming:- Ladder logic , Functional block programming, sequential function chat, Instruction list - Logic gates – Boolean Conversions – Decoder – Encoder – Flip flop – Math Instructions – Jump Instructions. Communication networks for PLC — connecting PLC to computer.

MODULE II SCADA AND ITS INTERFACE 9

Data acquisition system – SCADA - Hardware and software - Remote terminal units, Master station, Communication architectures - different types of protocols – SCADA for power systems – case studies on SCADA.

MODULE III DISTRIBUTED CONTROL SYSTEMS 9

DCS – various Architectures – Comparison – local control unit – process interfacing issues – displace study of any one DCS available in market - case studies in DCS.

MODULE IV INDUSTRIAL DATA COMMUNICATION 9

HART: Introduction - Evolution of signal standard - Communication protocol - Communication modes - HART networks - HART and OSI model. Field bus: Introduction - General field bus architecture - requirements of field bus standard – topology - Interoperability and Interchangeability. Profibus: Introduction – protocol stack –communication model – Communication objects. Foundation field bus Vs Profibus – Introduction to Device net and Ethernet.

MODULE V DATA NETWORK FUNDAMENTALS 9

Network hierarchy and switching – ISO/OSI Reference model – Data link control protocol:- HDLC - media access protocol :- Command / response, Token passing and CSMA/CD – TCP/ IP – Bridges – Routers – Gateways – Standard ETHERNET and ARCNET Configuration.

PRACTICALS

List of experiments

1. Basic Programming on logic gates
2. FBD of Timer and counter
3. Development of Ladder program for simple on-off applications
4. Development of Ladder program for Timing applications
5. Development of Ladder program for counting applications
6. Configuring and tag assignments in DCS
7. DCS based PID control for level loop.
8. Alarm annunciation using SCADA
9. Reporting and Trending in SCADA System
10. Study of HART communicator and field bus.

L – 45; P – 30; TOTAL HOURS – 75

TEXT BOOKS:

1. F.D. Petruzella, “Programmable Logic Controllers”, Tata Mc-Graw Hill, 5th edition, 2019

2. Michael P. Lukas, “Distributed Control Systems: Their Evaluation and Design”, Van Nostrand Reinhold Co., 1986.

3. Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP3, 4. 60870.5 and Related Systems”, Newnes, 1st Edition, 2004.

REFERENCES:

1. T.A. Hughes, Programmable Controllers, Fourth edition, ISA press, 2005

2. Krishna Kant, Computer Based Industrial Control, Second edition, Prentice Hall of India, New Delhi, 2010

3. John W. Webb and Ronald A. Reis, ‘Programmable Logic Controllers, Fifth edition, Prentice Hall of India, New Delhi, 2010

4. John R. Hackworth and Frederick D. Hackworth Jr, Programmable Logic Controllers, Pearson, New Delhi, 2007.

5. Bowten, R “HART Application Guide”, HART Communication foundation, 1999.

6. Berge, J., “Field Busses for process control: Engineering, operation,

maintenance“, ISA press, 2004.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: design all types of logical, discrete and continuous signals using PLC.

CO2: design SCADA for any industrial system.

CO3: interface any type of PLC with DCS to achieve the required operation.

CO4: design a communication model for industrial network.

CO5: establish network in a process control plant.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	L	L	H	L	-	-	L	-	-	-	L	L	L
CO2	L	M	L	L	L	-	-	L	-	-	-	L	H	H
CO3	L	L	M	L	L	-	-	L	-	-	-	L	L	L
CO4	L	L	L	H	L	-	-	L	-	-	-	L	H	H
CO5	L	L	L	H	L	-	-	L	-	-	-	L	M	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG No. 9

The application of industrial communication and network will help in promoting industries/automation plant to next level.

PROFESSIONAL ELECTIVE COURSES
POWER SYSTEMS

EEDX 01	DISTRIBUTION SYSTEM ENGINEERING	L	T	P	C
SDG: 8, 9		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on

COB1: the fundamentals of distribution system.

COB2: voltage drop and power loss of different types of distribution feeders.

COB3: substation design, grounding system and distribution protection.

COB4: the methods of analysis of distribution systems.

COB5: concepts of demand side management.

MODULE I INTRODUCTION TO DISTRIBUTION SYSTEM 9

General - Introduction to distribution system, an overview of the role of computers in distribution system planning. Load modeling and characteristics: Definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor - Relationship between the load factor and loss factor - Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics

MODULE II DISTRIBUTION FEEDERS 9

Design consideration of Distribution feeders -voltage levels – different types of feeder loading- voltage drop and power loss calculations.

MODULE III SUBSTATIONS, GROUNDING SYSTEM AND DISTRIBUTION PROTECTION 12

Types of substations - Design considerations of the secondary distribution system - Bus-bar arrangements - Substation bus schemes - Rating of a distribution substation - Service area with primary feeder - Resistance of grounding systems - Grounding grids - Design principles of substation grounding system- Distribution protection- Coordination of protective devices. IEEE/IEC standards.

MODULE IV DISTRIBUTION SYSTEM ANALYSIS 9

Voltage drop and power loss calculations - Derivation of volt-drop and power loss in lines – dc distribution – ac distribution –three phase balanced primary lines- Non-three-phase primary lines.

MODULE V CONCEPTS AND METHODS OF DEMAND SIDE MANAGEMENT, LOAD CONTROL 6

Load control - Energy efficiency - Load management - DSM planning, design, marketing, impact assessment - Direct, distributed and local control – Assessment of impact on load shape.

L – 45 ; TOTAL HOURS – 45

TEXT BOOK:

1. Turan Gonen, “Electric Power Distribution System Engineering”, Mc.Graw-Hill Book Company, 1986.

REFERENCES:

1. A.S.Pabla, “Electric Power Distribution”, Tata Mc Graw-Hill Publishing Company, 5th Edition, 2019.
2. V. Kamaraju, Electrical Power Distribution Systems”, Tata Mc Graw-Hill Publishing Company, 2017.
3. S.N. Singh, “Electric Power Generation, Transmission and Distribution”, Prentice Hall of India Pvt. Ltd, New Delhi, 2008.
4. Luces M.Fualkenberry, Walter Coffer, “Electrical Power Distribution and Transmission”, Pearson Education, 1996.
5. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill Publishing Company, 2003
6. Gellings, C.W. and Chamberlin, J. H., “Demand-Side Management: Concepts & Methods”, Firmont Press, 1993.
7. B.R.Gupta, ‘Power System Analysis and Design’, S.Chand, New Delhi, 2005.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: attain skills on various components of the distribution system.

CO2: design distribution feeders based on voltage drop and power loss.

CO3: implement grounding system in substations and co-ordination of protective devices.

CO4: perform analysis of voltage drop and power loss on different type of distributors.

CO5: carry out the demand side management.

Board of Studies (BoS) :	**Academic Council:**
17th BOS of EEE held on 15.07.2022	19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	M	L	L	L	-	-	-	-	-	-	L	M	-
CO2	M	M	H	H	L	-	-	-	-	-	L	M	M	-
CO3	H	M	M	M	L	-	-	-	-	-	-	M	-	H
CO4	-	M	M	M	L	-	-	-	-	-	-	M	M	-
CO5	L		M	L	L	-	-	-	-	-	M	L	M	-

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic

Statement: The learners of this course can get Decent work and earn financial benefits

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

		L	T	P	C
EEDX 02 **SDG: 3,8,9,11,12**	**ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES: To impart knowledge on

COB1: generation of electrical power by conventional and non-conventional methods.

COB2: economics of power generation, Electrical energy conservation and energy auditing.

COB3: principle and design of illumination systems for different applications.

COB4: methods of heating and welding.

COB5: electric traction and Industrial applications of electric drives.

MODULE I CONVENTIONAL & NON CONVENTIONAL METHODS OF POWER GENERATION 12

Thermal, hydro and nuclear based power generation- Selection of site for power plants- schematic arrangement- merits and demerits of power plants. Fuel cells-tidal waves- wind- geothermal – solar - bio mass - Co generation. schematic arrangement - merits and demerits of power plants.

MODULE II ECONOMIC ASPECTS OF GENERATION 8

Economic aspects of power generation - load and load duration curves - number and size of units - cost of electrical energy - tariff. Economics of power factor improvement - power capacitors - power quality. Importance of electrical energy conservation - methods - energy efficient equipments. Introduction to energy auditing.

MODULE III ILLUMINATION 8

Importance of lighting - properties of good lighting scheme - laws of illumination - photometry - types of lamps - lighting calculations - basic design of illumination schemes for residential, commercial, street lighting, and sports ground - energy efficiency lamps.

MODULE IV HEATING AND WELDING 8

Introduction - advantages of electric heating - modes of heat transfer – methods of electric heating -resistance heating - arc furnaces - induction heating - dielectric heating - electric welding - types -resistance welding - arc welding - power supply for arc welding - radiation welding.

MODULE V ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification -electric braking - train movement and energy consumption.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Wadhwa, C.L. "Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt. Ltd, 2015.
2. Gupta B.R., "Generation of Electrical Energy", Eurasia Publishing House (P) Ltd, New Delhi, 2010.

REFERENCES:

5. Partab.H, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2004.
6. Openshaw Taylor.E, "Utilization of Electrical Energy in SI Units", Orient Longman Pvt. Ltd, 2003.
7. Gupta.J.B, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2018.
8. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited.,2007

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: apply the concepts of conventional and non-conventional power generation systems.

CO2: find the number and size of units from load curve, compute tariff and power factor correction for practical system and carry out energy management and auditing for industries.

CO3: suggest lighting scheme for various applications

CO4: analyze practical implications of electric heating and welding

CO5: select suitable motor for different applications including traction system.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	H	M	-	-	-	-	-	-	-	H	H	L
CO2	H	H	H	M	--	--	--	--	--	--	--	L	H	M
CO3	H	H	H	M	-	-	-	-	-	-	-	L	H	M
CO4	H	H	H	M	-	-	-	-	-	-	-	L	H	L
CO5	H	H	H	M	-	-	-	-	-	-	-	H	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3: Good health and well being.

Statement: Understanding of the fundamentals can help in designing systems to promote good health and well being.

SDG 8: Decent work and economic

Statement: The learners of this course can get Decent work and earn financial benefits and they can work in interdisciplinary areas

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

SDG 11: Sustainable cities and communities.

Statement: Statement: Understanding the renewable energy sources helps in building sustainable cities and communities.

SDG 12: Responsible consumption and production.

Statement: Use of right and energy efficient electric and electronic components and devices results in reasonable consumption and production

		L	T	P	C
EEDX 03	**ENERGY CONSERVATION AND AUDIT**	**L**	**T**	**P**	**C**
SDG: 3, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the general concepts and methodologies of energy auditing.

COB2 : To understand the procedures and techniques involved in energy auditing.

COB3: To explore the possibilities of energy saving

COB4: To gain knowledge on different instruments involved in energy auditing.

COB5: To understand the procedures and working techniques of energy auditing instruments.

MODULE I GENERAL ASPECTS, METHODOLOGY AND APPROACH 10

General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management - Energy Audit: Need, Types - Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.

MODULE II ENERGY AUDIT PROCEDURES 9

Data gathering: Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy / fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.

MODULE III ENERGY AUDIT TECHNIQUES 8

Analytical Techniques: Incremental cost concept, mass and energy balancing techniques, inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process and energy system simulation.

MODULE IV EVALUATION OF SAVING OPPORTUNITIES 9

Determining the savings, Noneconomic factors, Conservation opportunities, estimating cost of implementation. Energy Audit Reporting: The plant energy study report- Importance, contents, effective organization, report writing and presentation - Identification of losses, Improvements, Energy Balance sheet.

MODULE V ENERGY AUDIT INSTRUMENTS 9

Basic measurements – Electrical measurements, Light, Pressure, Temperature and heat flux, Velocity and Flow rate, Vibrations, etc. Instruments Used in Energy systems: Load and power factor measuring equipments, Wattmeter, flue gas analysis, Temperature and thermal loss measurements, air quality analysis.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. W.R.Murphy, G.Mckay 'Energy Management', Butterworth Scientific, 1981

REFERENCES:

1. C.B.Smith 'Energy Management Principles', Pergamon Press, 1981
2. I.G.C.Dryden 'Efficient Use of Energy', London : Butterworth Scientific in collaboration with the Institute of Energy acting on behalf of the United Kingdom Department of Energy, 1982.
3. A.V.Desai 'Energy Economics', Wiley Eastern, 1990.
4. D.A. Reay 'Industrial Energy Conservation', Pergammon Press, 1977
5. Steve Doty (Author), Wayne C. Turner (Author), 'Energy Management Handbook, Fairmont Press, 2012.
6. L.C. Witte, P.S. Schmidt, D.R. Brown 'Industrial Energy Management and Utilization', Washington: Hemisphere Publishing; Berlin: Springer-Verlag, c 1988
7. Bureau of Energy Efficiency, General Aspects of Energy Management and Energy Audit. New Delhi, 2016.

COURSE OUTCOMES:

At the end of the course, the student is expected to

CO1: demonstrate the importance of energy auditing.

CO2: implement the right procedure for energy auditing.

CO3: select the right technique for energy auditing.

CO4: utilize the possibilities of reducing the losses and saving the energy systematically.

CO5: apply appropriate instruments in the process of energy auditing.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	M	L	L	-	-	-	-	-	-	-	-	M	L
CO2	H	M	L	L	-	-	-	-	-	-	-	-	M	L
CO3	M	H	L	M	-	-	-	-	-	-	-	-	M	L
CO4	H	M	L	L	-	-	-	-	-	-	-	-	M	L
CO5	H	M	L	L	-	-	-	-	-	-	-	-	M	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3: Good health and wellbeing.
Statement : Understanding of the fundamentals of this course can help in designing systems to promote good health and well-being.

SDG 9: Build resilient Infrastructure, to support economic development and human well-being with a focus on affordable and equitable access for all.
Statement : The complete understanding of energy auditing methods will lead to sustainable industrialization and promote economic development.

		L	T	P	C
EEDX 04	**FLEXIBLE AC TRANSMISSION SYSTEMS**	**3**	**0**	**0**	**3**
SDG: 5,8,9					

COURSE OBJECTIVES:

COB1: To understand the need for reactive power compensation in AC transmission system.

COB2: To study the conventional FACTS devices and to understand its operation.

COB3: To understand the working of Static Var Compensators in power systems.

COB4: To understand the need for TCSC and its working in power systems.

COB5: To study the working of FACTS controllers, STATCOM, UPFC, SSSC.

MODULE I REACTIVE POWER CONTROL IN TRANSMISSION SYSTEM 8

Reactive power - uncompensated transmission lines - load compensation - system compensation - lossless distributed parameter lines -symmetrical lines - midpoint conditions of a symmetrical line case study - passive compensation - shunt compensation -series compensation effect on power-transfer capacity.

MODULE II CONVENTIONAL FACTS DEVICES 8

Types, definitions and representation of various FACTS controllers - Synchronous Condensers - Saturated Reactor (SR) - Thyristor Controlled Reactor (TCR) - operating characteristics of a TCR - Fixed Capacitor–Thyristor Controlled Reactor (FC - TCR) - Thyristor Switched Capacitor (TSC)- Thyristor Switched Capacitor– Thyristor Controlled Reactor (TSC–TCR).

MODULE III STATIC VAR COMPENSATOR (SVC) 10

Voltage Control - V-I characteristics of the SVC - dynamic Characteristics- steady- State characteristic advantages of the slope in the SVC dynamic characteristic influence of the SVC on system voltage- Increase in steady-state power-transfer capacity-enhancement of transient stability.

MODULE IV THYRISTOR-CONTROLLED SERIES CAPACITOR (TCSC) 9

Fixed-series compensation - need for variable series compensation-advantages of the TCSC - TCSC controller- operation of the TCSC - modes of TCSC operation - capability characteristics - single-module TCSC- multi -module TCSC - variable-reactance model of TCSC-applications of TCSC.

MODULE V EMERGING FACTS CONTROLLERS 10

STATCOM : principle of operation - V-I characteristic - applications of STATCOM-SSSC :principle of operation - applications of SSSC-UPFC : principle of operation-applications of UPFC.

L – 45; TOTAL HOURS – 45

TEXTBOOK:

1. Mohan Mathur.R., Rajiv. K.Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc 2000.

REFERENCES:

1. Narain G. Hingorani, “Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors, Delhi, 2001.
2. A.T.John, “Flexible A.C. Transmission Systems”, Institution of Electrical and Electronic Engineers (IEEE), 1999.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: compute power transmission capability of a transmission system and apply reactive compensation methods for its improvement.

CO2: analyze the different conventional FACTS devices in the transmission line for compensation..

CO3: analyze the operation of SVC and its characteristics.

CO4: choose a suitable mode of TCSC and to model it for stability analysis.

CO5: analyze and utilize the emerging FACTS devices in the utility networks.

Board of Studies (BoS) :
17th BOS of EEE held on 15.07.2022

Academic Council:
19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	L	-	-	-	-	M	-	-	-	M	H	H	M
CO2	H	H	L	M	-	-	M	-	-	-	L	-	H	H
CO3	H	H	L	M	-	-	M	-	-	-	-	-	H	H
CO4	H	H	M	H	M	L	-	-	-	-	L	M	H	M
CO5	H	M	M	H	M	L	-	-	-	-	-	M	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 5: Gender equality

Statement: Acquiring the interdisciplinary knowledge help to overcome the gender barriers in work place.

SDG 8: Decent work and economic

Statement: The learners of this course can get Decent work and earn financial benefits and they can work in interdisciplinary areas such as FACTS devices etc.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

EEDX 06	**INDUSTRIAL POWER SYSTEM**	**L**	**T**	**P**	**C**
SDG: 8, 9	**ANALYSIS AND DESIGN**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To impart knowledge on Motor Starting Studies.

COB2: To understand the need for power factor correction and to study the various methods that are used in the power factor correction studies.

COB3: To learn about the sources of harmonics, evaluate the harmonics present in the power system and mitigate them by filters.

COB4: To analyse the sources that can cause the voltage flicker and find solutions to minimize the flicker.

COB5: To impart knowledge on the ground grid analysis.

MODULE I MOTOR STARTING STUDIES 9

Introduction - Evaluation Criteria - Starting Methods - System Data - Voltage Drop Calculations - Calculation of Acceleration Time - Motor Starting with limited capacity generators - Computer aided Analysis - IEEE/ IEC Standards.

MODULE II POWER FACTOR CORRECTION STUDIES 9

Introduction - System description and Modeling - Acceptance criteria - Frequency Scan Analysis - Voltage Magnification Analysis - Sustained Over voltages - Switching Surge Analysis - Back to Back Switching

MODULE III HARMONIC ANALYSIS 9

Harmonic Sources - System Response to Harmonics - System Model for Computer Aided Analysis - Acceptance Criteria - Harmonic Filters - harmonic Evaluation - Case Study- IEEE/ IEC Standards.

MODULE IV FLICKER ANALYSIS 9

Sources of Flicker - Flicker Analysis - Flicker Criteria - Data for Flicker analysis – Case Study - Arc Furnace Load - Minimizing the Flicker Effects.

MODULE V GROUND GRID ANALYSIS 9

Introduction - Acceptance Criteria - Ground Grid Calculations - Computer-Aided Analysis - Improving the Performance of the Grounding Grids.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Ramasamy Natarajan, "Computer Aided Power System Analysis", Marcel Dekker Inc.,2002.
2. Shoaib Khan, "Industrial Power Systems", CRC Press, 2008.

REFERENCES:

1. Duncan Glover J., Mulukutla Sarma S., Thomas Overbye, “Power System Analysis and Design", 2011.
2. Turan Gonen, "Electrical Power Transmission System Engineering: Analysis and Design", Mcgraw Hill publishers, 1986.
3. Sen, S.K., "Principles of electrical machine Designs with Computer Programmes", Oxford and IBH Publishing Co.Pvt.Ltd., New Delhi, 1987.

COURSE OUTCOMES:

At the end of the course, the student is expected to

CO1: select appropriate starting methods of induction motor and to perform calculations on voltage drop and acceleration time.

CO2: perform power factor correction studies.

CO3: identify and to analyze harmonics.

CO4: identify the flicker and minimize it.

CO5: perform ground grid analysis.

Board of Studies (BoS) :	**Academic Council:**
17th BOS of EEE held on 15.07.2022	19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	H	M	H	-	-	-	-	-	-	H	H	H
CO2	H	H	H	L	H	-	-	-	-	-	-	L	H	M
CO3	H	H	H	L	H	-	-	-	-	-	-	L	H	M
CO4	H	H	H	H	H	-	-	-	-	-	-	L	H	M
CO5	H	H	H	H	H	-	-	-	-	-	-	L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas such as power devices etc.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

		L	T	P	C
EEDX 07	**POWER SYSTEM OPERATION AND CONTROL**	**L**	**T**	**P**	**C**
SDG: 3, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the significance of power system operation and control

COB2: To familiarize the real power-frequency interaction and design of power frequency controller

COB3: To understand the reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load

COB4: To understand the economic operation of power system.

COB5: To familiarize the SCADA and its application for real time operation and control of power systems.

MODULE I INTRODUCTION 8

Power scenario in Indian grid – National and Regional load dispatching centres – requirements of good power system - necessity of voltage and frequency regulation – real power Vs frequency and reactive power Vs voltage control loops - system load variation, load curves and basic concepts of load dispatching - load forecasting - Basics of speed governing mechanisms and modeling - speed load characteristics - regulation of two generators in parallel.

MODULE II REAL POWER – FREQUENCY CONTROL 10

Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - LFC of two area system - tie line modeling – block diagram representation of two area system - static and dynamic analysis – tie line with frequency bias control – state variability model -integration of economic dispatch control with LFC.

MODULE III EXCITATION SYSTEM, REACTIVE POWER AND VOLTAGE CONTROL 12

Types of excitation system - Modeling- Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – stability compensation- Requirements of voltage and reactive power control – relation between node voltage, power and reactive power at a nodes – methods of voltage control-reactive power compensation -tap changing transformers.

MODULE IV UNIT COMMITMENT AND ECONOMIC DISPATCH 8

Unit commitment - Need – constraints, solution methods, priority listing scheme- numerical problems. Incremental cost curve – co- ordination equation without and with losses using lambda iteration method - flow chart – transmission loss formula by

B coefficient method.

MODULE V COMPUTER CONTROL OF POWER SYSTEMS 7

Energy control centre – functions – monitoring, data acquisition and control system hardware configuration – SCADA and EMS functions – power system security – various operating states.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. Allen J. Green Wood and Bruce F.Wollenberg, "Power Generation, operation and control", John Wiley and spons, Inc., 2003.

REFERENCES:

1. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", Tata Mc Graw Hill Publishing company Ltd, New Delhi, Second Edition, 2003.
2. P.Kundur, "Power System Stability and Control", Mc.Graw Hill Publications,USA,1994.
3. D.P.Kothari and I.J.Nagrath", Modern Power System Analysis", Third edition, Tata Mc Graw Hill Publishing company limited, New Delhi, 2003.
4. N.V.Ramana, "Power System Operation and control", Pearson Education India, 2010.

COURSE OUTCOMES:

At the end of the course, the student is expected to

CO1: analyze the day-to-day operation of electric power system.

CO2: model and implement the LFC in power systems.

CO3 : choose appropriate excitation system for voltage control

CO4: perform unit commitment and economic dispatch.

CO5: implement SCADA for real time operation.

Board of Studies (BoS) :	**Academic Council:**
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	L	H	-	L	-	-	-	-	-	-	H	H
CO2	H	M	H	L	H	-	-	-	-	-	-	-	M	M
CO3	H	M	-	-	-	-	-	-	-	-	-	-	-	H
CO4	H	L	-	-	-	-	-	-	-	-	-	-	-	-
CO5	M	M	L	H	H	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3 : Good health and wellbeing.
Statement : Understanding of the fundamentals of this course can help in designing systems to promote good health and well being.
SDG 9 : Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.
Statement : The complete understanding of power system operation and control will lead to sustainable industrialization and promote economic development.

EEDX 08	**POWER SYSTEM TRANSIENTS**	**L**	**T**	**P**	**C**
SDG: 3, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To identify and analyze the cause of surges and their propagation and their effect on power system components

COB2: To understand & distinguish between power frequency and surge voltages and currents and accordingly model the power system components.

COB3: To understand the switching transients of RLC circuits.

COB4: To understand and analyse the travelling wave concepts.

COB5: To identify and analyze the transients in integrated power system.

MODULE I INTRODUCTION 9

Types of power system transients – modeling of lines for surges and power frequency over voltages – effect of transients & power system components – importance of study of transients in planning, IEEE/IEC standards, Effect of transients & power system components

MODULE II LIGHTNING TRANSIENTS 11

Lightning phenomenon: charge formation in clouds, rate of charging of thunder clouds, mechanism of lightning strokes, characteristic of lightning strokes - protection against lightning over voltage by shielding and non shielding methods.

MODULE III SWITCHING TRANSIENTS AND OVER VOLTAGES 11

Circuit closing transients in RL and RLC circuits with sinusoidal excitation to simulate faults – circuit breaker restriking and recovery voltage – double frequency transients- Generation of system over voltages - current chopping – reclosing circuit breaker and compound transients – control of switching over voltages.

MODULE IV TRAVELLING WAVES AND COMPUTATION OF TRANSIENTS 9

Wave equations and its solution- travelling voltage and current waves: velocity, attenuation and distortion-reflection, refraction of travelling waves – behavior at line termination multiple reflections – Lattice diagram.

MODULE V TRANSIENTS IN INTEGRATED POWER SYSTEM AND ANALYSIS 5

Over voltage in integrated power system and its simulation and analysis using EMTP.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. Allan Greenwood, “Electrical Transients in Power Systems”, Wiley India Pvt. Ltd.,, 2nd edition, 2012.

REFERENCES:

1. R.D. Begamudre, “Extra High Voltage AC Transmission Engineering”, Wiley Eastern Limited,1986.
2. Pritidra Choudary, “Electromagnetic Transients in Power System”, John Wiley and sons Inc,1996.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: identify the occurrence of transient disturbance in the power system

CO2: analyze the lightning stroke current

CO3: design the protective schemes against transient disturbance

CO4: calculate the multiple reflections in power system due to travelling waves.

CO5: analyze the power system using EMTP software

Board of Studies (BoS):	**Academic Council:**
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CO1	L	H	L	-	H	-	-	-	-	-	-	-	L	H
CO2	H	H	H	M	M	-	-	-	-	-	-	-	M	H
CO3	H	M	H	-	H	-	-	-	-	-	-	-	M	H
CO4	H	H	L	H	-	-	-	-	-	-	-	-	H	M
CO5	M	H	H	H	H	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3 : Good health and wellbeing.

Statement : Understanding of the fundamentals of this course can help in designing systems to promote good health and well being.

SDG 9 : Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement : The complete understanding of power system transients will lead to sustainable industrialization and promote economic development.

EEDX 10 RESTRUCTURED POWER SYSTEM

SDG: 8, 9

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

COB1: To provide the student a background on restructuring of power system which has taken place in many countries in the world including our country

COB2: To compare and calculate various pricing strategies in restructured environment.

COB3: To familiarize different utility markets and their operation in United States.

COB4: To provide insight on new trends in operation and control in deregulated power systems.

COB5: To highlight electric energy trading in the electricity market.

MODULE I INTRODUCTION TO RESTRUCTURING 9

Restructuring Models: Pool Co Model, Bilateral Contracts Model, Hybrid Model- Independent System Operator (ISO): The Role of ISO - Power Exchange (PX): Market Clearing Price (MCP) - Market operations: Day-ahead and Hour-Ahead Markets, Elastic and Inelastic Markets - Market Power.

MODULE II KEY ISSUES IN RESTRUCTURING 8

Transmission Pricing: The MW-Mile Method -Congestion Pricing: Congestion Pricing Methods, Management of Inter-Zonal/Intra Zonal Congestion: Solution procedure.

MODULE III ELECTRIC UTILITY MARKETS IN THE UNITED STATES 7

California Markets- New York Market: Market operations - PJM interconnection - New England ISO.

MODULE IV OPEN ACCESS SAME TIME INFORMATION SYSTEM (OASIS) & AVAILABLE TRANSFER CAPABILITY (ATC) 12

Structure of OASIS: Functionality and Architecture of OASIS - Definition of Available Transfer Capability (ATC) - Calculation of ATC using network response method- Formulation of D.C. Optimal Power Flow (DCOPF) model for assessment of Available Transfer Capability (ATC).

MODULE V ELECTRIC ENERGY TRADING 9

Essence of Electric Energy Trading - Energy Trading Framework: The

Qualifying factors - Derivative Instruments of Energy Trading: Forward Contracts, Futures Contracts, Options, Swaps, Applications of Derivatives in Electric Energy Trading.

L – 45 ; TOTAL HOURS – 45

TEXT BOOK:

1. Mohammad Shahidehpour and Muwaffaq Almoush, "Restructured Electrical Power systems: Operation, Trading and Volatility", Marcel Dekkar, Inc., 2001.

REFERENCES:

1. G.Zaccour, "Deregulation of Electric Utilities", Kluwer Academic Publishers,1998.
2. M.Ilic, F. Galiana and L.Fink, "Power Systems Restructuring : Engineering and Economics", Kluwer Academic Publishers, 2000.
3. Editor: Loi Lei Lai, "Power System Restructuring and Deregulation: Trading, Performance and Information Technology", John Wiley and sons Ltd, 2001
4. K.Bhattacharya, M.H.J.Bollen and J.E.Daader, "Operation of Restructured Power Systems", Kluwer Academic Publishers, 2001.
5. J.H.Chow,F.F.Wu and J.A.Momoh, "Applied Mathematics for restructured electric power systems: Optimization, Control and Computation Intelligence", Springer 2004.
6. F.C.Schweppe, M.C.Caramanis, R.D.Tabors and R.E.Bohn, "Spot Pricing of Electricity", Kluwer Academic Publishers, 2002.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: perform the various steps of electricity trading operation such as market clearing and settlement for an exchange.

CO2: compute transmission pricing and perform inter zonal and intra zonal congestion management.

CO3: explain the operation of different electricity markets in United States.

CO4: interpret the real time information available in an OASIS and compute the ATC in restructured power systems.

CO5: determine the loss or profit in forward contracts, future contracts, put options and call options contract.

Board of Studies (BoS):	**Academic Council:**
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	M	M	L	-	-	-	-	-	-	-	M		M
CO2	M	M	H	M	-	-	-	-	-	-	-	M		M
CO3	M		M	M	-	-	-	-	-	-	-		H	
CO4	M	H	M	M	-	-	-	-	-	-	-	M		M
CO5	M	H	M	M	-	-	-	-	-	-	-	M		M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced infrastructure.

EEDX 11	HIGH VOLTAGE ENGINEERING	L	T	P	C
SDG: 3, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To gain fundamental knowledge on effects of over voltage in power systems.

COB2: To understand breakdown mechanisms in gaseous, liquids, solid and composite dielectrics.

COB3: To understand the generation of high voltages and currents.

COB4: To study different measurement techniques for high voltages and currents.

COB5: To study various high voltage testing methods.

MODULE I OVER VOLTAGE PHENOMENON AND INSULATION COORDINATION 10

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems. IEEE / IEC standards.

MODULE II BREAKDOWN IN GASEOUS, LIQUID AND SOLID DIELECTRICS 9

Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law - Streamer theory-Breakdown in non-uniform fields and corona discharges. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. -intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, Solid dielectrics used in practice.

MODULE III GENERATION OF HIGH VOLTAGES AND CURRENTS 8

Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Triggering and control of impulse generators.

MODULE IV MEASUREMENT OF HIGH VOLTAGES AND CURRENTS 9

Measurement of High DC, AC and impulse voltages, Measurement of High DC, AC and impulse currents, Digital techniques in high voltage measurements.

MODULE V HIGH VOLTAGE TESTING 9

High voltage testing of Transformers, Insulators and bushings, cables, Isolators and circuit breakers, surge Arresters- Radio Interference measurements.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. M.S.Naidu and V. Kamaraju - High Voltage Engineering", by – TMH Publications, 3rd Edition, 2000

REFERENCES:

1. C.L.Wadhwa, "High Voltage Engineering", by New Age Internationals (P) Limited, 1997
2. RavindraArora, Wolfgang Mosch, "High Voltage Insulation Engineering", by New Age International (P) Limited, 1995.
3. E.Kuffel, W.S.Zaengl, J.Kuffel, "High Voltage Engineering", Fundamentals by Elsevier, 2nd Edition, 1999.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: analyze the causes of abnormal operating conditions (faults, lightning and switching surges) in power systems and the principles of insulation coordination in high voltage and extra high voltage systems

CO2: identify various breakdown mechanisms in, liquid, solid and gaseous dielectrics

CO3: apply the concept of the high AC,DC and impulse voltages and currents

CO4: measure high AC, DC and impulse voltages and impulse currents.

CO5: select appropriate type of test for each high voltage power apparatus

Board of Studies (BoS):
17th BOS of EEE held on 15.07.2022

Academic Council:
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	L	H	L	-	-	-	-	-	-	-	-	H	M
CO2	H	M	M	M	-	-	-	-	-	-	-	-	H	H
CO3	L	H	M	L	-	-	-	-	-	-	-	-	M	H
CO4	M	M	H	H	-	-	-	-	-	-	-	-	H	M
CO5	H	M	H	H	-	-	-	-	-	-	-	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3 : Good health and wellbeing.

Statement : Understanding of the fundamentals of this course can help in designing systems to promote good health and well being.

SDG 9 : Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement : The complete understanding of high voltage engineering concepts will lead to sustainable industrialization and promote economic development.

EEDX 12	**NETWORK ANALYSIS AND SYNTHESIS**	**L**	**T**	**P**	**C**
SDG: 3,8,11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To impart basic knowledge on s domain analysis using Laplace transforms**.**

COB2: To introduce two port networks and analysis of special types of networks.

COB3: To impart knowledge on network topology.

COB4: To understand the elements of network synthesis.

COB5: To gain knowledge on basic theory about the design of filters and attenuators.

MODULE I s DOMAIN ANALYSIS 6

s domain network – driving point and transfer impedances and their properties– transform network analysis – poles and zeros of network functions – time response from pole – zero plots.

MODULE II TWO PORT NETWORKS 12

Characterization of two port networks in terms of Z, Y, h and ABCD parameters Network equivalents – relation between network parameters –T and pi representation - Analysis of Ladder, Bridged T and lattice networks.

MODULE III NETWORK TOPOLOGY 9

Network graphs, tree and cutsets – tie set and cutset schedules – V shift and I shift – primitive impedance and admittance matrices – application to network solutions.

MODULE IV ELEMENTS OF NETWORK SYNTHESIS 9

Reliability of one port network – Hurwitz polynomials and properties – Positive Real functions and properties – Synthesis of RL, RC and LC one port networks using Foster and Cauer methods.

MODULE V FILTERS AND ATTENUATORS 9

Classification of filters: Classification of Pass Band and Stop Band – Characteristic impedance in the pass and stop bands- Design of constant k low pass and high pass filters - Design of m derived filters – Band pass filters – Band elimination filter- Types of Attenuators.

L – 45 ; TOTAL HOURS – 45

TEXT BOOK:

1. Sudhakar. A., and Shyammohan, “Circuits and Networks Analysis and Synthesis”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2011.

REFERENCES:

1. Kuo F.F., “Network Analysis and Synthesis”, Wiley International Edition, 2nd Edition, 1966.
2. Paranjothi S.R., “Electric Circuit Analysis”, New age International Publishers, 2nd Edition, 2000.
3. Van Valkenburg, M.E., “Network Analysis”, Prentice – Hall of India Private Ltd., New Delhi, 3rd Edition, 1974.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: analyze the networks in s domain.

CO2: determine Z, Y, h and ABCD parameters.

CO3: obtain network solutions through network topology.

CO4: realize RL, RC and LC networks using Cauer and Foster form.

CO5: design different types of filters and attenuators.

Board of Studies (BoS) :
17th BOS of EEE held on 15.07.2022

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CO1	H	H	H	L	H	L	M	L	L	L	M	L	H	M
CO2	H	H	H	L	H	L	M	L	L	L	M	L	H	M
CO3	H	H	H	L	H	L	M	L	L	L	M	L	H	M
CO4	H	M	H	L	H	L	M	L	L	L	M	L	H	M
CO5	H	M	H	L	H	L	M	L	L	L	M	L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3: Good health and well being.

Statement: Understanding of the fundamentals of circuits can help in designing systems to promote good health and well being.

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 11: Sustainable cities and communities.

Statement: Use of network solution techniques learnt through this course can play a major role in establishing sustainable cities and communities.

EEDX13	GAS INSULATED SUBSTATION	L	T	P	C
SDG: 7,9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce and acquire knowledge of Gas Insulated Substation (GIS)

COB2: To familiarize the concept of SF6 for GIS and to learn the handling of SF6 with safety and environmental aspects

COB3: To study the design, development and protection of the Gas insulated substation and to explore the concept of ZX family GIS

COB4: To explore the control, monitoring and testing of GIS

COB5: To learn the various applications of GIS

MODULE I	Introduction to GIS	9

Definitions - Characteristics of GIS- Comparison of Air Insulated Substation and GIS- Reliability GIS versus AIS - Economics of GIS – cost and potential advantages of GIS- Cost comparison: GIS Vs conventional substation- User Requirements for GIS – Main Features of GIS - GIS International Standards.

MODULE II	SF_6 Based GIS	9

Introduction - Features of SF_6 -Gas Categories - General Safety Rules and Recommendations - Methods for Storage of SF_6 - Handling Procedures of SF_6 Gas- Safe handling of Sf_6 gas in electrical equipment – Recovery/Re-use of SF_6 - Environmental Aspects of SF6 - -Specification of SF6 gas for GIS application.

MODULE III	Design, Construction and Operation of GIS &Gas insulated Switchgear (Indoor-33kV,66kV,132kV)	9

Introduction – Design Aspects of GIS components- Advancement of GIS –Rating of GIS components – Insulation Design for Components – Insulation Design for GIS- Modular Components, Design, and Development Process - Switching and Arrester Devices: Disconnect Switches Fast-acting Disconnect Combination Disconnect- Earthing Switch - Gas Insulated Bus Design Features- Operation of a Gas Insulated Substation-ZX2 gas-insulated switchgear: Characteristics, benefits and fundamental structure .

MODULE IV	Control, Monitoring and Testing	9

GIS Monitoring- Gas Monitoring Practices- Defect Types -Partial Discharge (PD) - Discharge Measurements- Insulation Diagnostic methods: PD Measurement and UHF Method - Circuit Breaker Monitoring- Gas Monitoring and Leak Detection System - Local Control Cabinet- Control Schemes- Digital Communication- Communication Requirements- Location of Controls - Testing: Type Tests, Routine Tests.

MODULE V	Applications of GIS	9

Typical GIS Layouts- 115 kV GIS Switching Station- 115 kV and 2000 A Outdoor Single Bus GIS- 345 kV and 4000 A Indoor Breaker and Half-Scheme GIS -500 kV and 4000 A/8000 A Indoor Breaker and Third GIS- 69 kV and 1600 A Outdoor Single Bus GIS- GIS Case Study-Mobile GIS- Containerized GIS - Mixed Technology Switchgear (MTS) - MTS Design Features and Applications- Cable connection to GIS/ Switchgear / cable connectors.

	L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. M. S. Naidu," Gas Insulated Substations"- IK International Publishing House, 2009.
2. Hermann J. Koch, "Gas Insulated Substations", Wiley-IEEE Press, 2014.

REFERENCES:

1. S. A. Boggs & R. Y. Chu & N. Fujimoto, Gas-Insulated Substations: Technology and Practice : Proceedings of the International, Pergamon press Canada, Ltd, 1996.
2. Olivier Gallot – Lavellee, "Dielectric materials and Electrostatics" , Wiley-IEEE Press, 2013.
3. Jaun Martinez, "Dielectric Materials for Electrical Engineering", Wiley-IEEE Press, 2010.

COURSE OUTCOMES: At the end of the course, the student is expected to

CO1: develop knowledge on the basic concept of GIS systems and compare its advantages over air insulated systems.

CO2: apply the safety rules and methods of storing SF6 gas in GIS.

CO3: choose appropriate design and construct the GIS and to propose the suitable protection system.

CO4: identify different monitoring and measuring device for GIS

CO5: implement GIS in various types of Substation.

Board of Studies (BoS) :	**Academic Council:**
18th BoS of EEE held on 10.02.2023	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	M	L	L	M	M							L	L	L
CO2	L	M	L	L	M							L	M	M
CO3	H	H	H	M	M							L	H	H
CO4	M	H	H	M	M							L	H	H
CO5	M	H	H	H	M							L	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG No. 7 Establishment of clean energy
Statement: To promote the usage of clean energy by reshaping the infrastructure of substation and to provide clean energy.
SDG No. 9 Industry, Innovation & Infrastructure Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.
Statement: The complete understanding of GIS system and design, monitor and control the GIS to sustainable industrialization and promote economic development.

POWER ELECTRONICS & DRIVES

EEDX 21 SDG: 8, 9	CONVERTERS, APPLICATIONS AND DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of power electronics for designing converters

COB2: To learn the mathematics in analyzing switching converter circuit performance.

COB3: To study the engineering problems related to switching converters.

COB4: To understand the controller design for power converter circuits.

COB5: To study the power electronic circuits for UPS, SMPS etc.

MODULE I SWITCHED MODE POWER CONVERSION – OVERVIEW 7

Overview of switched mode power conversion, Prior art, Power semi conductor switches – ideal, non ideal switch characteristics, issues related to switches. Design of Transformer, inductor, capacitor for SMPS.

MODULE II DC – DC CONVERTERS 10

Introduction to DC – DC Converters, continuous and discontinuous operation of DC- DC Converters, primitive converter, non- isolated converter, Isolated Converters – performance analysis under ideal and non ideal conditions.

MODULE III MODELING OF CONVERTERS 9

Modeling of DC – DC converter- State space representation - Circuit Averaging – DC-DC converter controller structure.

MODULE IV CONTROLLER DESIGN FOR DC-DC CONVERTER 9

Controllers and Sensing Circuit, - controller structure- Current Control Implementation of PID controller for DC- DC converter – PWM-Controller Design, Regulation of Multiple outputs.

MODULE V SIMULATION STUDIES 10

Complete closed loop controller design for: dc-dc systems – buck, boost, open loop and closed loop, isolated converters.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Ned Mohan, Undeland and Robbin, "Power Electronics - converters, Application and design”, John Wiley and sons. Inc, New York, Third Edition 2009.
2. Rashid M.H., “Power Electronics Circuits, Devices and Applications " , Prentice Hall India, New Delhi, Third Edition 2011.

REFERENCES:

1. Umanand.L, Power Electronics: Essentials and Applications, Wiley India, 2009.
2. Sen P.C., “Modern Power Electronics”, Wheeler Publishing Co, Third edition, New Delhi, 2008.

COURSE OUTCOMES:

The students will be able to

CO1: design SMPS.

CO2: design DC-DC converter.

CO3: model controller circuit for DC – DC Converter.

CO4: design and implement power conversion devices.

CO5: choose appropriate power converter topologies and design the power stage and feedback controllers for various applications

Board of Studies (BoS):

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	M	L	L	H	L	-	-	-	-	-	-	L	H	M
CO2	M	L	M	H	L	-	-	-	-	-	-	L	H	M
CO3	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO4	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO5	H	H	M	L	L	-	-	-	-	-	-	L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8 : Decent Work and Economic Growth

Statement: The complete understanding of switched mode power supplies lead to have sustainable industrialization and promote economic development.

SDG 9 : Industry, Innovation & Infrastructure

Understanding the fundamentals of power electronics, switching converters and its application in switched mode power supplies leads to the development of entrepreneurs in SMPS which further enhances the innovation and infrastructure.

		L	T	P	C
EEDX 22	**ELECTRIC POWER QUALITY**	**L**	**T**	**P**	**C**
SDG: 3,8,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To acquire knowledge on factors affecting power quality.

COB2: To study effects of sag and interruptions.

COB3: To study the cause of harmonics.

COB4: To study the different types of power filters to eliminate harmonics.

COB5: To familiarize the power quality monitoring devices.

MODULE I INTRODUCTION TO POWER QUALITY 8

Power quality terms and definitions– Short duration variations such as Voltage sag - Voltage swell - Voltage imbalance – Voltage fluctuations, interruption - Long duration variation such as under voltage, over voltage, sustained interruption Power frequency variations - Concepts of transients- International standards of power quality – Power Acceptability Curves- Computer Business Equipment Manufacturers Associations (CBEMA) curve and ITI curve. IEEE / IEC Electrical standards.

MODULE II VOLTAGE SAG AND INTERRUPTIONS 9

Estimating voltage sag performance - Thevenin's equivalent source - Fundamental Principles of Protection- Analysis and calculation of various faulted condition - Estimation of the sag severity - Solutions at the End-User Level- Mitigation of voltage sag, Static transfer switches and fast transfer switch.

MODULE III HARMONICS 9

Harmonic distortion - Voltage and current distortions - Harmonic indices Harmonics versus Transients -Harmonic sources from commercial and industrial loads - Locating harmonic sources –Power system response characteristics - Effect of harmonics- Inter harmonics – Harmonic Distortion Evaluations, IEEE / IEC standards.

MODULE IV CONVENTIONAL MITIGATION METHODS 10

Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators Simulation and Performance of Passive Power Filters- Limitations of Passive Filters- Principle of Operation of Active filters - Instantaneous Symmetrical Components- Instantaneous Real and Reactive Power - Fundamentals of load compensation- voltage regulation & power factor correction.

MODULE V CUSTOM POWER DEVICES & POWER QUALITY MONITORING 9

Principle & Working of DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR –Unified power quality conditioner. Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems - Quality measurement equipment - Harmonic / spectrum analyzer – Flicker meters Disturbance analyzer - Applications of expert systems for power quality monitoring.

L - 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1. Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.WayneBeaty, “Electrical Power Systems Quality”, McGraw Hill,2003
2. J. Arrillaga, N.R. Watson, S. Chen, “Power System Quality Assessment”, (New York: Wiley),2000.
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad,” Power Quality Problems & Mitigation Techniques” Wiley, 2015.

REFERENCES:

1. G.T. Heydt, “Electric Power Quality”, 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994.
2. M.H.J Bollen, “Understanding Power Quality Problems: Voltage Sags and Interruptions”, (New York: IEEE Press), 2000.
3. Arindam Ghosh and Gerard Ledwich, "Power Quality Enhancement using custom power devices", Kulwer academic publisher, 2004.
4. Wilson E. Kazibwe, Van Nostrand Reinhold, "Electrical power quality controls techniques".
5. C. Sankaran, Power Quality, CRC Press 2001.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1:identify various causes and effects of power quality problems.

CO2: analyze voltage sag and interruptions.

CO3:analyze the causes of harmonics.

CO4: implement various harmonic power filters to mitigate the harmonics.

CO5:monitor power quality disturbances with power quality monitoring devices.

Board of Studies (BoS) :	**Academic Council:**
17th BOS of EEE held on 15.07.2022	19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	H	-	-	-	L	-	-	-	L	-	H	M	-
CO2	H	H	M	L	L	M	L	L	-	L	M	H	H	M
CO3	H	H	M	M	L	M	L	L	-	L	M	H	H	M
CO4	H	H	M	_	H	M	L	L	-	L	H	-	H	H
CO5	M	M	L	-	H	-	-	-	-	L	M	-	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3: Good health and wellbeing.
Statement: Understanding of the fundamentals of this course can help in designing systems to promote good health and well-being.

SDG 8: Decent work and Economic Growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.
Statement: The complete understanding of electric power quality and its components will lead to sustainable industrialization and promote economic development.

EEDX 23	ELECTRICAL MACHINE DESIGN	L	T	P	C
SDG: 7, 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To study mmf calculation and thermal rating of various types of electrical machines.

COB2: To study armature and field systems for D.C. machines.

COB3: To learn core, yoke, windings and cooling systems of transformers.

COB4: To study the design concepts of induction machines.

COB5: To study the design concepts of synchronous machines and study their thermal behaviour.

MODULE I BASICS OF MACHINE DESIGN 8

Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise and Insulating Materials - Rating of machines – Standard specifications- IEC standards.

MODULE II DC MACHINE DESIGN 9

Output Equations – Main Dimensions – Choice of Specific Electric and Magnetic Loading - Magnetic Circuits Calculations - Carter's Coefficient - Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.

MODULE III TRANSFORMER DESIGN 10

Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.

MODULE IV INDUCTION MOTOR DESIGN 9

Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of poly phase machines- Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency.

MODULE V SYNCHRONOUS MACHINE DESIGN 9

Output equations – choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.
2. M.V.Deshpande “Design and Testing of Electrical Machine Design” Wheeler Publications, 2010.

REFERENCES:

1. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
2. R.K.Agarwal “ Principles of Electrical Machine Design” Esskay Publications, Delhi, 2002.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

COURSE OUTCOMES:

At the end of this course, the student will be able to

CO1: perform mmf calculation and thermal rating of various types of electrical machines.

CO2: design armature and field systems for D.C. machines.

CO3: design core, yoke, windings and cooling systems of transformers.

CO4: design induction machines.

CO5: design synchronous machines.

Board of Studies (BoS) :	**Academic Council:**
17th BOS of EEE held on 15.07.2022	19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	L	M	M	M	L	M	L	L	L	H	L
CO2	H	H	H	H	L	M	M	L	L	M	L	L	H	L
CO3	M	M	M	M	L	M	M	L	L	L	L	L	M	M
CO4	M	M	M	M	L	M	M	L	L	L	L	L	M	M
CO5	M	M	M	M	L	M	M	L	L	L	L	L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 7: Affordable and Clean Energy

Ensure access to affordable, reliable, sustainable and modern energy for all

Statement : Electrical Engineering contributes to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8 : Decent Work And Economic Growth

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: Decent Work And Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

EEDX 25	**HVDC TRANSMISSION**	**L**	**T**	**P**	**C**
SDG: 8,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain knowledge on the Planning of DC power transmission and comparison with AC power transmission.

COB2: To study six and twelve pulse converters.

COB3: To learn HVDC systems and to perform power flow analysis in AC/DC systems.

COB4: To acquaint with various protection methods for HVDC systems and harmonics.

COB5: To study power flow in HVDC system under steady state.

MODULE I INTRODUCTION 9

Necessity of HVDC systems, Economics and Terminal equipment of HVDC transmission systems, DC Power transmission technology–Comparison of AC and DC transmission–Application of DC transmission–Description of DC transmission system–Planning for HVDC transmission–Modern trends in HVDC technology–DC breakers–Operating problems– HVDC transmission based on VSC.

MODULE II ANALYSIS OF HVDC CONVERTERS 9

Types of HVDC Links -Line commutated converter -Analysis of Graetz circuit with and without overlap –Pulse number– Choice of converter configuration – Converter bridge characteristics– Analysis of twelve pulse converters– Analysis of VSC topologies and firing schemes.

MODULE III CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC link control–Converter control characteristics–System control hierarchy– Firing angle control– Current and extinction angle control–Starting and stopping of DC link –Power control –Higher level controllers –Control of VSC based HVDC link.

MODULE IV REACTIVE POWER AND HARMONICS CONTROL 9

Reactive power requirements in steady state - sources of reactive power– SVC and STATCOM– generation of harmonics- characteristics harmonics, calculation of AC harmonics - effect of pulse number on harmonics –Design of AC and DC filters– active filters.

MODULE V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Modelling of DC Links- DC Network- DC Converter- Controller Equations, Solution of DC load flow, Per unit system for DC quantities– DC system model –Inclusion of constraints –Power flow analysis -solution of AC-DC Power flow - Simultaneous method - Sequential method.

L - 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1. “K. R. Padiyar”, HVDC Power Transmission Systems: Technology and system Interactions, New Age International (P) Limited, and Publishers, 1990.
2. “S K Kamakshaiah, V Kamaraju”, HVDC Transmission, TMH Publishers, 2011
3. “S. Rao”, EHVAC and HVDC Transmission Engineering and Practice, Khanna publications, 3rd Edition 1999.

REFERENCES:

1. “Jos Arrillaga”, HVDC Transmission, The institution of electrical engineers, IEE power & energy series 29, 2nd edition 1998.
2. “E. W. Kimbark”, Direct Current Transmission, John Wiley and Sons, volume 1,1971.
3. “E. Uhlmann”, Power Transmission by Direct Current, B. S. Publications, 2009

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: apply the concepts of HVDC system.

CO2: analyze HVDC converters.

CO3: implement control in HVDC systems.

CO4: perform reactive power and harmonic control

CO5: perform power flow in HVDC system under steady state.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	L	-	-	-	-	-	-	-	-	M	H	L	L
CO2	H	M	M	M	M	-	-	-	-	-	H	H	L	H
CO3	M	L	-	-	-	-	-	-	-	-	L	L	H	L
CO4	H	H	M	H	M	-	-	-	-	-	H	H	M	H
CO5	H	L	L	M	L	-	-	-	-	-	M	M	L	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well-being with a focus on affordable and equitable access for all.

Statement: The complete understanding of this course will lead to sustainable industrialization and promote economic development.

SDG 12: Responsible consumption and production.

Statement: Use of the principles of HVDC transmission will result in reasonable consumption and production.

EEDX 26	POWER ELECTRONICS APPLICATION TO RENEWABLE ENERGY SYSTEMS	L	T	P	C
SDG: 3,5,8,12		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the emerging power electronics technologies to renewable systems.

COB2: To understand the operation and analysis of conversion systems.

COB3: To study the design of power electronics circuit that can control power flow in grids.

COB4: To familiarize various operating modes of solar energy systems and wind generators.

COB5: To acquire knowledge on hybrid renewable energy systems.

MODULE I OVERVIEW OF ENERGY CONVERSION AND RENEWABLE ENERGY SYSTEM 9

Environmental aspects of electric energy conversion, impacts of renewable energy generation on environment (Cost - GHG Emission), Qualitative study of different renewable energy resources: Solar, Wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

MODULE II ELECTRICAL ENERGY CONVERSION SYSTEM 9

Review of reference theory fundamentals, principle of operation and analysis: IG, PMSG, SCIG and DFIG, different conversion schemes, fixed and variable speed operation, drive selection, power control, braking systems, grid integration issues.

MODULE III POWER CONVERSION IN RENEWABLE SYSTEM 9

Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters - Inverters for high power applications: Multi-level Inverters, Analysis of their performance, Selection of inverter, Battery sizing, Array sizing, harmonics, Interaction with power grid.

MODULE IV ANALYSIS OF PV AND WIND ENERGY SYSTEM 9

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system, Grid connection Issues, grid Integrated solar system.

MODULE V HYBRID RENEWABLE ENERGY SYSTEM 9

Need for Hybrid System- Range and type of Hybrid system- micro wind systems and solar system- Grid integrated PMSG and SCIG based WECS.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. B.H.Khan, "Non-conventional Energy sources", Tata McGraw-hill Publishing Company, New Delhi,2009.
2. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.

REFERENCES:

1. Rashid M. H, "Power electronics Hand book", Academic press, 2001.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", Prentice Hall Inc, 1995.

COURSE OUTCOMES:

At the end of this course, the student will be able to

CO1: analyze different renewable energy resources

CO2: implement different types of energy conversion schemes.

CO3: design power electronics equipments related to renewable energy sources.

CO4: analyze the different operating modes of solar energy system and wind generators.

CO5: identify and integrate the techniques to be used in the planning and operation of grid control with renewable energy sources.

Board of Studies (BoS) :	**Academic Council:**
17^{th} BOS of EEE held on 15.07.2022	19^{th} Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	-	-	-	-	-	-	-	-	-	L	L	-
CO2	H	-	H	H	-	-	-	-	-	-	-	L	H	-
CO3	H	H	H	H	-	-	-	-	-	-	-	H	H	-
CO4	H	H	-	-	-	-	-	-	-	-	-	L	M	-
CO5	-	-	-	-	-	-	-	-	-	-	-	L	-	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3: Good health and well being.

Statement : Understanding of the fundamentals of various renewable source can help in designing systems to promote good health and well being.

SDG 5: Gender equality

Statement: Acquiring the knowledge to help and overcome the gender barriers in work place.

SDG 8: Decent work and Economic Growth

Statement: The learners of this course can get decent work and earn financial benefits.

SDG 12: Responsible consumption and production.

Statement: Use of right and design efficient renewable source results in reasonable for production.

EEDX 27	**SOLID STATE DRIVES**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the characteristics of various motors and loads and to select appropriate motor for the specified application.

COB2: To study rectifier fed drive system for real time applications.

COB3: To learn AC-DC and DC-DC fed electric drive system.

COB4: To familiarize with the induction motor fed electric drive system.

COB5: To understand the synchronous motor fed electric drive system.

MODULE I INTRODUCTION TO SOLID STATE DRIVES 7

Introduction to electric drive - Characteristics of DC motors, Induction motors, Synchronous motors - Constant torque and constant HP operations – Four quadrant operations –nature of load torque- load equalization - Rating of motors - Selection of drives

MODULE II CONVERTER FED DC DRIVES 10

Conventional methods of speed control for DC motor - Single phase semi and full converter fed dc motor (series, shunt and separately excited motor) - continuous and discontinuous modes - Three phase semi and full converter fed dc motor - Dual converter fed drives -Motoring and braking of DC motor- closed loop operation.

MODULE III CHOPPER FED DC DRIVES 9

Operation of Class A, B, C, D, E chopper fed DC drives - four quadrant operations – closed loop chopper fed drives - design of controllers- transfer function of chopper fed drives.

MODULE IV INDUCTION MOTOR DRIVES 10

Starting and braking of induction motor- AC voltage controller fed induction motor drive – VSI and CSI fed drives – closed loop stator controlled induction motor drives - Braking methods for induction motors- Rotor resistance control – slip power recovery scheme - Scherbius drive, Kramers drive– closed loop rotor controlled drives.

MODULE V SYNCHRONOUS MOTOR AND SPECIAL MACHINES BASED DRIVES 9

Permanent Magnet Synchronous Motor - construction, operation - PMSM fed drive – case study on real time application - Brushless DC Motor - construction, operation – BLDC fed Drive – Field Oriented Controllers and Algorithms - case study on real time application, switched reluctance motor- construction, operation – SRM fed Drive.

L – 45 ; TOTAL HOURS – 45

TEXT BOOK:

1. Gopal K.Dubey, "Power semiconductor controlled drives", Prentice Hall international, 2013.

REFERENCES:

1. W. Shepherd, L. N. Halley, D. T. W. Liang, Power Electronics and Motor Control, 2nd Edition, Cambridge University Press, 1998.
2. Vedam Subramanyam, "Thyristor control of Electrical Drives", Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2015.
3. Pillai.S.K., "A First Course on Electrical Drives", New Age International (P) Ltd., 2nd Edition, 2015.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: apply the basic concepts of electrical machines for designing electric drive

CO2: apply mathematics in analyzing the performance of converter circuit fed drive system.

CO3: design, analyze and apply chopper fed drive system for real time applications.

CO4: design, analyze and apply induction motor fed drive system for societal applications.

CO5: design, analyze and apply synchronous motor fed drive system for societal applications.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	L	L	-	-	-	-	-	-	-	L	-	M	L	M
CO2	H	M	L	M	L	-	-	-	-	L	L	M	M	H
CO3	H	M	M	H	M	-	-	-	-	M	L	H	M	H
CO4	H	H	H	H	H	-	-	-	-	M	M	H	H	H
CO5	H	H	H	H	H	-	-	-	-	M	M	H	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: In alignment with SDG 4 (Quality Education), this course on Solid State Drives aims to equip students with comprehensive knowledge and practical skills in the design, operation, and optimization of solid-state storage technologies. By understanding the principles and applications of solid-state drives, students will gain the necessary expertise to contribute to the development of efficient, reliable, and sustainable data storage systems.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced communication infrastructure.

This course on Solid State Drives aligns with SDG 9 (Industry, Innovation, and Infrastructure) by focusing on the advancements in data storage technology and their impact on building sustainable and resilient infrastructure. Through in-depth exploration of solid-state drive architecture, performance optimization, and emerging trends, students will gain the knowledge and skills necessary to contribute to the development of efficient and innovative data storage solutions.

EEDX 28	**SPECIAL ELECTRICAL MACHINES**	**L**	**T**	**P**	**C**
SDG: 3, 5, 8, 12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To review the fundamental concept of stepper motor and high speed application.

COB2: To acquire knowledge on principle of operation, control and performance of SRM and linear induction motor.

COB3: To illustrate the principle of operation, emf, torque and speed characteristics of PM brushless and PM synchronous motors.

COB4: To learn the principle of operation, emf, torque and speed characteristics of PM synchronous motors.

COB5: To gain knowledge on the constructional features and operating principles of various types of special electrical machines.

MODULE I STEPPER MOTORS 9

Constructional features, Principle of operation, Permanent magnet stepper motor, Variable reluctance motor, Hybrid motor, Single and multi stack configurations, Torque equations, Modes of excitations, Characteristics, Drive circuits, Control of stepping motors, Application.

MODULE II SWITCHED RELUCTANCE MOTOR 9

Constructional features, Principle of operation, Torque prediction, Power controllers, Microprocessor based control and characteristics.

MODULE III PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Permanent magnet brushless D.C. Motors, Types, Principle of operation, EMF and torque equations, Power controllers, Torque speed characteristics, Applications.

MODULE IV PERMANENT MAGNET SYNCHRONOUS MOTOR 9

Permanent magnet synchronous Motors, Principle of operation, EMF and torque equations, Power controllers, Torque speed characteristics, Applications.

MODULE V MISCELLANEOUS MACHINES 9

Constructional features, Principle of operation and Characteristics of Synchronous Reluctance Motor, Linear Induction motor, Repulsion motor, Applications.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. K.Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 2008.
2. T. Kenjo, Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984
3. E.G. Janardanan, Special electrical machines, PHI learning Private Limited, Delhi, 2014.

REFERENCES:

1. Miller, T. J. E., “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, 1989.
2. Taylor E.O., “The Performance and Design of AC Commutator Motors”, Sir Issac Pitmanand Sons, 1998.
3. T. Kenjo, S. Nagamori, “Permanent Magnet and Brushless DC Motors”, Clarendon Press, London, 1988.
4. Murphy J.M.D., “Power Electronics Control of AC Drives”, Pergamon Press, 1988.
5. Naser A. and Boldea L., “Linear Electric Motors: Theory Design and Practical Applications”, Prentice Hall of India, 1987.
6. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
7. M. Gopal, 'Digital Control and State Variable Methods', Tata McGraw-Hill,1997.

COURSE OUTCOMES:

At the end of this course, the student will be able to

CO1: estimate the performance and applications of stepping motors.

CO2: design control circuit for switched reluctance motors.

CO3: choose the appropriate type of permanent magnet brushless D.C. motor.

CO4: apply permanent magnet synchronous motor for industrial application.

CO5: choose special Machine for any industrial application.

Board of Studies (BoS) :

17th BOS of EEE held on 15.07.2022

Academic Council:

19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	M	H	H	H	M	-	-	-	-	-	-	M	M	-
CO2	M	H	H	H	M	-	-	-	-	-	-	L	H	-
CO3	-	-	-	-	H	-	-	-	-	-	-	H	-	H
CO4	-	M	M	M	M	-	-	-	-	-	-	M	M	-
CO5	L	-	-	-	H	-	-	-	-	-	-	H	-	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3: Good health and well being.
Statement : Understanding of the fundamentals of electrical machines can help in designing systems to promote good health and well being.

SDG 5: Gender equality
Statement: Acquiring the knowledge to help and overcome the gender barriers in work place.

SDG 8: Decent work and economic
Statement: The learners of this course can get decent work and earn financial benefits.

SDG 12: Responsible consumption and production.
Statement: Use of right and design efficient electric machines results in reasonable for production.

EEDX 29	**WIND ENERGY CONVERSION SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 7,9,11,12,13		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the fundamentals of wind power.

COB2: To study and understand about the wind turbine components, power generation machinery, and its control systems.

COB3: To understand about the wind turbine characteristics with fixed and variable speed turbine.

COB4: To study and understand about the wind turbine power system studies.

COB5: To simulate the wind turbine dynamic behavior when integrated to grid and in standalone operation.

MODULE I INTRODUCTION 10

Historical development and current status of wind power -Generators and power electronics for wind turbines - Impacts of wind power-Wind speed estimation-Wind speed measurements-Rayleigh distribution – Maximum Power obtainable-Bertz limit Power coefficient –Aerodynamics of wind rotor- Blade element theory-Aerodynamic efficiency-Wind energy conversion system components.

MODULE II WIND TURBINE 9

Types of Wind Turbine-Rotor design considerations-Tip speed ratio-Blade profile Power regulation -Yaw control –Pitch angle control-Stall control –Schemes for maximum power extraction.

MODULE III FIXED SPEED AND VARIABLE SPEED SYSTEMS 8

Fixed speed and variable speed wind turbine- Need of variable speed systems Power-wind speed characteristics-Generation schemes with fixed and variable speed turbines-Comparison of different schemes.

MODULE IV MODELING AND SIMULATION OF FIXED SPEED AND VARIABLE SPEED WIND GENERATORS 9

Modeling of fixed speed Induction generator - axes transformation - flux linkage equations - voltage equations-state equations-modeling of variable speed DFIG for wind energy conversion systems-converter control system- transient stability simulation of fixed speed induction generator using EUROSTAG - Doubly Fed Induction Generator (DFIG) modeling - controller modeling - Modeling of DFIG in EUROSTAG - Transient stability simulation of power systems with induction generators using EUROSTAG.

MODULE V CONTROL SCHEME AND GRID CONNECTED SYSTEMS 9

Induction generator-Controlled firing angle scheme with AC and DC side Capacitor-Scalar method-flux vector scheme-Control scheme for synchronous generator with variable speed drive-Variable speed synchronous generator control with boost converter- Stand alone and grid connected WECS system-Grid connection Issues-Impacts of wind power on power system stability-wind plant reactive power capability and its requirements-voltage control and active power control - Storage technologies.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. S.N.Bhadra, D.Kasthra, S.Banerjee, "Wind Electrical Systems, "Oxford Higher Eduction, 2005.

REFERENCES:

1. Thomas Ackermann, "Wind Power in Power system, "Wiley 2012.
2. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990.
3. Jian Zhang, Adam Dysko, John O'Reilly, William E. Leithead," Modeling and performance of fixed-speed induction generators in power system oscillation stability studies", Electric Power System Research Vol. 78 (2008) 1416-1424.
4. Andre´s Feijoo, Jose Cidras, Camilo Carrillo, "A third order model for the doubly-fed induction machine", Electric Power Systems Research 56(2000) 121-127.
5. Eurostag 4.3 Theory Manual Part I.
6. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
7. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge, 1976. S.Heir "Grid Integration of WECS", Wiley 1998.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: recognize the need of renewable energy technologies and their role in the world energy demand.

CO2: identify and mathematically model the wind turbine components, calculate the available wind power, predict mechanical loads based on design of the generation of electrical power.

CO3: simulate the wind turbine dynamic system behavior with integration of components, sensors, and control for given real time application.

CO4: mathematically model and simulate the transient and steady state performance of the stand-alone and grid connected wind generators using

EUROSTAG, MATLAB, CYME packages.

CO5: analyze the wind power integration issues and their mitigation techniques

Board of Studies (BoS):
17th BOS of EEE held on 15.07.2022

Academic Council:
19th Academic council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	L	H	L	M	L	H	L	L	L	L	M	H	M
CO2	H	M	H	M	M	L	M	L	L	L	M	L	H	M
CO3	L	H	H	L	M	M	L	L	L	L	L	L	M	H
CO4	M	M	H	H	L	H	H	L	L	L	L	M	H	H
CO5	H	M	M	H	L	H	H	L	L	L	M	M	M	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 7 : Affordable and Clean Energy
Ensure access to affordable, reliable, sustainable and modern energy for all
Statement: The course directly contributes to SDG 7 by promoting the development and utilization of wind energy as a clean and sustainable source of power. It aims to educate students on the design and operation of wind energy systems, fostering their understanding of renewable energy technologies.

SDG 9 : Industry, Innovation, and Infrastructure
Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
Statement: Industry, Innovation, and Infrastructure - The course contributes to SDG 9 by focusing on the design, development, and implementation of wind energy conversion systems. It encourages innovation in the field of renewable energy and supports the growth of sustainable infrastructure.

SDG 11: Sustainable Cities and Communities - Make cities and human settlements inclusive, safe, resilient, and sustainable.
Wind energy systems are increasingly integrated into urban landscapes. The course equips students with the knowledge to develop wind energy projects and contribute to sustainable urban planning, supporting the objectives of SDG 11.

SDG 12: Responsible Consumption and Production - Ensure sustainable consumption and production patterns.
The course emphasizes the importance of sustainable energy production and consumption. It promotes the responsible utilization of wind resources to generate clean energy, aligning with SDG 12's goal of promoting sustainable patterns of consumption and production.

SDG 13: Climate Action - Take urgent action to combat climate change and its impacts.
The course aligns with SDG 13 by addressing the urgent need to mitigate climate change and reduce greenhouse gas emissions. Wind energy is a crucial component of renewable energy systems and plays a significant role in combating climate change by replacing fossil fuel-based power generation.

ELECTRONICS AND COMMUNICATION ENGINEERING ELECTIVES

ECDX 011	ARM ARCHITECTURE AND PROGRAMMING	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1 : To define the fundamentals of an ARM processor.

COB2 : To explain the building blocks of an ARM processor.

COB3 : To Analyze the I/O ports, serial and parallel interfaces of an ARM processor.

COB4 : To apply the instruction sets of ARM processor.

COB5 : To discuss interrupt handling schemes and embedded operating systems.

PREREQUISITES:

Knowledge on Digital Electronics, Microprocessors and Microcontrollers

MODULE I ARM PROCESSOR FUNDAMENTALS 8

The RISC Design Philosophy, The ARM Design Philosophy. Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and Vector Table, Core Extensions, Architecture, ARM Processor Families.

MODULE II LPC21XX ARM CPU 9

Introduction: - Architectural Overview - Memory Mapping -Block Diagram - System control block functions: PLL - Power Control - Reset - VPB Divider - Wakeup Timer - Memory Acceleration Module - Timer0 and Timer1- PWM - RTC - On Chip ADC - On Chip DAC- Interrupts- Vector Interrupt Controller.

MODULE III LPC 21XX - PERIPHERALS 10

General purpose Input/output ports (GPIO) - Universal Asynchronous Receiver/Transmitter (UART) - I2C Interface - Multimaster and Multislave communication - SPI Interface - SSP Controller - USB 2.0 Device Controller.

MODULE IV INTRODUCTION TO THE ARM INSTRUCTIONS SET 9

ARM programmer’s model - Addressing modes- instruction set-Data processing instructions, Data transfer instructions, ARM Condition codes, Branches, Software interrupt (SWI), Multiply instructions-ARM Assembly Language programming.

MODULE V ARM APPLICATION DEVELOPMENT 9

Exception Handling – Interrupts – Interrupt handling schemes- Firmware and boot loader – Example: Standalone - Embedded Operating Systems – Fundamental Components - Example Simple little Operating System.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Dr. Jonathan W. Valvano, "Embedded Systems: Introduction to ARM Cortex-M Microcontrollers", 2012
2. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guide Designing and Optimizing System Software", Morgan KaufmannPublishers, Elsevier Inc, 2004.
3. William Hohl, Christopher Hinds , " ARM Assembly Language Fundamentals and Techniques, 2nd Edition, CRC Press, 2015.

REFERENCES:

1. A.K.Ray& K.M Bhurchandi, 'Advanced Microprocessor and Peripherals – Architecture, Programming and Interfacing', Tata Mc Graw Hill, 2006.
2. Steve Furber, "ARM System On Chip Architecture, Second Edition, Pearson Education Limited, 2000.
3. Gibson," ARM Assembly Language An Introduction, Second Edition, 2007.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1	**:**	Explain the ARM processor architecture and its family.
CO2	**:**	Develop assembly language programs to perform specific tasks using ARM instructions
CO3	**:**	Create ARM microcontroller applications using Embedded C language
CO4	**:**	Choose the external hardware interface of LPC214x microcontroller
CO5	**:**	Analyze embedded operating systems and its components.

Board of Studies (BoS):

22nd BoS of ECE held on 14.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	L	-	-	-	-	-	-	-	-	-	-	L	-
CO2	L	L	H	M	H	-	-	-	-	-	-	-	L	H
CO3	L	L	H	M	H	-	-	-	-	-	-	-	L	H
CO4	L	L	-	-	-	-	-	-	-	-	-	-	L	-
CO5	M	H	L	M	-	-	-	-	-	-	-	-	H	-

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: This course enables the student to understand the fundamentals of ARM CPU, peripherals to interface with ARM processor, constraints in developing an ARM based systems for applications.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Able to apply the programming concepts of ARM for various applications.

ECDX 081	**COMMUNICATION ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To discuss about different methods of analog communication and their significance

COB2: To describe the digital Communication methods for high bit rate transmission

COB3: To apply the concepts of coding techniques to enhance the transmission rate and minimizing the errors in transmission.

COB4: To analyze the concepts of multiple access techniques

COB5: To select the appropriate transmission medium

PREREQUISITE: Basic amplifier circuit, Analog and Digital IC concept.

MODULE I ANALOG COMMUNICATION 12

Elements of communication systems-Electromagnetic Spectrum -Need for modulation. Analog Modulation- generation and detection-AM, DSBSC, SSB, VSB – FM generation and detection. AM Transmitter and Receiver, FM transmitter and Receiver.

MODULE II DIGITAL COMMUNICATION 9

Pulse modulations – concepts of sampling and sampling theorems, PAM, PWM, PPM, PTM, quantization and coding: DCM, DM, slope overload error. Equalizer-ASK, FSK, PSK, Transmitter and Receiver – Mathematical model of channel.

MODULE III INFORMATION THEORY & CODING TECHNIQUES 6

Information & Entropy, Source Coding Theory, Discrete Memory less Channel, Mutual Information Channel Capacity, Channel Coding Theory.

Introduction-Information & Entropy, Source Coding Theory, Discrete Memory less Channel, Mutual Information Channel Capacity, Channel Coding Theory.

MODULE IV MULTIPLE ACCESS TECHNIQUES 9

SS&MA techniques: FDMA, TDMA, CDMA, SDMA application in wire and wireless communication-OFDMA

MODULE V TRANSMISSION MEDIA 9

Coaxial cable, optical fiber, Wireless Transmission, Terrestrial microwave, Satellite microwave. Wireless Propagation: Ground wave propagation, Sky Wave propagation, LoS Propagation. Evolution of 5G communication.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Taub & Schiling "Principles of Communication Systems" Tata McGraw Hill,2nd edition, 2008.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007.

REFERENCES:

1. S. Haykin "Digital Communications" John Wiley 2005.
2. William Stalling, "Data and Computer Communications", 10th Ed., Prentice-Hall, 2013.
3. Kennedy and Davis "Electronic Communication Systems" Tata McGraw hill, 4th Edition, 1993.
4. Sklar "Digital Communication Fundamentals and Applications" Pearson Education, 2001.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Apply analog and digital communication techniques

CO2: Use data and pulse communication techniques

CO3: Analyze Source and Error control coding

CO4: Analyze Source and Error control coding

CO5: Differentiate various medium for signal transmission

Board of Studies (BoS) :

22nd BoS of ECE held on 14.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	
CO1	H	M	L	L	L	-	-	-	-	-	-	-	M	L	
CO2	H	M	L	L	L	-	-	-	-	-	-	-	M	L	
CO3	M	H	L	M	L	-	-	-	-	-	-	-	H	L	
CO4	M	H	L	M	L	-	-	-	-	-	-	-	H	L	
CO5	M	H	L	M	L	-	-	-	-	-	-	-	H	L	

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Brief description in two - three lines connecting the course outcomes with the SDG. The holistic understanding of building materials and components leads to construction of resilient infrastructure and sustainable industrialization.

ECDX 082	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
SDG: 3, 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Study of discrete Fourier transform and its applications in digital Filter design.

COB2: Familiarize with the design of FIR and IIR digital filters.

COB3: To understand the concept of quantization noise and its effects in multi-rate signal processing.

COB4: To introduce signal processing concepts in systems having more than one sampling frequency.

COB5: To study the architecture and features of various digital signal processors.

MODULE I DISCRETE FOURIER TRANSFORM 9

Introduction to Discrete Fourier Transform, Direct computation of DFT and IDFT, FFT algorithms - Radix-2 FFT algorithms -Decimation in Time, Decimation in Frequency algorithms.

MODULE II IIR DIGITAL FILTERS 9

Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method.

MODULE III FIR DIGITAL FILTERS 9

Characteristics of FIR Digital Filters, Frequency Response, Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique and comparison of IIR & FIR filters.

MODULE IV MULTIRATE DIGITAL SIGNAL PROCESSING 9

Introduction, Down Sampling, Decimation, Upsampling, Interpolation, Sampling Rate Conversion, Conversion of Band Pass Signals, Concept of Resampling, Applications of Multi Rate Signal Processing.

MODULE V DIGITAL SIGNAL PROCESSORS 9

Introduction to DSP processor - Harvard and Von Neumann architecture - Pipelining -Architecture of TMS320C5X and C54X. Programming environment

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. J. G. Proakis, D.G. Manolakis and D.Sharma, Digital Signal Processing Principles, Algorithms and Applications, 2012, 4th edition, Pearson Education, Noida, India
2. S.K.Mitra, Digital Signal Processing, 2013, 4th edition, TMH, New Delhi, India.
3. Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing", Wiley, 2013.

REFERENCES:

1. Poorna Chandra S, Sasikala. B, Digital Signal Processing, Vijay Nicole/TMH, 2013.
2. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning, 2014.
3. B.P.Lathi, "Principles of Signal Processing and Linear Systems", Oxford University Press, 2010
4. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2009.
5. Dimitris G.Manolakis, Vinay K. Ingle, applied Digital Signal Processing, Cambridge, 2012.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Apply discrete Fourier transform on signals and understand the fast computation of DFT and appreciate the FFT processing.

CO2: Design a digital IIR filter for a given specification and analyze the frequency response

CO3: Design digital FIR filters and analyze the frequency response

CO4: Change the sampling rate based on application

CO5: Illustrate the basic architecture of digital signal processors.

Board of Studies (BoS):

22nd BoS of ECE held on 14.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	
CO1	H	M	L	M	L	-	-	-	-	-	-	-	M	L	
CO2	L	L	H	L	H	-	-	-	-	-	-	-	L	H	
CO3	L	L	H	L	H	-	-	-	-	-	-	-	L	H	
CO4	H	M	L	M	L	-	-	-	-	-	-	-	M	L	
CO5	M	H	L	H	L	-	-	-	-	-	-	-	H	L	

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3: To ensure healthy lives and promote well-being for all at all ages.

Statement: Signal processing plays a major role in medical instrumentation. Sound knowledge in these could lead to substantial research and development in health and well-being.

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: This course enables the student to understand the basic concepts of signal processing, digital filers, and processors.

SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

Statement: Signals and its processing forms the basis of control systems and automation.

ECDX 086	**COMPUTER COMMUNICATION NETWORKS**	**L T P C**
SDG: 4, 9		**3 0 0 3**

COURSE OBJECTIVES:

COB1 : To know about the flow of information from one node to another node in the network.

COB2 : Identify the component required to build different types of networks

COB3 : To focus on different error coding schemes.

COB4 : To distinguish different protocols of network layer, transport layer and application layer.

COB5 : To provide students with contemporary knowledge in Cryptography and Security.

PREREQUISITES:

Fundamentals of analog and digital Communications, Digital electronics & Signals and Systems

MODULE I INTRODUCTION TO DATA COMMUNICATION 9

Overview of Data Communication, Networks and its types, Overview of Internet, Protocols and Standards, Line Configuration, Topology, Transmission Modes, Transmission impairment, Categories of Networks - OSI and TCP/IP protocol model: Modem.

MODULE II DATA LINK LAYER 10

Overview of Data link Control and Media access control , Error - detection and correction – Forward error correction- Block coding, Cyclic codes, Checksum, Backward error correction- stop and wait - go back N ARQ - selective repeat ARQ- sliding window techniques- Random access, Controlled access, - Ethernet (802.3) - Wireless LANs -Bluetooth– WiFi – 6LowPAN–Zigbee .

MODULE III NETWORK LAYER 8

Packet Switching, Circuit switching – Network layer performance, Internet protocol, IPV4 Addresses, Overview of IPv6 Addressing – Transition from IPv4 to IPv6, Mobile IP, ICMP, Routing algorithms - Distance Vector Routing - Link State Routing – Path vector routing- Unicast routing protocols- Routing Information Protocol, Open Shortest Path First (OSPF).

MODULE IV TRANSPORT LAYER & APPLICATION LAYER 10

Transport layer: Introduction to transport layer-User Datagram Protocol (UDP) - Transmission Control Protocol (TCP) – congestion control -Quality of services (QOS). Application Layers: Client server programming- Iterative programming using UDP and TCP- WWW and HTTP, FTP, Electronic mail.

MODULE V NETWORK SECURITY 8

Cryptography: Symmetric-Key Ciphers, Asymmetric-Key Ciphers, Network layer security, transport layer security, application layer security, Basic of Firewalls and cloud Computing, cloud Security.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Behrouz A. Forouzan., "Data Communications and Networking", McGraw-Hill Publishers, 5th edition, 2017.
2. William Stallings., "Data and Computer Communications", Pearson Publishers, 10th Edition, 2017.
3. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach", 6th Edition, Pearson Education, 2017.
4. Chee Hock Ng, Soong Boon-Hee, Professor Soong Boon-Hee "Queueing Modelling Fundamentals with Applications in Communication Networks" Wiley, 2008.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufmann Publishers Inc., 2011.
2. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill Publisher, 2011.
3. John Rittinghouse& James Ransome, Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Understand data communication and its components.

CO2 : Classify the layer functionalities of OSI model and TCP/IP

CO3 : Implement the error detection and correction techniques in data communication & networks

CO4 : Compare the operation and features of application layer protocol.

CO5 : Use cryptography techniques in data communication and networks

Board of Studies (BoS) :
22nd BoS of ECE held on 14.12.2021

Academic Council:
18th Academic council held on 24.02.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	L	L	-	-	-	-	-	-	-	-	-	-	-	L
CO 2	M	L	L	-	-	-	-	-	-	-	-	-	-	L
CO 3	H	M	L	-	-	-	-	-	-	-	-	-	-	M
CO 4	-	H	M	-	-	-	-	-	-	-	-	-	-	H
CO 5	H	M	L	-	-	-	-	-	-	-	-	-	-	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Statement: This course enables the student to understand basic network components, models and protocols and helps for lifelong learning of newer technologies and concepts related to data communication and networking.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
Statement: Able to apply the theoretical concepts for the various application of computer networks.

EIDX 91	**ADVANCED CONTROL SYSTEM**	**L**	**T**	**P**	**C**
SDG : 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide the students a comprehension about the state space model and to understand the importance of the system state.
COB2: To make the students able to apply nonlinear system analysis.
COB3: To provide knowledge on design state feedback control and state observer
COB4: To give basic knowledge in describing function analysis
COB5: To provide students an understanding of basic analysis and synthesis of control systems and to provide opportunities for students to gain practical experience in the use of computer design and analysis tools in Matlab and Simulink

MODULE I STATE SPACE ANALYSIS OF SYSTEMS 9

Concept of state variables, state model for typical linear systems, construction of state model from differential equations, block diagram representation of state models, state space model for electrical circuits, mechanical systems, electro-mechanical system-DC motors, State space model to transfer function model, transfer function model to state space model.

MODULE II STATE FEEDBACK AND OBSERVER DESIGN 9

Concept of controllability and observability of systems, state feedback controller design using pole placement method- Ackerman's formula, design of full state and reduced order observers. State feedback and observer design using control system toolbox

MODULE III NONLINEAR CONTROL SYSTEMS 9

Introduction to nonlinearities and non linear phenomenon, Nonlinear system behavior. Methods of linearization, Phase Plane Analysis: Concepts of Phase Plane Analysis, Phase Portraits, Singular Points, Symmetry in Phase Plane Portraits, Methods of Constructing Phase Portraits: Analytical method, the method of Isoclines.

MODULE IV NONLINEAR MODELS AND LINEARIZATION 9

Methods of linearization-Taylor series expansion-Jacobian method, Role of Eigen values and Eigen vectors-State transition matrix and its properties-stabilizability and detectability, Nonlinear system models- Hammerstein and Weiner models, case study.

MODULE V DESCRIBING FUNCTION METHOD 9

Basic concepts, describing functions for common nonlinearities, stability analysis by describing function approach, lyapunov stability criterion, popov's stability criterion.

L – 45; TOTAL HOURS – 45

TEXT BOOKS

1. Gopal, M., "Digital Control and State Variable Methods", 3rd Edition, Tata McGraw Hill, 2008.
2. Gopal, M., "Modern Control Engineering", New Age International, 2005.

REFERENCES:

1. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 8th Edition, Pearson Education, 2004.
2. Gopal, M., "Control Systems: Principles and Design", 2nd Edition, Tata McGraw Hill, 2003.
3. Katsuhiko Ogata, "Discrete-Time Control Systems", Pearson Education, 2002.

COURSE OUTCOMES:

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

CO1: determine state space model of electrical, mechanical and electromechanical systems

CO2: convert a transfer function model to state space model and vice versa

CO3: design state feedback controller and state observer

CO4: analyze linear and nonlinear systems using phase plane method

CO5: analyze nonlinear systems using describing function method

CO6: obtain models of MIMO systems

Board of Studies (BoS):

18th BOS meeting of EIE held on 12.07.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	H	H	H	-	-	-	-	-	-	-	H	M
CO2	H	M	M	H	M	-	-	-	-	-	-	-	M	L
CO3	H	H	H	M	H	-	-	-	-	-	-	-	H	M
CO4	M	M	L	M	L	-	-	-	-	-	-	-	L	L
CO5	M	L	L	L	L	-	-	-	-	-	-	-	L	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

The knowledge in this course will enable the students to grow with technological developments in the field of Control Systems

EIDX 92	BIO INSTRUMENTATION AND SIGNAL ANALYSIS	L	T	P	C
SDG: 3, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To provide an acquaintance of the physiology of the brain, heart and lungs.

COB2: To introduce the student to the biosensors, electrodes and amplifiers.

COB3: To introduce the typical measurement and devices of bio-electric origin

COB4: To provide the latest trends of imaging techniques and monitoring and awareness of electrical safety.

COB5: To bring out the importance of bio-signal analysis and diagnosis

MODULE I ANATOMY AND PHYSIOLOGY 7

Basic components of a biomedical system, Cell and its structure – Action and resting – Potential propagation of action potential – Sodium pump – Nervous system – Nerve cell – Synapse – Cardio pulmonary system – Physiology of heart and lungs – Circulation and respiration.

MODULE II TRANSDUCERS AND AMPLIFIERS 10

Transducers – Different types – Piezo-electric, ultrasonic, resistive, capacitive, inductive transducers – Selection criteria. Electrodes – Micro, needle and surface electrodes – Amplifiers – Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier- ECG isolation amplifiers.

MODULE III ELECTRO – PHYSIOLOGICAL MEASUREMENTS 9

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms.

MODULE IV MEDICAL IMAGING AND PMS 10

Computer tomography – MRI – Vascular Interventional Radiography – Echo Cardiography - Ultrasonography – Digital Mammography - Nuclear medicine scans Patient Monitoring Systems (PMS) – Electrical safety.

MODULE V BIO SIGNAL ANALYSIS 9

Objectives of biomedical signal analysis – Difficulties encountered in biomedical signal acquisition and analysis – preprocessing techniques – feature extraction-feature selection methods - time domain analysis and frequency domain analysis – Computer aided diagnosis – Case Studies: The above techniques applied to ECG and EEG

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. R.S.Khandpur, “Hand Book of Bio-Medical instrumentation’, 3rd Edition, Tata McGraw Hill Publishing Co Ltd., 2014.
2. J.Webster, “Medical Instrumentation – Application and Design”, 5th Edition, John Wiley & Sons, 2020.
http://fa.bme.sut.ac.ir/Downloads/AcademicStaff/3/Courses/4/Medical%20instrumentation%20application%20and%20design%204th.pdf

REFERENCES:

1. M.Arumugam, “Bio-Medical Instrumentation”, Anuradha Agencies, 2017.
2. L.A. Geddes and L.E.Baker, “Principles of Applied Bio-Medical Instrumentation”, John Wiley & Sons, 1975.
3. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, “Bio-Medical Instrumentation and Measurements”, 2nd Edition, Prentice Hall of India, 2014.

COURSE OUTCOMES:

CO1: Identify physiological parameters for measurement.
CO2: select transducers and design amplifiers for acquiring biosignals
CO3: analyze typical waveforms of bio potentials of the human system
CO4: suggest diagnostic methods for treatment and therapy and provide safety for human beings during bio signal measurements
CO5: analyze the problems in abnormal conditions and report

Board of Studies (BoS):
18th BOS meeting of EIE held on 12.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L	M	L	-	-	-	-	-	-	-	L	L
CO2	H	H	M	H	M	-	-	-	-	-	-	-	M	L
CO3	L	M	H	M	M	-	-	-	-	-	-	-	L	L
CO4	M	H	M	H	M	-	-	-	-	-	-	-	M	L
CO5	L	M	M	M	H	-	-	-	-	-	-	-	L	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3 : Engineering solutions are key to empowering local health workers to provide accessible, quality healthcare.

SDG 9 : An effective, efficient and equitable data infrastructure will generate value for the succeeding generations and foster innovation.

		L	T	P	C
EIDX 93	**BIOMEDICAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
SDG: 3, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To study the characteristics of different biosignals

COB2: To learn linear and non-linear filtering techniques to extract desired information

COB3: To realize filtering and wavelet techniques for biosignals

COB4: to learn about automated classification and decision making to aid diagnosis

COB5: to study feature extraction of signals by multivariate analysis

MODULE I BIOSIGNAL AND SPECTRAL CHARACTERISTICS 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

MODULE II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, lattice representation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

MODULE III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

MODULE IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

MODULE V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Arnon Cohen, "Bio-Medical Signal Processing Vol I and Vol II", CRC Press Inc., Boca Rato, Florida, 1999.
2. Rangaraj M. Rangayyan, "Biomedical Signal Analysis-A case study approach", Wiley, 2nd Edition, 2016.

REFERENCES:

1. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2003.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, "Digital Signal processing- A Practical Approach'',Pearson education Ltd., 2004.
3. Raghuveer M. Rao and Ajith S.Bopardikar, "Wavelets transform – Introduction to theory and its applications", Pearson Education, India, 2000.
4. K.P.Soman, K.Ramachandran, "Insight into wavelet from theory to practice", PHI, New Delhi, 3rd Edition, 2010.
5. John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications'', Taylor& Francis Inc, 2004.
6. Kayvan Najarian and Robert Splerstor, "Biomedical signals and Image processing'', CRC – Taylor and Francis, New York, 2nd Edition, 2012.
7. D.C.Reddy, "Biomedical Signal Processing – Principles and Techniques'', Tata McGraw-Hill Publishing Co. Ltd, 2005.
8. Gari D. Clifford, Francisco Azuajeand Patrick E.McSharry, "Advanced Methods and Tech for ECG Data Analysis", ARTECH House, Boston, 1st Edition, 2006.

COURSE OUTCOMES:

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

CO1: Preprocess the Biosignals.

CO2: Analyze biosignals in time domain & to estimate the spectrum

CO3: Apply wavelet detection techniques for biosignal processing.

CO4: Classify Biosignals using neural networks and statistical classifiers

CO5: Extract the features using multivariate component analysis

Board of Studies (BoS):
18th BOS meeting of EIE held on 12.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	L	L	M	L	-	-	-	-	-	-	-	L	M
CO2	H	M	M	H	M	-	-	-	-	-	-	-	L	M
CO3	M	H	L	M	L	-	-	-	-	-	-	-	L	M
CO4	L	M	H	M	M	-	-	-	-	-	-	-	L	M
CO5	M	M	M	H	H	-	-	-	-	-	-	-	L	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 3 : Engineering solutions are key to empowering local health workers to provide accessible, quality healthcare.

SDG 9 : An effective, efficient and equitable data infrastructure will generate value for the succeeding generations and foster innovation.

EIDX 94	**INDUSTRIAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide sound knowledge about various techniques used for the measurement of Industrial Parameters.

COB2: Introduction to Load cells, torque meter and various velocity pickups.

COB3: Exposure to various accelerometer pickups, vibrometers, density and viscosity measuring instruments.

COB4: To provide an adequate knowledge about pressure measuring instruments.

COB5: To provide an idea about the temperature standards, calibration and signal conditioning used in RTD's.

COB6: To provide knowledge regarding characteristics of thermocouples and signal conditioning modules.

COB7: To provide adequate knowledge about various flow measuring meters.

MODULE I MEASUREMENT OF FORCE, TORQUE AND VELOCITY 7

Electric balance – Different types of load cells – Magnets - Elastic load cells– Strain gauge load cell – Different methods of torque measurement – Strain gauge – Speed measurement – Revolution counter-Capacitive tacho-drag cup type tacho – D.C. and A.C. tacho generators – Stroboscope.

MODULE II MEASUREMENT OF ACCELERATION AND VIBRATION 8

Accelerometers – LVDT, piezoelectric, strain gauge and variable reluctance type accelerometers. – Mechanical type vibration instruments – Seismic instrument as an accelerometer and vibrometers – Calibration of vibration pickups.

MODULE III PRESSURE MEASUREMENT 10

Modules of pressure – Manometers – Different types – Elastic type pressure gauges – Bourdon type bellows – Diaphragms – Electrical methods – Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor - Measurement of Vacuum – McLeod gauge– Thermal conductivity gauges - Ionization gauge – Testing and calibration of pressure gauges – Dead weight tester. Differential Pressure Transmitter

MODULE IV TEMPERATURE MEASUREMENT 10

Bimettalic thermometer – Electrical methods of temperature measurement, signal conditioning of industrial RTD and their characteristics - three lead and four lead RTD.–Thermocouples - signal containing of thermocouples - commercial circuits for cold junction compensation – Pyrometers – Radiation and optical type.

MODULE V FLOW MEASUREMENT 10

Flow measurement: Introduction, definitions - Theory of fixed restriction variable head type flow meters –Orifice plate – Venturi tube – Flow nozzle – Dall tube – Pitot tube- variable area type flow meter -Rota meter– Theory – Electrical type flow meter - Principle and constructional details of electromagnetic flow meter –Ultrasonic flow meters – transit time-frequency difference type – Coriolisflow meter — Solid flow rate measurement– Guidelines for selection of flow meter

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill Publishing Company, 2008.
2. R.K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1999.
3. Liptak, B.G., —Mechanical and Industrial Measurements‖ Khanna Publishers, Delhi, 1999.

REFERENCES:

1. D.S. Kumar, "Mechanical Measurements and Control", 3rd edition, Metropolitan books, 1979.
2. A.K. Sawhney, —A Course on Mechanical Measurements, Instrumentation and Control‖, DhanpathRai and Co, 2017.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Know relevant force, torque and velocity measurements pertaining to Process Industries.

CO2: Select transducers like LVDT, Strain gauge and load cells etc to measure acceleration and vibration.

CO3: Identify pressure and flow measuring devices for various applications in process Industries.

CO4: Select transducers for the contact and non contact type of temperature measurements

CO5: Carry out the effective operation and maintenance of pressure, temperature and flow instruments in process industries.

Board of Studies (BoS):
18th BOS meeting of EIE held on 12.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	-	-	-	-	-	-	-	-	-	-	M	-
CO2	-	H	M	-	-	-	-	-	-	-	-	-	H	-
CO3	L	-	-	-	-	-	-	-	-	-	-	-	L	-
CO4	H	-	-	L	-	-	-	-	-	-	-	-	M	-
CO5	-	M	H	M	-	-	-	-	-	-	-	-	M	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities
The knowledge in this course will enable the students to grow with technological developments in the field of Sensors and Transducers.

EIDX 95	**SENSORS FOR BIOMEDICAL**	**L**	**T**	**P**	**C**
SDG : 3, 9	**APPLICATION**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To get the basic idea of measurements and the errors associated with measurement.

COB2: To know about the various types of transducers.

COB3: To understand the function of signal generators and analyzers

COB4: To gain knowledge on functioning of the various measuring instruments, display devices

COB5: To know about the different sensors for medical application

MODULE I INTRODUCTION TO BIOMEDICAL SENSORS 9

General concept and terminology, Sensor classification and calibration, static and dynamic characteristics, errors and uncertainty.

MODULE II MEASUREMENT OF NON-ELECTRICAL QUANTITIES 8

LVDT, Strain gauges, Transducer: Pressure, Capacitive, Inductive, Electrochemical, Piezo-electric, Hall Effect, Opto-electronic Digital encoding/digital, Fiber-optic, Flow and liquid level, and Electrochemical transducer.

MODULE III SIGNAL GENERATORS AND SIGNAL ANALYZER 9

Signal generator: AF, Pulse, AM, FM, Function, and Sweep frequency generator, Signal analyzer Wave, Spectrum, Logic, and Distortion analyser

MODULE IV DIGITAL DATA DISPLAY AND RECORDING SYSTEM 9

DVM and millimeters, Frequency, Period measurement, Time interval and pulse width measurement, Graphic recorders-strip chart, X-Y recorder, Magnetic tape recorder, CRO basics: CRT, General purpose oscilloscope, Dual trace, Dual beam, Sampling oscilloscope, Digital storage oscilloscope

MODULE V MEDICAL APPLICATIONS OF SENSORS 5

Gas sensor, Microbial sensor, electro analytical sensor, Enzyme based sensor-- Glucose sensor, Electronic nose- halitosis, Advances in sensor technology: Lab-on-a –chip, Smart sensor, MEMS and Nano sensor.

L – 45; Total Hours – 45

TEXT BOOKS:

1. Sawhney A.K, “A course in electrical and electronic measurements and instrumentation”, Dhanpat Rai & Co (P) Ltd, Educational and Technical Publishers, 1996.

2. Cooper, “Electronic Instrumentation and Measurement techniques” Prentice Hall of India, 1998

REFERENCES:

1. Renganathan S, “Transducer engineering”, Allied Publishers Limited, 2003

2. Murty DVS, “Transducer and instrumentation”, PHI, second edition, 2008.

3. Manoj Kumar Ram, Venkat R. Bhethanabolta, “Sensors for chemical and biological applications”, CRC press, 2010

4. Patranabis D, “Sensors and transducers”, PHI, Second Edition, 2004.

5. Jacob Fraden, “Handbook of Modern Sensors: Physics, Designs and applications”, Third edition, Springer International, 2010.

6. Doeblin, “Measurements Systems: Application and Design”, Tata McGraw-Hill, 2003

7. Neubert HKP, “Instrument Transducers”, Oxford University Press, 1999 8. Bakshi U.A, Bakshi A.V, “Measurement & Instrumentation” Technical Publication, 2nd Edition 2011.

COURSE OUTCOMES:

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

CO1: Describe the purpose and methods of measurements

CO2: Explain the principle of different sensors and its applications

CO3: Describe the need and function of various signal conditioning circuits

CO4: Explain different display and recording devices for various applications

CO5: Analyze the characteritics of different transducers.

Board of Studies (BoS):

18th BOS meeting of EIE held on 12.07.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	M	-	L	-	-	-	-	-	-	-	-	M	-
CO2	M	M	-	L	-	-	-	-	-	-	-	-	L	-
CO3	L	L	-	-	-	-	-	-	-	-	-	-	L	-
CO4	M	M	-	L	-	-	-	-	-	-	-	-	L	-
CO5	H	H	M	M	-	-	-	-	-	-	-	-	H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3 : Engineering solutions are key to empowering local health workers to provide accessible, quality healthcare.

SDG 9 : An effective, efficient and equitable data infrastructure will generate value for the succeeding generations and foster innovation.

EIDX 96	**TRANSDUCERS**	**L**	**T**	**P**	**C**
SDG: 4		**2**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To give knowledge about basic measurement Systems and Units & standards.

COB2: To provide an introductory knowledge about transducers.

COB3: To give adequate knowledge about the characteristics of transducer.

COB4: To have in depth knowledge about Resistive, capacitive and inductive transducers.

COB5: To introduce basic knowledge about other types of transducers like Piezoelectric, magnetostrictive transducers and smart transducers.

MODULE I SCIENCE OF MEASUREMENT 7

Units and Standards - Importance of measurement – Functional blocks of a measurement system - Errors - Classification of errors – Error analysis – Statistical methods – Odds and uncertainty and its analysis- Calibration methods.

MODULE II CLASSIFICATION & CHARACTERISTICS OF TRANSDUCERS 9

Definition of transducers - classification of transducers - Static characteristics : Accuracy, precision, resolution, sensitivity, linearity, threshold, hysteresis, bias, range, span and loading effect - Dynamic characteristics: Mathematical model of transducer – Zero, I and II order transducers - Response to impulse, step, ramp , sinusoidal and nonlinear inputs.

MODULE III VARIABLE RESISTANCE TRANSDUCERS 7

Principle of operation, construction details, characteristics and applications of resistance potentiometer, strain gauge, resistance thermometer, thermistor, hotwire anemometer, piezo-resistive sensor and humidity sensor.

MODULE IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 8

Inductive Transducers: Principle of operation, Construction details,-Induction potentiometer – variable reluctance transducers – EI pick up – LVDT– synchro – MicroSyn. Capacitive transducers: Principle of operation, Construction details three types - capacitor microphone – capacitive pressure sensor - proximity sensor.

MODULE V OTHER TRANSDUCERS 7

Piezoelectric transducer – Hall Effect Transducers- magnetostrictive transducer –Introduction to IC sensors -Thick & Thin film sensors (Bio Sensor & Chemical sensor), Introduction to MEMS – Digital transducers– Smart Transducer – Fiber optic transducer- Introduction to nano materials - Nano transducers – different types of nano position sensors - nano actuators – applications.

L – 45 ; TOTAL HOURS 45

TEXT BOOKS:

1. Doebelin E.O, and Manik D.N., “Measurement Systems – Applications and Design”, Tata McGraw Hill, New York, 2011.
2. Neubert, H.K.P., “Instrument Transducers – An introduction to their Performance and Design”, Oxford University Press, Cambridge, 2003.

REFERENCES:

1. A.K. Sawhney, “A course in Electrical & Electronic Measurement and Instrumentation”, Dhanpat Rai and Co (P) Ltd., 2014.
2. D. Patranabis, “Sensors and Transducers”, Prentice Hall of India, 2010.
3. John P. Bentley, “Principles of Measurement Systems”, 3rd edition, Pearson Education,2004.
4. D.V.S Murthy, “Transducers and Instrumentation”, Prentice Hall of India, 2010.
5. Renganathan S., “Transducer Engineering”, Allied Publishers, New Delhi, 2003.

COURSE OUTCOMES:

CO1: Carry out error analysis and find the probable error in a measurement system

CO2: Analyze the static and dynamic characteristics of the transducers

CO3: Compare the construction, characteristics and operation of different variable resistance transducers

CO4: Select the appropriate variable inductance and capacitive transducers for industrial applications

CO5: Evaluate the characteristics and applications of piezoelectric, magnetostrictive, digital, and smart transducers and

CO6: Identify the salient features of nano transducers, nano actuators and solar cells based on nano particles

Board of Studies (BoS):
18th BOS meeting of EIE held on 12.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	H	-	-	-	-	-	-	-	-	H	-
CO2	H	H	L	H	-	-	-	-	-	-	-	-	H	-
CO3	M	M	-	M	-	-	-	-	-	-	-	-	M	-
CO4	L	L	-	-	-	-	-	-	-	-	-	-	L	-
CO5	H	H	M	H	-	-	-	-	-	-	-	-	H	-
CO6	H	M	L	M	-	-	-	-	-	-	-	-	M	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

The knowledge in this course will enable the students to grow with technological developments in the field of Sensors and Transducers.

COMPUTER SCIENCE ENGINEERING

		L	T	P	C
CSDX 81	**INTRODUCTION TO CLOUD COMPUTING**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To comprehend the technical capabilities and business benefits of virtualization and cloud computing.

COB2: To lay the foundation on various types of cloud services, technologies and service providers.

COB3: To study the design challenges of cloud infrastructure.

COB4: To acquire knowledge on different programming models and cloud software.

COB5: To elaborate on energy efficient, privacy and security issues in cloud environments.

MODULE I VIRTUALIZATION 9

Implementation Levels of Virtualization - Virtualization Structures - Virtualization of CPU, Memory and I/O Devices - Virtual Clusters and Resource Management - Virtualization for Datacenter Automation.

MODULE II CLOUD FUNDAMENTALS 9

Scalable Computing Service over The Internet - Technologies for Network based Computing - System Models for Distributed and Cloud Computing - Introduction to Cloud Computing – Essential Characteristics - Benefits and challenges of cloud computing- Cloud Delivery Models - Deployment models - cloud computing vendors.

MODULE III CLOUD INFRASTRUCTURE 9

Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Implementation of resource scheduling algorithm using cloud simulation tool kits.

MODULE IV PROGRAMMING MODEL 9

MapReduce programming model - MapReduce and extensions – Relational operations – Parallel Efficiency of Map Reduce- Cloud File Systems - MongoDB - Hadoop - Cloud platforms in Industry – Google App Engine - Cloud Software Environments –Eucalyptus

MODULE V ENERGY EFFICIENT CLOUD COMPUTING 9

Energy efficiency in clouds – Green Computing - Energy efficient cloud computing architecture – energy aware virtual machine placement in data centers -Energy aware dynamic resource allocation – case studies.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi, "Mastering Cloud Computing", McGraw-Hill Education Private Ltd., ISBN : 9781259029950, 2013

REFERENCES:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, — "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, ISBN : 9780123858801, 2012.
2. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", 1st Edition, Prentice Hall/ Pearson PTR, 2013.
3. Michael J. Kavis "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)" 1st Edition, wiley, ISBN:9781118617618, 2014.

COURSE OUTCOMES: Students who complete this course will be able to

CO1: Demonstrate the different taxonomy of parallel and distributed computing.

CO2: Describe the basic concepts of cloud computing.

CO3: Compare and contrast the delivery and deployment models of cloud computing.

CO4: Analyze the core issues of cloud computing such as energy efficiency, security, privacy and interoperability.

CO5: Identify problems, explain, analyze, and evaluate various cloud computing solutions.

Board of Studies (BoS):

19th BoS of CSE held on 28.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	M	-	M	L	-	-	-	-	-	-	-	-	M
CO2	L	L	-	L	L	-	-	-	-	-	-	-	-	L
CO3	-	H	-	H	M	-	-	-	-	-	-	-	-	H
CO4	-	H	-	H	M	-	-	-	-	-	-	-	-	H
CO5	H	M	M	M	M	-	-	-	-	-	-	-	M	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The learner will be able to work with energy efficient, privacy and security issues in cloud environments.

CSDX 82 SDG: 8	COMPUTER HARDWARE AND INTERFACING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn various types of computer hardware.

COB2: To get familiarize on motherboards and processing units.

COB3: To acquire knowledge on memory and storage devices of computer.

COB4: To provide adequate knowledge on input, output devices and computer peripherals.

COB5: To explore interfacing with various components of hardware.

MODULE I INTRODUCTION TO COMPUTER HARDWARE 9

Computer through generations – Basic Computer Hardware structure – Hardware and Software – Different types of Computers – Features of Computer Systems: Desktop systems, Server Computers, Laptops, Tablets – Disassembling computers.

MODULE II MOTHERBOARDS AND PROCESSING UNITS 9

Features of Mother boards – Components of Mother board – Processor Support – Mother board controller – Memory and Graphics Support – BIOS – IDE and SATA Connectors – Power Supply connectors - External devices interfaces – Audio and LAN systems – Buses and Expansion slots – Speaker and Battery – Front Panel Headers – System board Jumpers and LED – I/O addresses and interrupt –Selection of Mother boards – External Interfaces and Connectors – Processing Units :Processor features –Development stages of CPU – Processor architecture – Graphics Processing Unit.

MODULE III MEMORY AND STORAGE 9

Features of computer memory – Types of computer memory – Memory map – Storage devices: Hard disks – Solid state drives – Optical storage device – Multi drives – Disc burning software – Blu-ray discs – External Storage devices.

MODULE IV INPUT AND OUTPUT DEVICES 9

Keyboard: Types and features of Keyboard – Keyboard interfaces – Mouse: Different Mouse types – Working of mouse – Features of mouse – Mouse interfaces – Computer monitors: Features of monitor – CRT monitors – LCD monitors – LED monitors and Touch screens.

MODULE V PERIPERALS 9

Computer Printers: Types of printers – Dot Matrix printer – Inkjet printer – Laser printer – Multifunction Devices (MFD) – Scanners – Computer speakers – Adding speakers and audio cards.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. K.L.James ,"Computer Hardware", PHI Learning, ISBN: 9788120347984, 2013.

REFERENCES:

1. JyotiSnehi, "Computer Peripherals and Interfacing", Laxmi Publications Pvt Limited,ISBN: 9788170089292,2006.
2. Gary Stringham," Hardware/Firmware Interface Design", Elsevier Science, ISBN: 9780080880198, 2009.

COURSE OUTCOMES: Students who complete this course will be able to

CO1: Comprehend the components of computer hardware.

CO2: Examine the features and working of mother board and processing units.

CO3: Utilize effectively memory and storage units of computer.

CO4: Analyze various components of hardware in computers.

CO5: Interface with input & output devices, peripherals and external devices.

Board of Studies (BoS):
19th BoS of CSE held on 28.12.2021

Academic Council:
18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	L	L	-	-	-	-	-	-	-	-	-	-	-	L
CO2	M	L	-	-	-	-	-	-	-	-	-	-	-	M
CO3	H	M	L	-	-	-	-	-	-	-	-	-	-	M
CO4	-	H	M	-	-	-	-	-	-	-	-	-	-	H
CO5	H	M	L	-	-	-	-	-	-	-	-	-	-	M

Note: L - Low Correlation M -Medium Correlation H - High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning this course, students are able to gain knowledge on components and working of computer hardware and interfacing devices which gives the opportunity of employment.

CSDX 83	**COMPUTER NETWORKS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Build an understanding of the fundamental concepts of computer networking, protocols, architectures, and applications

COB2: Gain expertise in design, implement and analyze performance perspective of ISO- OSI layered Architecture

COB3: Deal with the major issues of the layers of the model.

COB4: Build an understanding of the fundamental concepts of routing mechanisms and different routing protocols.

COB5: Know about different application layer protocols.

MODULE I INTRODUCTION TO COMPUTER NETWORKS 9

Introduction-Computer networks and distributed systems-Classifications of computer networks-Preliminaries of layered network structures-Data communication Components-Representation of data and its flow-Various Connection Topology-Protocols and Standards-OSI model-Transmission Media.

MODULE II NETWORK TOPOLOGY AND BANDWIDTH 7

LAN-Wired LAN-Wireless LAN-Virtual LAN-Techniques for Bandwidth utilization-Multiplexing - Frequency division-Time division and Wave division-Concepts on spread spectrum.

MODULE III DATA LINK LAYER AND MEDIUM ACCESS SUBLAYER 10

Fundamentals of Error Detection and Error Correction-Block coding-Hamming Distance-CRC-Flow Control and Error control protocols - Stop and Wait-Go-back–N-ARQ-Selective Repeat ARQ-Sliding Window-Piggybacking-Random Access-Multiple access protocols - Pure ALOHA-Slotted ALOHA-CSMA/CD-CDMA/CA.

MODULE IV NETWORK LAYER AND TRANSPORT LAYER 10

Switching-Logical addressing – IPV4-IPV6- Address mapping – ARP- RARP-BOOTP and DHCP–Delivery-Forwarding and Unicast Routing protocols-Process to Process Communication-User Datagram Protocol (UDP)-Transmission Control Protocol (TCP)-SCTP Congestion Control-Quality of Service (QoS)-QoS improving techniques - Leaky Bucket and Token Bucket algorithms.

MODULE V APPLICATION LAYER 9

DNS-DDNS-TELNET-EMAIL-FTP-WWW-HTTP-SNMP-Bluetooth-Firewalls.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Andrew S. Tanenbaum., “Computer Networks”, Pearson Education, Limited, 5th edition, United States of America, 2019, ISBN-13: 978-0-13-212695-3.

REFERENCES:

1. Kurose, Ross, “Computer Networking: A top down approach”, Pearson Education, 7th edition, India, 2017, ISBN-13: 978-0-13-359414-0.

COURSE OUTCOMES:

CO1: Interpret the different building blocks of Communication network and its architecture.

CO2: Contrast different types of switching networks and analyse the performance of network

CO3: Implement various error detection and correction mechanisms, flow control mechanisms and various routing protocols

CO4: Design subletting and analyze the performance of network layer, Construct and examine various routing protocols.

CO5: Implement the functionality of various layer and its associated protocols.

Board of Studies (BoS):

19th BoS of CSE held on 28.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	PO1 1	P O 12	PSO 1	PSO 2	PSO 3
CO 1	M							L					H	L	M
CO 2														M	M
CO 3	H			M				L					M	L	L
CO 4								L						L	M
CO 5	M			H				L						L	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Industry, Innovation & Infrastructure

The comprehensive understanding of analysis, design and implementation of secure and efficient networks aids in effective communication that leads to construction of resilient infrastructure and sustainable industrialization.

		L	T	P	C
CSDX 84	**FUNDAMENTALS OF DATA STRUCTURES**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To assess how the choice of data structures impacts the performance of programs.
COB2: To design and implementation of various basic and advanced data structures
COB3: To expose the different types of non-linear structures
COB4: To employ the different data structures to find the solutions for specific problems.
COB5: To develop application using data structures.

MODULE I OVERVIEW, ARRAYS 9

Introduction – Basic Terminology- Data Structures – Algorithms – Linear Arrays – Linear and Multidimensional arrays -Representation of arrays in Memory – Traversing linear arrays – Insertion and deletion – Sorting – Selection and Insertion sort – Searching.

MODULE II LINKED LIST 9

Linked list – Representation of linked list in Memory – Traversing a Linked List – Searching a Linked List – Memory allocation – Insertion into a Linked list – Deletion from a Linked List – Header Linked Lists – Two- ways Lists.

MODULE III STACKS AND QUEUES 9

Stacks – Array Representation of Stacks-Linked Representation of Stacks – Arithmetic Expressions – Towers of Hanoi, an application of stacks – Recursion – Quick Sort – Merge Sort – Queues – Linked representation of Queues – Circular Queues - Dequeues – Priority Queues.

MODULE IV TREES 9

General Trees - Binary Trees – Binary Tree Representation –Tree Traversals – Operations on Binary Trees – Threaded Binary Trees – Search Trees - AVL Search Trees – Insertion in an AVL Search Trees – Deletion in an AVL Search Trees – m-way search trees – B trees – Heaps - Heap sort – Path Length - Huffman's Algorithms.

MODULE V GRAPHS AND THEIR APPLICATIONS 9

Graph Terminology –Representation of a Graph – Operations on a Graph –Warshall's Algorithm - Topological Sorting

L – 45; TOTAL HOURS – 45

TEXTBOOKS

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education; Second edition, ISBN-10: 9332535841, ISBN-13: 978-9332535848, 2014.
2. Seymour Lipschutz, “Data Structures”, McGraw Hill Education, Revised First edition, ISBN-10: 1259029964, ISBN-13: 978-1259029967, 2014

REFERENCES:

1. Narasimha Karumanchi, ”Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles” ,CareerMonk Publications, Fifth Edition, ISBN-10: 819324527X, ISBN-13: 978-8193245279, 2016.
2. Reema Thareja, “Data Structures Using C”, Oxford Publisher, Second Edition, ISBN-10: 0198099304, ISBN-13: 978-0198099307, 2014

COURSE OUTCOMES: Students who complete this course will be able to

CO1: Describe basic ADTs such as Arrays, Linked List, stacks, queues, trees and graphs

CO2: Develop skills in implementations and applications of data structures.

CO3: Compare between different data structures and pick an appropriate data
structure for a design situation.

CO4: Implement basic sorting and searching algorithms

CO5: Analyze the strength and weakness of different data structures

Board of Studies (BoS):

19th BoS of CSE held on 28.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	-	H	H	H	-	-	-	L	M	-	H	-	L
CO2	M	L	H	H	H	-	-	-	L	M	-	H	-	L
CO3	L	L	H	H	H	-	-	-	L	M	-	H	-	L
CO4	L	L	H	H	H	-	-	-	L	M	-	H	-	L
CO5	L	L	H	H	H	-	-	-	L	M	-	H	-	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: This course is characterized by an abundance of basic and complex data structures and various algorithms for their processing. This course is designed from the point of view of preparation for an interview in hiring as a programmer, including at a large IT organization (Google, Microsoft, Apple, Amazon, etc.) or for a promising startup. This course supports all the processes of designing and constructing software products.

CSDX 85	JAVA PROGRAMMING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand Object Oriented Programming concepts and basic characteristics of Java

COB2: To know the principles of packages, inheritance and interfaces..

COB3: To define exceptions and use I/O streams.

COB4: To develop a Java application with threads and generics classes.

COB5: To design and build simple Graphical User Interfaces.

MODULE I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

Object Oriented Programming - Abstraction - objects and classes - Encapsulation- Inheritance - Polymorphism - OOP in Java - Characteristics of Java -The Java Environment - Java Source File - Structure - Compilation. Fundamental Programming Structures in Java - Defining classes in Java - constructors, methods - access specifiers - static members - Comments - Data Types – Variables – Operators - Control Flow -Arrays - Packages - Javadoc comments.

MODULE II INHERITANCE AND INTERFACES 9

Inheritance - Super classes - sub classes - Protected members - constructors in sub classes - the Object class - abstract classes and methods - final methods and classes - Interfaces - defining an interface - implementing interface - differences between classes and interfaces - extending interfaces - Object cloning - inner classes - Array Lists – Strings

MODULE III EXCEPTION HANDLING AND I/O 9

Exceptions - Exception hierarchy - throwing and catching exceptions - built-in exceptions - creating own exceptions - Stack Trace Elements - Input / Output Basics - Streams - Byte streams and Character streams - Reading and Writing Console - Reading and Writing Files

MODULE IV GENERIC AND CONCURRENT PROGRAMMING 9

Motivation for generic programming - generic classes - generic methods - generic code and virtual machine - inheritance and generics - reflection and generics - Stack Trace Elements - assertions - logging - Multi-threaded programming - interrupting threads - thread states - thread properties - thread synchronization - thread-safe Collections - Executors - synchronizers - threads and event - driven programming.

MODULE V EVENT DRIVEN PROGRAMMING 9

Graphics programming - Frame - Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - Event handlers - Adapter classes - Actions - mouse events - AWT event hierarchy - Introduction to Swing - layout management - Swing Components - Text Fields - Text Areas - Buttons - Check Boxes - Radio Buttons – Lists – Choices - Scrollbars - Windows - Menus Dialog Boxes.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Herbert Schildt, “Java The complete referencell”, 8th Edition, McGraw Hill Education, 2011, ISBN: 9781259002465
2. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9th Edition, Prentice Hall, 2013.ISBN: 978-0-13-708189-9.
3. Paul Deitel, Harvey Deitel, ”Java SE 8 for programmers”, 3rd Edition, Pearson, 2015, ISBN: 978-0-13389138-6.

REFERENCES:

1. Steven Holzner, “Java 2 Black book”, Dreamtech press, 2011,
2. Timothy Budd, “Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.

COURSE OUTCOMES:

CO1: Use a version control system to track source code in a project.

CO2: Read and make elementary modifications to Java programs that solve real-world problems

CO3: Validate input in a Java program.

CO4: Design java applications by using exceptions and I/O streams concepts

CO5: Document a Java program using Javadoc.

Board of Studies (BoS):
19th BoS of CSE held on 28.12.2021

Academic Council:
18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	-	H	H	H	-	-	-	M	M	-	H	-	M
CO2	M	L	H	H	H	-	-	-	M	M	-	H	-	M
CO3	L	L	H	H	H	-	-	-	L	M	-	H	-	L
CO4	L	L	H	H	H	-	-	-	L	M	-	H	-	L

CO5	L	-	H	H	H	-	-	-	L	M	-	H	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.
The holistic understanding of an integrated development environment to write, compile, run, and test simple object-oriented Java programs.

RECENT TECHNOLOGIES IN ELECTRICAL ENGINEERING

EEDX 51 SDG: 7, 8	ARTIFICIAL INTELLIGENCE FOR ELECTRICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the fundamentals of Neural networks and their architecture

COB2: To gain knowledge on the applications of Neural networks for modeling and control.

COB3: To know the concept of fuzzy set theory

COB4: To understand Fuzzy logic theory for modeling and control.

COB5: To learn hybrid control schemes and optimization algorithms.

MODULE I ARTIFICIAL NEURAL NETWORK 8

Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perceptron – Limitation – Multi layer perceptron – Back propagation algorithm (BPA) – Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning.

MODULE II NEURAL NETWORKS FOR MODELING AND CONTROL 9

Modeling of non-linear systems using ANN – Generation of training data – Optimal architecture – Model validation – Control of non-linear systems using ANN – Direct and indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox- Case study - Artificial Neural Network Base Short-Term Electricity Load Forecasting.

MODULE III FUZZY SET THEORY 10

Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions.

MODULE IV FUZZY LOGIC FOR MODELING AND CONTROL 9

Modeling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox - Case study - Application of Fuzzy Logic for Control of Electrical Machines.

MODULE V HYBRID CONTROL SCHEMES 9

Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron – Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to support vector machine – Particle swarm optimization – Familiarization with ANFIS toolbox. Case study – Hybrid AI schemes for load frequency control.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Laurene Fausett, “Fundamentals of Neural Networks”, Prentice Hall, Englewood Cliffs, N.J., 1992.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 1997.

REFERENCES:

1. Goldberg, “Genetic Algorithm in Search, Optimization and Machine learning”, Addison Wesley Publishing Company Inc. 1989.
2. Millon W.T., Sutton R.S. and Webrose P.J., “Neural Networks for Control”, MIT press, 1992
3. Ethem Alpaydin, “Introduction to Machine learning (Adaptive Computation and Machine Learning series)’, MIT Press, 2004
4. Zhang Huaguang and Liu Derong, “Fuzzy Modeling and Fuzzy Control Series: Control Engineering”, 2006.

COURSE OUTCOMES:

At the end of this course, the student will be able to

CO1: select the different structures of artificial neural network and the techniques used for their learning.

CO2: apply neural networks for modeling of systems and design of controllers

CO3: evaluate the characteristics of fuzzy systems and the methods of framing fuzzy rules.

CO4: design fuzzy logic controller for selected applications.

CO5: optimize membership function and rule base of FLC using GA and other optimization algorithms and develop neuro fuzzy control system.

Board of Studies (BoS):
17th BoS of EEE held on 15.07.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	M	M	M	L	M	-	-	-	-	-	-	-	H	L
CO2	M	H	H	H	L	-	-	-	-	-	-	-	H	L
CO3	M	M	M	M	L	-	-	-	-	-	-	-	M	L
CO4	M	M	M	M	L	-	-	-	-	-	-	-	M	M
CO5	H	M	M	M	L	-	-	-	-	-	-	-	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 7: Affordable and Clean Energy
Ensure access to affordable, reliable, sustainable and modern energy for all
Statement : Electrical Engineering contributes to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8: Decent Work and Economic Growth
Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Statement: Decent Work and Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

EEDX 52	**AUTOMOTIVE TRANSMISSION AND COMMUNICATION**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the various components in transmission system and drive line units of automobiles.

COB2: To understand various communication modules in electric vehicle.

COB3: To gain knowledge on the applications of automatic transmission in a vehicle.

COB4: To acquire knowledge about practical vehicle control.

COB5: To gain knowledge on the network protocol in automotive system.

MODULE I INTRODUCTION TO VEHICLE TRANSMISSION 9

Traction demand and torque supply at constant speed and transient driving states – Fuel Economy Optimization – Launch and Synchronizing Speeds – Gear Ratios and their design - Fundamentals and active principles – Transfer elements - Electromechanical actuation – Energy and power balance.

MODULE II POWER TRAIN DYNAMICS AND ACTUATION 9

Power train model – Inertia – Spring Stiffness – Substitute system – Eigen frequencies and Eigen modes – Excitation – Forced Oscillation – Rotational vibration damping on the transmission input – Vehicle dynamics – Dynamic coupling.

MODULE III VEHICLE CONTROL 9

Electronic Control Units – Software Architecture – Signal processing – Selecting the shift point – Shift execution – Safety in transmission system – In vehicle Networking (IVN) protocols: Local Interconnect Network(LIN), Control Area Network (CAN), Media Oriented System Transport (MOST) and Flex Ray - Wireless Access in Vehicular Environment (WAVE).

MODULE IV POWER TRAIN ELECTRIFICATION AND COMMUNICATION 9

Electric and hybrid power train – Requirements – Components and configurations – Functions – Strategies Case studies – Truck, Bus, Tractor, Motor cycle, Racing Transmissions - Communication Between Plug-In Vehicles and Off-Board DC Chargers.

MODULE V COMMUNICATION IN ELECTRIC VEHICLE 9

Transmission network – Distribution network – Demand side management and Control – Communication standards and technologies – Inter and Intra control center communications – Communication requirements & Performance metrics.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Iqbal Husain, “Electric and hybrid vehicles – Design Fundamentals”, CRC Press, 2nd Edition 2018.
2. “A survey on communication technologies and requirements for internet of electric vehicles”, RASIP Journal on Wireless Communications and Networking, 2014.

REFERENCES:

1. “The automotive transmission book”, Technology & Engineering, Springer May 2015.
2. Heinz Heisler, "Advance vehicle Technology", Butterworth-Heinemann, 2002.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: analyze the dynamics of an electric vehicle.

CO2: compute the performance parameter for actuator, servo and ancillary system.

CO3: design electronic control units to ensure safety in vehicle transmission system.

CO4: differentiate and analyze the performance of electrification for any application.

CO5: apply suitable technique for automotive communication.

Board of Studies (BoS):

17th BoS of EEE held on 15.07.2022

Academic Council:

19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	L	L	-	-	-	-	-	-	-	-	L	L
CO2	L	L	H	L	-	-	-	-	-	-	-	-	L	M
CO3	L	H	L	L	-	-	-	-	-	-	-	-	L	L
CO4	L	L	H	L	-	-	-	-	-	-	-	-	H	L
CO5	L	L	L	L	-	-	-	-	-	-	-	-	L	L

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG No. 9

Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement: The novel development of automotive transmission and communication helps to incarnate the growth of industry.

EEDX 53	**DC MICRO GRID**	**L**	**T**	**P**	**C**
SDG: 8,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the importance of DC Microgrids.

COB2: To study the impact of Microgrid on grid integration.

COB3: To study concept of microgrid and its configuration.

COB4: To learn dc micro grid with distributed energy resources.

COB5: To explore control and various modes of operation of DC Microgrids.

MODULE I INTRODUCTION 9

Overview of Microgrids- Challenges of Microgrid-Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

MODULE II FUNDAMENTALS OF MICROGRID 9

Concept and definition of microgrid- Classification of Microgrids Microgrid Architecture - Benefits of Microgrid -microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids.

MODULE III IMPACT OF GRID INTEGRATION 9

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues- Energy Management in Microgrid System.

MODULE IV DC MICROGRID WITH DISTRIBUTED ENERGY RESOURCES 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, -Characteristics of distributed energy System- Control of DER Units-Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.

MODULE V CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, DC Microgrid Power Flow Control-microgrid communication infrastructure, Power Converters in Microgrids-Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

L - 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1. Voltage Source Converters in Power Systems: Modeling, Control and Applications", Amirnaser Yezdani, and Reza Iravani, IEEE John Wiley Publications, 2010
2. Power Switching Converters: Medium and High Power", Dorin Neacsu, CRC Press, Taylor & Francis, 2006.
3. Fusheng Li, Ruisheng Li, Fengquan Zhou, Microgrid Technology and Engineering Application, Elsevier, 2015
4. S. Chowdhury, P. Crossley, Microgrids and Active Distribution Networks, Institution of Engineering and Technology, 2009
5. Manuela Sechilariu, Fabrice Locment, Urban DC Microgrid: Intelligent Control and Power Flow Optimization, Butterworth-Heinemann, 2016.

REFERENCES:

1. "Solar Photo Voltaics", Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi,2009
2. Wind Energy Explained, theory design and applications," J.F. Manwell, J.G. McGowan Wiley publication, 2009.
3. Biomass Regenerable Energy", D. D. Hall and R. P. Grover, John Wiley, New York, 1987.
4. Nikos Hatziargyriou, Microgrids Architectures and Control John Wiley Sons, 2014
5. Hassan Bevrani, BrunoFrançois, Toshifumi Ise, Microgrid Dynamics and Control John Wiley Sons, 2017
6. Gevork B. Gharehpetian, S. Mohammad Mousavi Agah, Distributed Generation Systems: Design, Operation and Grid Integration, Butterworth Heinemann, 2017

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: conceptualize the basic operation, control and modelling of distributed energy systems.

CO2: select the basic components of a range of distributed energy sources including wind, PV, hydro, cogeneration, and energy storage systems**.**

CO3: apply standards and grid codes.

CO4: illustrate the impact of grid integration.

CO5: implement the control and operation of microgrid in islanding and grid connected modes.

Board of Studies (BoS):

17th BoS of EEE held on 15.07.2022

Academic Council:

19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	L	-	-	-	M	-	-	-	-	L	H	L	M
CO2	H	M	L	L	-	H	-	-	-	-	H	H	L	H
CO3	H	M	L	L	-	H	-	-	-	M	M	H	L	H
CO4	H	M	L	M	M	H	-	-	-	M	H	H	M	H
CO5	H	H	M	H	M	H	-	-	-	H	H	H	M	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement : The complete understanding of microgrids and its integration lead to sustainable industrialization and promote economic development.

SDG 12: Responsible consumption and production.

Statement: Use of distributed energy sources incorporating power quality measures results in reasonable consumption and production.

EEDX 54	ENERGY DEVICES FOR ELECTRIC VEHICLES	L	T	P	C
SDG: 7, 12		3	0	0	3

COURSE OBJECTIVES:

COB1: To study about the various energy storage devices.

COB2: To acquire detailed knowledge on design of batteries.

COB3: To disseminate the design of storage systems in electric vehicle.

COB4: To gain basic knowledge about fuel cell technology and its impact on environment.

COB5: To learn about hybridization of storage devices with the help of energy storage devices.

MODULE I ENERGY STORAGE SYSTEMS 9

Mechanical Storage Systems – Pumped Hydro Storage – Compressed Air Energy Storage – Flywheel Energy Storage – Electrochemical Storage Systems – Flow Batteries – Secondary Batteries- Chemical Storage Systems – Electrical Energy Storage Systems - Thermal Energy Storage Systems – Environmental aspects.

MODULE II BATTERY ENERGY STORAGE 7

Batteries in Electric and Hybrid Vehicle – Battery Basics – Battery Specific Parameters – Electrochemical Cell Fundamentals – Battery Modeling – Electric Circuit Models – Empirical Models - Different Types of Traction Batteries – Battery Pack Management.

MODULE III BATTERY TECHNOLOGIES 10

Electrochemical Batteries – Electrochemical Reactions – Thermodynamic Voltage – Specific Energy and Power – Energy Efficiency – Battery Technologies – Lead Acid Batteries – Nickel based Batteries – Nickel/Iron System – Nickel/Cadmium System – Nickel Metal Hydride (Ni-MH) Battery – Lithium Based Batteries – Lithium Polymer (Li-P) Battery – Lithium – Ion (Li-Ion) Battery.

MODULE IV FUEL CELLS 9

Fuel Cells – Operating Principles – Electrode Potential and Current-Voltage Curve – Fuel and Oxidant Consumption – Characteristics - Fuel Supply – Hydrogen Storage – Compressed Hydrogen – Cryogenic Liquid Hydrogen – Metal Hydrides – Steam Reforming – POX Reforming – Auto thermal Reforming – Ammonia as Hydrogen Carrier – Non hydrogen Fuel Cells.

MODULE V ULTRACAPACITORS AND FLYWHEELS 9

Ultracapacitors – Features – Basic Principles – Performance – Ultracapacitor Technologies – Ultrahigh-Speed Flywheels – Operation Principles and Power Capacity of Flywheel System – Flywheel Technologies – Hybridization of Energy Storages

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K.. Modern electric, hybrid electric, and fuel cell vehicles. CRC press, 2018
2. Hannan, M. A., Hoque, M. M., Mohamed, A., &Ayob, A., Review of energy storage systems for electric vehicle applications: Issues and challenges. Renewable and Sustainable Energy Reviews, 69, 771-789, 2017.

REFERENCES:

1. Husain, I. , Electric and hybrid vehicles: design fundamentals. CRC press, 2011
2. Teresa Donateo “Hybrid Electric Vehicles”, Intechopen publisher, 2017.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: design an energy storage system.

CO2: select appropriate battery energy storage system.

CO3: model an energy efficient battery system.

CO4: choose suitable fuel cell system for electric/hybrid vehicle.

CO5: apply the basic principles of Ultracapacitor technologies and Ultra-high Speed Technologies for e-vehicles.

Board of Studies (BoS):

17th BoS of EEE held on 15.07.2022

Academic Council:

19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	L	L	L	-	-	-	-	-	-	-	-	H	H
CO2	L	L	L	L	-	-	-	-	-	-	-	-	L	L
CO3	H	H	L	L	-	-	-	-	-	-	-	-	M	M
CO4	L	L	L	L	-	-	-	-	-	-	-	-	L	M
CO5	L	H	H	L	-	-	-	-	-	-	-	-	L	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 7: Affordable & Clean Energy

Statement: The design of suitable energy storage system will provide clean energy for sustainable environment without harming it.

SDG 12: Responsible consumption and production.

Statement: Use of right and energy efficient battery and vehicle components results in reasonable consumption and production.

		L	T	P	C
EEDX 55	**GRID INTEGRATION OF RENEWABLE ENERGY SYSTEMS**				
SDG: 8,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To study the role of renewable energy and storage system.

COB2: To study the control of renewable energy and renewable energy market.

COB3: To study about battery management.

COB4: To acquire knowledge on grid connected solar PV system.

COB5: To study the power compensation in grid connected wind energy system.

MODULE I RENEWABLE ENERGY MARKET AND STORAGE SYSTEM 8

Energy, society and electricity - Exploitation of renewable energy source – Role of energy storage –Types, application and commercialization of energy storage – Classification of storage system.

MODULE II GRID CONNECTED STORAGE SYSTEM 8

Frequency control – Self supply – Uninterrupted power supply – Arbitrage/energy trading – Load levelling/peak shaving – Renewable energy market and applications in comparison with existing markets.

MODULE III SYSTEM ASPECTS FOR BATTERY 9

Battery management: Monitoring and control of battery parameters-Electrochemical storage systems – battery diagnostics- double use of storage systems.

MODULE IV GRID CONNECTED SOLAR PV SYSTEM 10

Rooftop Solar PV system – Network structure, voltage imbalance, power flow analysis, Sensitivity analysis. Conventional MPPT Algorithms: Curve Fitting Method, Perturb and Observe- Incremental Conductance - Fractional Open-Circuit Voltage -Fractional Short-Circuit Current - Ripple Correlation Control (RCC) - Current Sweep - DC Link Capacitor Droop Control. Computational Intelligence Based Techniques: Fuzzy Logic Control (FLC) - Artificial Neural Network (ANN) - Genetic Algorithm (GA) - Hybrid methods

MODULE V GRID CONNECTED WIND ENERGY CONVERSION SYSTEM 10

Model of wind generator – power flow analysis: Sequential and simultaneous method – Grid strengthening – reactive power compensation – Variable speed wind generator model – Wind AGC control – case studies

L – 45 ; TOTAL HOURS – 45

TEXT BOOK:

1. Jahangir Hossain, Apel Mahmud, "Renewable Energy Integration: Challenges and Solutions", Springer Science & Business Media, January 2014.

REFERENCES:

1. Patrick T. Moseley, Jurgen Garche, "Electrochemical Energy Storage for Renewable Sources and Grid Balancing", Newnes, Technology & Engineering October 2014.
2. Sudipta Chakraborty, Marcelo G. Simoes, William E. Kramer, "Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration", Springer Science& Business Media, June 2013.
3. Padmanaban S, Sharmeela C, Sivaraman P, Holm-Nielsen JB. Residential Microgrids and Rural Electrifications. Elsevier Science & Technology; December 2021.

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: illustrate the operation of renewable energy storage system

CO2: design, analyze and apply storage for real time integration

CO3: design, analyze and apply battery modeling for grid connected system.

CO4: design grid connected solar PV system

CO5: apply power electronic control for reactive power compensation in grid connected system

Board of Studies (BoS):

17th BoS of EEE held on 15.07.2022

Academic Council:

19th Academic Council held on 29.09.2022

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CO1	M	L	L	H	L	-	-	-	-	-	-	L	H	M
CO2	M	L	M	H	L	-	-	-	-	-	-	L	H	M
CO3	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO4	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO5	H	H	M	L	L	-	-	-	-	-	-	L	H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 8: Decent work and economic growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.
Statement : The complete understanding of renewable energy sources and its integration will lead to sustainable industrialization and promote economic development.

SDG 12: Responsible consumption and production.
Statement: Use of distributed energy sources incorporating power quality measures results in reasonable consumption and production.

EEDX 56	HEV / XEV MOTOR DRIVES AND CONTROLLERS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study about electrical drives for HEV/ xEV.

COB2: To learn about the use of different power electronics devices and converters used for HEV/ xEV.

COB3: To gain knowledge on electrical machines and its drives.

COB4: To study various electric drive techniques.

COB5: To gain in-depth knowledge on modelling of drives and controller.

MODULE I POWER ELECTRONIC DEVICES 7

Overview of Power Electronics Devices: Power diode, ESD protection diode – Insulated Gate Bipolar Transistor (IGBT), Metal-Oxide-Silicon Field Effect Transistor (MOSFET) – Principle of operation, power density, efficiency – Silicon carbide materials.

MODULE II POWER CONVERTERS 10

Converter Topologies: Buck, boost, transformer less - Inverter Topology: Basics of single & three phase inverter Six pack inverter - Sources of loss in Power Electronics - Conduction, switching, leakage and control losses - Effects of air vs. liquid cooling – Multi convertor vehicular dynamics & Control.

MODULE III MACHINES FOR ELECTRIC VEHICLES 10

DC motor, Induction motor and BLDC motor: Types, Principle, Construction – Peak Power Source(PPS) - Torque and Speed Coupling – Selection of Motors under variable parameters - Testing of Motors/Generators - HEV/xEV traction motor control – Online testing of SoC & Adaptive charging.

MODULE IV ELECTRIC VEHICLE DRIVES 9

Electric drive components – DC drives: Two & Four quadrant chopper, Open loop drive, Steady state analysis, Modes of operation - Operating point analysis – AC drive: Six step operation – PWM techniques, Current control methods – Vector control of Induction motor: Direct & Indirect control.

MODULE V ADVANCED MOTOR DRIVES AND MODELLING 9

BLDC motor drive: Speed and position control, Sensor less control technique and its methods, Back MEF sensing techniques – Modeling of an electric drive, Vehicle body – Drive & wheel and PID based drive. Case study on High voltage bus spike control and thermal control of HEV battery system.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Wie Liu,"Hybrid Electric Vehicle System Modeling and Control", General Motors, 2nd Edition, 2017.
2. Ali Emadi, "Advanced Electric Drive Vehicles",CRC Press, 1st Edition, 2017.
3. Mohan, N., "Electric Drives: An Integrative Approach", MNPERE , 2001.

REFERENCES:

1. Iqbal Husain, "Electric and hybrid vehicles – Design Fundamentals", CRC Press, 2nd Edition 2010.
2. Ali Emadi, Mehrdad Ehsani, John M. Miller, "Vehicular Electric Power System – Land, Air and Space Vehicles", CRC press, 1st Edition, 2003.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: select appropriate power electronics device and control IC.

CO2: analyze and design power converters.

CO3: model various drives and analyze its performance.

CO4: analyze the different control scheme of special electrical machine.

CO5: design, model and modify an electric drive according to customer requirements.

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Academic Council:

19th Academic Council held on 29.09.2022

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CO1	M	L	L	H	L	-	-	-	-	-	-	L	H	M
CO2	M	L	M	H	L	-	-	-	-	-	-	L	H	M
CO3	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO4	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO5	H	H	M	L	L	-	-	-	-	-	-	L	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.

Statement: The industrial growth can be alleviated with new configurations of electric vehicle drive system along with energy efficient and hazard free storage and control elements.

EEDX 57	IMAGE AND VIDEO PROCESSING	L	T	P	C
SDG: 3, 9 & 11		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn about the basic concepts of digital image processing and various image transforms.

COB2: To familiarize with image enhancement techniques.

COB3: To understand the use of current technologies those are specific to image processing systems.

COB4: To understand the data analytics for processing video content.

COB5: To learn the emerging trends in image and video analytics.

MODULE I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction – Applications of Image Processing - Steps in image processing Applications - Digital imaging system- Sampling and Quantization - Pixel connectivity – Distance measures - Color fundamentals and models - File Formats, Image operations.

MODULE II IMAGE ENHANCEMENT AND IMAGE RESTORATION 9

Image Transforms: Fast Fourier Transform and Discrete Fourier Transform. Image Enhancement in Spatial and Frequency domain - Gray level transformations - Histogram processing - Spatial filtering - Smoothing and sharpening - Frequency domain: Filtering in frequency domain. Image Restoration - Image degradation model - Noise modeling – Blur – Order statistic filters – Image restoration algorithms.

MODULE III IMAGE SEGMENTATION AND FEATURE EXTRACTION 9

Image Segmentation - Detection of discontinuities - Edge operators - Edge linking and boundary Detection - Thresholding - Region based segmentation. Image Features and Extraction – Image Features – Types of Features – Feature extraction - Texture - Feature reduction algorithms – PCA – Feature Description.

MODULE IV MINING DATA STREAMS AND VIDEO ANALYTICS 9

Introduction To Streams Concepts – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Analytic Processes and Tools – Video shot boundary detection – Model Based Annotation and Video Mining – Video Database – Video Categorization – Video Query Categorization.

MODULE V EMERGING TRENDS IN IMAGE PROCESSING 9

Affective Video Content Analysis – Parsing a Video Into Semantic Segments – Video Indexing and Abstraction for Retrievals – Automatic Video Trailer Generation – Video In painting – Forensic Video Analysis – Video processing applications in measurements, manufacturing, medicine, agriculture and food industry – OpenCV software application - Case studies.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Rafael C.Gonzalez and Richard E.Woods, Digital Image Processing, Third Edition, Pearson Education, 2009.
2. S.Sridhar, Digital Image Processing‖, Oxford University Press, 2011.
3. Roy, A., Dixit, R., Naskar, R., Chakraborty, R.S., “Digital Image Forensics: Theory and Implementation”, Springer, 2018.
4. A. Murat Tekalp, “Digital Video Processing” Second Edition, Prentice Hall, 2015.

REFERENCES:

1. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis and Machine Vision‖, Second Edition, Thompson Learning, 2007.
2. Anil K.Jain, Fundamentals of Digital Image Processing‖, PHI, 2011.
3. Sanjit K. Mitra, & Giovanni L. Sicuranza, Non Linear Image Processing‖, Elsevier, 2007.

COURSE OUTCOMES: At the end of the course, the students will be able to

CO1: implement basic image processing algorithms.

CO2: design an application that uses different concepts of Image processing.

CO3: apply and develop new techniques in the areas of image enhancement and segmentation.

CO4: perform mining data streams and video analytics.

CO5: design applications for video analytics in current trend.

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CO1	L	L	L	M	L	-	-	-	-	-	-	-	L	H
CO2	M	L	M	H	L	-	-	-	-	-	-	-	L	H
CO3	L	M	H	H	L	-	-	-	-	-	-	-	L	H
CO4	M	L	H	M	L	-	-	-	-	-	-	-	L	H
CO5	L	M	H	H	L	-	-	-	-	-	-	-	L	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3: Good health and well-being.
Statement: Understanding of the image and video processing techniques can help in designing systems to promote good health and well-being.

SDG 9: Industry, innovation and infrastructure
Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced communication infrastructure.

SDG 11: Sustainable cities and communities.
Statement: Use of image and video processing techniques learnt through this course can play a major role in establishing Sustainable cities and communities.

EEDX 58	**INDUSTRIAL IOT**	**L**	**T**	**P**	**C**
SDG: 3, 7, 8, 9 & 11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain knowledge on basic concepts of Industry 4.0

COB2: To have a basic understanding of Industrial IoT.

COB3: To have a thorough understanding of IIoT analytics.

COB4: To understand IoT security.

COB5: To familiarize IIoT concepts with various case studies.

MODULE I INDUSTRY 4.0 9

Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.

MODULE II INDUSTRIAL IoT 9

IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.

MODULE III IIoT ANALYTICS 9

Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop.

MODULE IV IoT SECURITY 9

Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT.

MODULE V CASE STUDY 9

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies: Milk Processing and Packaging Industries, Manufacturing Industries.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2017.
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat “Industrial Internet of Things: Cyber Manufacturing Systems” Springer, 2017.

REFERENCE:

1. Giacomo Veneri, Antonio Capasso, "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT", Packt, 2018.

COURSE OUTCOMES: At the end of the course, the students will be able to

CO1: illustrate the future technologies with Industry 4.0.

CO2:apply the architecture of Industrial IoT.

CO3:design an application that uses different concepts of IIoT analytics.

CO4: implement the security, fog computing and cloud computing IIoT applications.

CO5: apply the IIoT on various domains.

Board of Studies (BoS):

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CO1	L	L	-	H	H	-	-	-	-	-	-	-	-	L
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	M	H	H	H	-	-	-	-	L	-	-	-	L
CO4	L	-	M	M	H	M	-	L	L	L	-	-	-	L
CO5	L	-	H	H	H	M	-	L	L	L	-	-	-	L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3: Good health and well-being.

Statement: Understanding of the Industry 4.0 can help in designing systems to promote good health and well-being.

SDG 7: Affordable and Clean Energy

Statement: Knowledge on Industrial Internet of Things can help in the analysis of affordable and clean energy systems.

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Industry, innovation and infrastructure

Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced communication infrastructure.

SDG 11: Sustainable cities and communities.

Statement: Use of IIoT learnt through this case can play a major role in establishing Sustainable cities and communities.

		L	T	P	C
EEDX 59	**IOT FOR ELECTRICAL ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 3, 7, 8, 9 & 11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To learn IoT in Electrical and Electronics Engineering.

COB2: To gain knowledge and practical experience with IoT and microcontroller systems.

COB3: To acquire knowledge on various communication protocols for IoT.

COB4: To understand various cloud Platforms and Protocols.

COB5: To study the use of IoT.

MODULE I INTRODUCTION TO INTERNET OF THINGS (IoT) 6

Introduction - Overview of the Architecture of Internet of Thing - Overview of the top-level components: the device, gateway and cloud - IOT enabling technologies.

MODULE II IOT COMPONENTS 7

Device platforms: Raspberry Pi - Arduino controller – Overview of Device platforms and interfacing - USB – GPIO - Wi-Fi module - Inter-Integrated Circuit serial bus Serial Peripheral Interface Bus, Universal Asynchronous Receiver/Transmitter (UART) - Sensors: Temperature and Humidity – Moisture – light - Voltage – Current – IR - PIR and Hall sensors.

MODULE III COMMUNICATION PROTOCOLS FOR IoT 10

Basics of the MQTT, HTTP, CoAP Protocols –installing the Arduino MQTT Libraries - testing MQTT.

MODULE IV OVERVIEW OF CLOUD PLATFORMS 10

Overview of Cloud platforms - AWS IoT Platform - Microsoft Azure IoT Hub - IBM Watson/ Blue mix cloud IoT Platform - Google Cloud Platform - SAP Cloud Platform - Node-RED programming tool - Arduino Ethernet Shield, GSM module and Node MCU.

MODULE V APPLICATION OF IOT IN TEMPERATURE MEASUREMENT AND SMART GRID 12

LM 35 Temperature sensor and calibration – interfacing LM 35 with ESP32 – Interfacing Ethernet shield with ESP32 – sending data from ESP32 to cloud platform – monitoring temperature in the cloud – Case Study: Advanced metering infrastructure (AMI) – remote control operation of energy consuming devices.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Peter Waher “Learning Internet of Things”, Packt Publishing, 2015
2. Pradeeka Seneviratne, “Internet of Things with Arduino Blueprints”, Published byPackt Publishing Ltd. UK, 2015.
3. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems Dr. Ovidiu Vermesan, Dr. Peter Friess Published by River Publishers Denmark, 2013.
4. John Soldatos “Building Blocks for IoT Analytics Internet-of-Things Analytics” River Publishers, Denmark, 2017.

REFERENCES:

1. Martin P. Bates, ”Programming 8-bit PIC Microcontrollers in C: With Interactive Hardware Simulation, Newnes, 2008.
2. Michael Margolis “Arduino Cookbook” O’Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472, March 2011.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:work on different projects making use of the IoT.

CO2: design and develop Arduino microcontroller and NodeMCU based automation systems.

CO3: interface a IoT system to devices such as relays, meters, motor controls and sensors, etc. using various communication protocols.

CO4: implement sensor interfaces in various cloud systems by using various interfacing techniques.

CO5: design and develop Arduino microcontroller and NodeMCU based automation systems.

Board of Studies (BoS):

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CO1	L	L	L	M	L	-	-	-	-	-	-	-	L	H
CO2	M	L	M	H	L	-	-	-	-	-	-	-	L	H
CO3	L	M	H	H	L	-	-	-	-	-	-	-	L	H
CO4	M	L	H	M	L	-	-	-	-	-	-	-	L	H
CO5	L	M	H	H	L	-	-	-	-	-	-	-	L	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3: Good health and well-being.
Statement: Understanding of the IoT technologies can help in designing systems to promote good health and well-being.

SDG 7: Affordable and Clean Energy
Statement: Knowledge on Internet of Things can help in the analysis of affordable and clean energy systems.

SDG 8: Decent work and economic growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Industry, innovation and infrastructure
Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced communication infrastructure.

SDG 11: Sustainable cities and communities.
Statement: Use of IoT learnt through this course can play a major role in establishing sustainable cities and communities.

EEDX 60	**MICRO GRID PROTECTION**	**L**	**T**	**P**	**C**
SDG: 7,8,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the basic concepts of Microgrid and its types.

COB2: To learn the operation of various distributed energy resources and storage devices.

COB3: To understand the issues in microgrid operation and its protection schemes.

COB4: To learn about the communication techniques applied for microgrid.

COB5: To learn about the control of various microgrid pilots and its components.

MODULE I INTRODUCTION 7

Microgrid basic concepts – architecture - operational conditions, Microgrid : merits and demerits - functionalities and variables in microgrid - issues in microgrid. Types of microgrid (LV microgrid, MV microgrid - DC microgrid, AC microgrid, hybrid) - Microgrid as part of smarter grid.

MODULE II DISTRIBUTED ENERGY RESOURCES AND STORAGE DEVICES 10

Distributed Energy Resources- solar, wind, CHP, MCHP, Micro turbine - Diesel generators - plug-in electric vehicle –P-Q Control, Power Voltage (PV) Control Scheme, V/f Control Scheme, Droop Concept, adaptive droop control, Phase locked loop- Storage devices-Batteries - fuel cells - super capacitors.

MODULE III MICRO-GRID PROTECTION AND CONTROL 10

Modes of operation: grid connected mode - islanded mode - transition between grid connected mode and islanded mode. Primary control strategy - secondary control strategy- Control of distribution generation - demand side management - Opportunities and risk of different market players.

Requirements of protection - issues in protection- challenges in protection scheme -design of digital relays: under/over voltage relay- over current relay-differential relay – directional over current relay.

MODULE IV COMMUNICATION FOR MICROGRIDS 10

Communication lines in power system: PLC - Microwave – fiber optic links - PMU basic concepts- International Electrotechnical Commission (IEC) 61850, 61850-7-420, 61850-8. Renewable Microgrid controller RMC 600. Review / Comparison on simulation packages used for Microgrid Protection

MODULE V MICROGRID COMPONENTS 8

Microgrid pilots : KERI – CERTS - Intelligent Electronic Devices (IED) -

Microgrid Management system (MMS) - Static Transfer switch (STS) - RTU/ gateway - Smart metering –Sensing Devices.

L – 45 ; TOTAL HOURS – 45

TEXT BOOK:

1. Jukka Ihamäki, “Integration of microgrids into electricity distribution networks” Master’s Thesis in Lappeenranta University of Technology, 2012.

REFERENCES:

1. Amirhossein Hajimiragha, “Generation Control in Small Isolated Power Systems”, Master of Science Thesis -Royal Institute of Technology, Department of Electrical Engineering Stockholm ,2005.
2. Stanley H.Horowitz and Arun G. Phadke, “ Power System Relaying third edition, John Wiley & sons, 2008.
3. Renewable Microgrid controller RMC 600 – ABB Brochure

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: explain the significance of microgrid and its types.

CO2: realize the operation of distributed energy resources and storage devices and its integration issues.

CO3: solve the issues involved in microgrid protection.

CO4: incorporate communication techniques and standards for microgrid protection.

CO5: choose microgrid components.

Board of Studies (BoS):

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CO1	L	M	L	L	L	-	-	-	-	-	-	L	M	-
CO2	M	M	H	H	L	-	-	-	-	-	L	M	M	-
CO3	H	M	M	M	L	-	-	-	-	-	-	M	-	H
CO4	-	M	M	M	L	-	-	-	-	-	-	M	M	-
CO5	L		M	L	L	-	-	-	-	-	M	L	M	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 7: Affordable & Clean Energy

The fundamental concept of microgrid encourages the installation of more clean energy sources.

SDG 8: Decent Work and Economic Growth

Statement: The complete understanding of microgrid leads to sustainable industrialization and promote economic development.

SDG 9: Industry, Innovation & Infrastructure

The complete understanding of microgrid encourages the implementation of more number of microgrids which further enhances the power industry and its infrastructure.

		L	T	P	C
EEDX 61	**SMART GRID**	**L**	**T**	**P**	**C**
SDG: 8,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To study the fundamentals of smart grids.

COB2: To learn modeling of devices associated with smart grids.

COB3: To explore different automation and networking standards.

COB4: To gain knowledge on the concept of Wide area measuring systems and Phasor measurement units.

COB5: To acquire knowledge about the high performance computing for smart grid applications.

MODULE I SMART GRID FUNDAMENTALS 8

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid. Smart grid structure – Interactive grid – Micro grid – Distributed Resources modeling – communication infrastructure – sensing and Control devices – smart grid characteristics.

MODULE II SMART GRID COMPONENTS, STANDARDS AND TECHNOLOGIES 8

Smart grid components – Metering – Virtual power plants-Benefits and cost elements – Pricing regulations – Networking Standards and integration – Analytics- Smart energy resources, Smart substations.

MODULE III AUTOMATION TECHNOLOGIES AND SMART METERS 9

Substation Automation, Feeder Automation, Transmission systems-Control centre systems – Data management principles – Smart Grid implementation standards and procedure – Advanced Metering Infrastructure – Outage management – Distribution and Substation automation- case study -Smart meters – Cloud computing and security issues.

MODULE IV WIDE AREA MEASUREMENT SYSTEMS AND PMU 10

Wide area measurement systems – Phasor Measurement Units - Optimal placement algorithm for PMUs. Smart grid experimentation plan for load forecasting. case study - Forecasting – Coordination between cloud computing and Smart power grids- Intelligent Electronic Devices (IED) & their application for monitoring & MICRO.

MODULE V RECENT TRENDS IN SMART POWER GRIDS 10

Demand Response – concepts and models-Real time pricing models for practical applications - SCADA in smart grids. Basics of Web Service and CLOUD Computing to make Smart Grids smarter - Development of power system models and control and communication software- Smart grid development in India, a case study.

L - 45 ; TOTAL HOURS- 45

TEXT BOOKS:

1. Ali Keyhani :" Design of Smart Power Grid Renewable Energy Systems ", First Edition , John Wiley Inc., 2011
2. Tony Flick and Justin Morehouse : "Securing the Smart Grid –Next generation Power Grid security ", Elsevier Publications,2011.
3. Krzysztof Iniewski: Smart Grid Infrastructure and Networking , 1st Edition , McGraw Hill, 2012.
4. Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012.

REFERENCES:

1. Stephen F Bush Smart Grid Communication – Enabled Intelligence for Electric Power Grid, Wiley IEEE., 2014
2. James Momoh : Smart Grids , Fundamentals of Design and Analysis, Wiley IEEE Press, 2014.
3. Mini . S. Thomas :Power System SCADA and Smart Grids, CRC Press, 2015.
4. Kenneth . C.Budka, Jayant G.Deshpande :Communication Networks for Smart Grids: Making Smart Grid Real , Springer, 2014.
5. https://www.iitk.ac.in/npsc/Papers/NPSC2014/1569993451.pdf

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: design and implement smart Power Grid Power Systems.

CO2: apply the concept of demand response in Smart grids.

CO3: apply smart grid concepts to real time applications.

CO4: implement optimal location strategies of PMU in smart grids.

CO5: coordinate the use of cloud computing application for smart grids.

Board of Studies (BoS):

17th BoS of EEE held on 15.07.2022

Academic Council:

19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	M	L	L	H	L	-	-	-	-	-	-	L	H	M
CO2	M	L	M	H	L	-	-	-	-	-	-	L	H	M
CO3	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO4	H	H	M	H	L	-	-	-	-	-	-	L	H	M
CO5	H	H	M	L	L	-	-	-	-	-	-	L	H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 8: Decent work and economic growth.
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Build resilient Infrastructure, to support economic development and human well being with a focus on affordable and equitable access for all.
Statement : The complete understanding of smart grid will lead to sustainable industrialization and promote economic development.

SDG 12: Responsible consumption and production.
Statement: Use of smart metering and management result in reasonable consumption and production.

EEDX 62	SOLAR ENERGY TECHNOLOGY	L	T	P	C
SDG: 7, 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn about the implication of solar energy and its concepts in solving numerical problems pertaining to solar radiation geometry.

COB2: To acquire in-depth understanding of design parameters to help design and simulate the performance of a solar PV power plant

COB3: To explore the features and benefits of PV systems that operate independently of the electric utility grid and operate in parallel with the electric utility grid.

COB4: To learn the features and benefits of flat plate collectors and its applications.

COB5: To study the importance of conservation and energy efficiency as they relate to PV system applications and energy storage.

MODULE I INTRODUCTION TO SOLAR ENERGY 9

Energy scenarios - Overview of energy conversion devices and applications- Physics of propagation of solar radiation from the sun to earth - solar radiation geometry: solar radiation and sunshine measuring instruments-Geometry, angles and measurement. Solar radiation Estimation: Estimation of radiation under different climatic conditions-estimation of radiation in horizontal and inclined surface.

MODULE II FUNDAMENTALS OF PHOTOVOLTAIC CONVERSION 9

Fundamentals of PV cells - Semiconductor Physics - Performance characterization of PV cells - photovoltaic modules and arrays.

MODULE III STANDALONE AND GRID CONNECTED PV SYSTEM 9

Standalone PV System: Components of standalone PV system- Design of standalone PV system. Grid connected PV system: Functioning and components of Grid connected PV system- Design of a Grid connected PV system - performance analysis of a Grid connected PV system.

MODULE IV FLAT PLATE COLLECTORS 9

Basics of thermal collectors- basics of heat transfer- solar collector losses and loss estimation - analysis of flat plate collector- influence of various parameters on the performance of Liquid Flat Plate Collector(LFPC)- testing and application of LFPC.

MODULE V THERMAL ENERGY STORAGE AND 9

APPLICATIONS OF SOLAR ENERGY

Sensible heat, latent heat and thermo chemical energy storage- Solar pond - solar pond power plant design. Solar Air heaters- performance analysis. solar energy applications in cooking , desalination, refrigeration and electricity generation.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Solar Energy- Principles of thermal collection and storage by S.P Sukhatme, Tata McGraw-Hill, New Delhi, 2006.

REFERENCES:

1. Solar Engineering of Thermal Processes by JA Duffie and WA Beckman, John Wiley, NY, 2011.
2. Fundamentals of Solar Cells: PV Solar Energy Conversion by AL Fahrenbruch and RH Bube, Academic Press, New York, 1983.
3. Principles of Solar Engineering by F Kreith and JF Kreider, McGraw-Hill., 1978.
4. Solar Photovoltaics. Fundamental Technologies and Application by Chetan Singh Solanki, PHI Publication, 2015.

COURSE OUTCOMES:

At the end of this course, the student will be able to

CO1: explain the principles that underlie the ability of various natural phenomena to deliver solar energy.

CO2: develop basic knowledge on the photo voltaic conversion systems.

CO3: solve the issues in grid connected PV systems.

CO4: design and evaluate different solar collectors and their performance.

CO5: implement the various methods of energy storage.

Board of Studies (BoS):

17th BoS of EEE held on 15.07.2022

Academic Council:

19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	L	-	-	-	-	-	-	-	-	H	L
CO2	H	H	H	H	-	-	-	-	-	-	-	-	H	L
CO3	M	M	M	M	-	-	-	-	-	-	-	-	M	M
CO4	M	M	M	M	-	-	-	-	-	-	-	-	M	M
CO5	M	M	M	M	-	-	-	-	-	-	-	-	H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 7: Affordable and Clean Energy

Ensure access to affordable, reliable, sustainable and modern energy for all

Statement : Solar energy systems contribute to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.

SDG 8: Decent Work and Economic Growth

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: Decent Work and Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering stay in the area and support the economic growth and viability of local companies.

		L	T	P	C
EEDX 63	**MACHINE LEARNING**	**L**	**T**	**P**	**C**
SDG: 3, 7, 8, 9 & 11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To study the basic concepts and techniques of Machine Learning.

COB2: To gain knowledge on the Supervised and Unsupervised learning techniques.

COB3: To study the various probability based learning techniques.

COB4: To understand dimensionality reduction and evolutionary models.

COB5: To understand graphical models of machine learning algorithms.

MODULE I INTRODUCTION 9

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

MODULE II LINEAR MODELS 9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

MODULE III TREE AND PROBABILISTIC MODELS 9

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.

MODULE IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis –

Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.

MODULE V GRAPHICAL MODELS 9

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Stephen Marsland, Machine Learning An Algorithmic Perspective‖, Second Edition, Chapman and Hall / CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, Machine Learning‖, First Edition, McGraw Hill Education, 2013.

REFERENCES:

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
2. Jason Bell, Machine learning, Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014.
3. Ethem Alpaydin, Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: distinguish between, supervised, unsupervised and semi-supervised learning.

CO2: apply the exact machine learning strategy for any given problem.

CO3: suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.

CO4: design systems that uses the appropriate graph models of machine learning.

CO5: modify existing machine learning algorithms to improve classification efficiency.

Board of Studies (BoS):
17th BoS of EEE held on 15.07.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	L	M	M	M	M	-	-	M	-	-	-	-	M	L
CO2	M	H	H	H	H	-	-	M	-	-	-	L	L	M
CO3	M	H	H	H	H	-	-	M	-	-	-	L	L	M
CO4	M	H	H	H	H	-	-	M	-	-	-	-	M	M
CO5	M	H	H	H	H	-	-	M	-	-	-	-	M	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 3: Good health and well-being.
Statement: Understanding of the machine learning techniques can help in designing systems to promote good health and well-being.

SDG 7: Affordable and Clean Energy
Statement: Knowledge on artificial intelligence can help in the analysis of affordable and clean energy systems.

SDG 8: Decent work and economic growth
Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 9: Industry, innovation and infrastructure
Statement: The knowledge on this course would result in new innovative systems for industry and establishing advanced communication infrastructure.

SDG 11: Sustainable cities and communities.
Statement: Use of machine learning learnt through this course can play a major role in establishing sustainable cities and communities.

EEDX64	COST ECONOMICS OF RENEWABLE ENERGY SYSTEMS	L	T	P	C
SDG: 7,8		3	0	0	3

COURSE OBJECTIVES:		
COB1: To impart knowledge on the world and Indian energy scenario		
COB2: To learn the basics of economic analysis of solar energy systems		
COB3: To educate the students about the economics of wind energy		
COB4: To study the biomass based energy projects for their economic profitability		
COB5: To plan the India's future needs of electricity		
MODULE I	**ENERGY SCENARIO**	**6**
Introduction- World's production and reserves of commercial energy sources: Fossil fuels, coal, oil, natural gas - water power- nuclear power- other sources - Electricity production in the world- annual production of energy - India's energy production and reserve.		
MODULE II	**ECONOMIC ANALYSIS OF SOLAR ENERGY SYSTEMS**	**10**
Introduction - Initial and annual costs - payback period - present worth calculation - repayment of loan in equal annual instalments- economic analysis of a standalone renewable energy system - economic analysis of an add-on renewable energy system - levelized cost of electricity - clean development mechanism.		
MODULE III	**ECONOMICS OF WIND ENERGY**	**12**
Factors influencing the wind energy economics : site specific factors , machine parameters, energy market, incentives and exemptions. The present worth approach - cost of wind energy : initial investment , operation and maintenance cost - present value of annual costs. Benefits of wind energy - Yardsticks of economic merits: Net Present Value (NPV) - benefit cost ratio - payback period - internal rate of return- tax deduction due to investment depreciation.		
MODULE IV	**ECONOMIC ASSESSMENT OF BIOMASS BASED POWER GENERATION**	**11**
Biomass types and characterization - Biochemical conversion processes - Bioconversion of substrates into alcohol and thermo-chemical conversion of biomass - Basics of economic assessment of a biomass based power generation system : Economic analysis and use of discounted cash flow - Tools used for economic performance analysis - Life cycle cost analysis - NPV analysis - Internal rate of return analysis - Discounted payback period - Levelized Cost Of Energy (LCOE) - Profitability Index (PI) - case studies.		
MODULE V	**ESTIMATION OF INDIA'S FUTURE NEEDS OF ELECTRICITY**	**6**
India's future needs of electricity- Mean Annual Per Capita Needs of Electricity (MACE) in the future - Distribution of annual per capita value. Energy alternatives: the need - solar energy option - nuclear energy option - Miscellaneous sources.		
	L – 45; TOTAL HOURS – 45	

TEXT BOOKS:

1. S.P. Sukhatme, J.K.Nayak, "Solar Energy", 4th Edition, Tata McGraw Hill, 2018.
2. Khan B. H., Non-Conventional Energy Resources, 2 nd Edition, Tata McGraw-Hill Education Pvt. Ltd. 2009.
3. Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Elsevier, 2013.

REFERENCES:

1. The Economics of Renewable Energy, Roger Fouquet , Edward Elgar Publishing, Incorporated , 2018. ISBN: 9781786437365, 1786437368
2. Ahmad Taher Azar, Nashwa Ahmad Kamal, Renewable Energy Systems: Modelling, Optimization and Control. (2021). Netherlands: Elsevier Science.
3. Abdul Malek ABM et al. Energy, economic, and environmental analysis of 10-MW biomass gasification based power generation in Malaysia. Energy & Environment. 2021;32(2):295-337
4. A. Malek, "Economic Assessment of Biomass Based Power Generation", in Biomass, Biorefineries and Bioeconomy. London, United Kingdom: IntechOpen,2022. https://www.intechopen.com/chapters/81162 doi: 10.5772/intechopen.103692
5. Evans A, Strezov V, Evans TJ. Sustainability considerations for electricity generation from biomass. Renewable and Sustainable Energy Reviews. 2010;14(5):1419-1427

COURSE OUTCOMES: At the end of the course, the student is expected to

CO1: assess the energy scenario

CO2: conduct economic analysis on solar energy systems

CO3: perform economic assessment on wind energy systems

CO4: elucidate the economic assessment on bio-mass based power generation

CO5: estimate the future electricity needs of India through economic analysis

Board of Studies (BoS) :	Academic Council:
18th BoS of EEE held on 10.02.2023	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	L	H	L	L	M	-	-	-	-	-	-	L	H	L
CO2	H	L	L	L	L	-	-	-	-	-	-	L	L	H
CO3	L	H	M	L	M	-	-	-	-	-	-	L	M	M
CO4	M	L	H	L	L	-	-	-	-	-	-	L	L	L
CO5	L	L	L	L	H	-	-	-	-	-	-	L	L	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 7 : Affordable and Clean Energy
Statement: Renewable energy systems contribute to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.
SDG 8 : Decent Work And Economic Growth
Statement: Decent Work And Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering support the economic growth and viability of local companies.

EEDX 65	**DIGITAL ELECTRICAL CONTROL SYSTEM FOR MODERN BUILDINGS**	**L**	**T**	**P**	**C**
SDG: 7,8		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To discuss the need of Digital Electrical Control System for modern buildings.

COB2: To impart knowledge on Digital Electrical Control System components.

COB3: To equip the students with the Digital Control System Architecture and Application functions.

COB4: To familiarize the Digital Control System connectivity to other Systems.

COB5: To understand the advanced applications and futuristic functions of Digital Control System.

MODULE I	**INTRODUCTION**	**9**

Definition of Digital Electrical Control System and its need in Modern buildings such as high-rise towers, Factories, Airports, Ports, Railways, Hospitals &Data Centres -Operational benefits of Digital Electrical Control System-Financial benefits of Digital Electrical Control System-Implementation cost vs Return of Investment (ROI)-Meet performance specifications for energy management and sustainability-Extension of asset life- IEEE 1451 & IEC 61499 family of standards.

MODULE II	**DIGITAL CONTROL SYSTEM COMPONENTS**	**9**

Types of Sensors integrated with Digital Electrical Control System- connected data driven Sensors - Nature of Data collected from the sensors- Need for integrating Data driven Sensors with Digital Electrical Control System -Digital Electrical Control System connectivity with MV/LV Switchgears, RTUs, Relays, Power Distribution Units, LV Motor control centre (MCC), LV Power control centre boards (PCC), Energy meters, Inverters, UPS etc (hardwired or protocol connected)- Communication Protocols.

MODULE III	**SYSTEM ARCHITECTURE AND APPLICATION FUNCTIONS**	**9**

Digital Electrical Control System applications and Architectures- Electrical Distribution System monitoring & Controls- Electrical SLD visualization &Control -Primary Equipment (CB, ISO, Pumps, Transformer and other mechanical equipment monitoring)- Alarms management -, Outgoing feeders and availability of power to feed the loads- Automatic functions (Bus bar transfer, Bus section transfer, load transfer, Power & frequency load shedding, Capacitor bank switching) - Protection Relays integration for fault monitoring- Remote terminal Units (RTU)/ Controllers integration for hardwired and protocol connected data - Analysis of fault disturbance records- Sequence of Events during normal & fault condition- Energy metering integration-billing, energy import/export and efficiency monitoring.

MODULE IV	**CONNECTIVITY TO OTHER SYSTEMS**	**9**

Transversal connectivity to other Control Systems such as chiller /boiler controls, HVAC controls, Fire Alarm System, Security surveillance Systems- Upper layer connectivity to Management information System (MIS) or Analytics platforms e.g. cloud-based analytics - Physical security integration in Digital Electrical Control System (Electronic perimeter fencing, access controls, surveillance cameras, Intrusion detection & prevention)- Systems Integration connectivity with Public Address System, Telephony, EPABX.		
MODULE V	**ADVANCED APPLICATION FUNCTIONS**	**9**
Smart Grid connectivity- Distributed energy resource and energy storage-Advanced Metering Systems-green initiatives, - - Renewable integration and Distributed energy management System (demand & forecasting)-Cyber Security Implementation-Cyber Security integration (Malicious Intrusions, Cyber-attacks, Role based access, defence in depth).		
		L – 45; TOTAL HOURS – 45

TEXTBOOKS:

3. Mini S Thomas & John D MCDonald , Power System SCADA & Smart Grids , CRC press, 2015.
4. ShengweiWang , Intelligent Buildings and Building Automation , Spon Press, 2010.

REFERENCES:

5. EvelioPadilla , Substation Automation Systems Design and Implementation , John Wiley & Sons, Ltd, 2016.
6. Ali Keyhani , Design of smart power grid renewable energy systems , John Wiley & Sons, Ltd, 2019.
7. H. Lee Willis, Robert G. Wilson, James Northcote-Green, Robert G. Wilson, Control and Automation of Electrical Power Distribution Systems , CRC press, 2017.
8. Hermann Merz, Thomas Hansemann, Christof Hübner, Building Automation, Communication systems with EIB/KNX, LON and BACnet, Springer Cham, 2007.
9. John T. Wen (Editor), Sandipan Mishra, Intelligent Building Control Systems: A Survey of Modern Building Control and Sensing Strategies (Advances in Industrial Control), Springer, 2017.

COURSE OUTCOMES: At the end of the course, the student is expected to

CO1: describe the need for Digital Electrical Control System

CO2: analyze the various system components & blocks of a Digital Electrical Control System

CO3: compare the differenttypes of system architectures and various case applications

CO4: apply Digital Electrical Control System

CO5: diagnose possible futuristic Digital Electrical Control System application functions

Board of Studies (BoS) :	**Academic Council:**
18th BoS of EEE held on 10.02.2023	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	M	L	L	M	M	-	-	-	-	-	-	L	L	L
CO2	L	M	L	L	M	-	-	-	-	-	-	L	M	M
CO3	H	H	H	M	M	-	-	-	-	-	-	L	H	H
CO4	M	H	H	M	M	-	-	-	-	-	-	L	H	H
CO5	M	H	H	H	M	-	-	-	-	-	-	M	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 7 : Affordable and Clean Energy
Statement: Renewable energy systems contribute to clean sustainable energy, by generating, storage and transport electricity and help to produce climate neutral power to the world.
SDG 8 : Decent Work And Economic Growth
Statement: Decent Work And Economic Growth is supported via an increasing supply of competent engineers who will help solve the challenges of the future in all areas of everyday life. Most of the engineers graduated from Electrical Engineering support the economic growth and viability of local companies.

PHYSICS ELECTIVE

PHDX 01	**NON DESTRUCTIVE TESTING OF MATERIALS**	**L**	**T**	**P**	**C**
SDG: 4	**(common to Civil, Mechanical, Automobile and Aero)**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the importance, principle, concept and inspection methods of various surface NDT methods and develop the skills of interpretation of results effectively.

COB2: To study the working and instrumentation of thermography and eddy current testing methods and apply to interpret the results and investigate the possible defects.

COB3: To get full exposure about principle, instrumentation and standards of various radiographic NDT methods and improve the skill to identify the defects suitably.

COB4: To get deep insight into the principle, types of waves, instrumentation, standards, calibration methods of ultrasonic NDT methods.

COB5: To understand the importance, principle, concept and inspection methods of various surface NDT methods and develop the skills of interpretation of results effectively.

MODULE I SURFACE NDT METHODS 7

Liquid Penetrant Inspection – Principles, Types of dye and methods of application,developers, advantages and limitations of various methods, Interpretation of results. Magnetic Particle Inspection- Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Interpretation of field indicators, Particle application, Inspection,Residual magnetism Principles and methods of demagnetization.

MODULE II THERMOGRAPHY AND EDDY CURRENT TESTING 7

Thermography- Principles, Contact and non contact inspection methods, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Applications, advantages, Limitations, Interpretation/Evaluation.

MODULE III RADIOGRAPHY 8

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square law, characteristics of films -graininess, density, speed, contrast, characteristic curves. Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Digital Radiography.

MODULE IV ULTRASONIC TESTING 8

Ultrasonic Testing: Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, Calibration methods, use of standard blocks, technique for normal beam inspection.

L – 30; Total Hours –30

TEXT BOOKS:

1. ASM Metals Handbook,Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, 2018.
2. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.

REFERENCES:

1. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010.
2. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition New Jersey, 2005.
3. Charles, J. Hellier, Handbook of Nondestructive evaluation, McGraw Hill, New York 2001.
4. B.P.C. Rao, Practical Eddy Current Testing, Alpha Science International Limited (2006).

COURSE OUTCOMES:

CO1: Demonstrate the importance, principle, concept and inspection methods of various surface NDT methods and apply the same to interpret the results effectively.

CO2: Comprehend the ideas behind working of thermography and eddy current testing methods and apply them to interpret the results of testing and analyse the defects and problem.

CO3: Grasp the fundamental principles, and standards of various radiographic NDT methods and utilise them to identify the defects and defect location suitably.

CO4: Assimilate the ideas concerning the principle, types of waves, instrumentation, standards, calibration methods of ultrasonic NDT methods and identify the areas for their application.

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 02	**MATERIALS SCIENCE FOR ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 4	(For Polymer)	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To impart knowledge on the fundamentals of materials science and engineering.

COB2: To provide a basis for understanding properties and applications of dielectric materials.

COB3: To expose the students to different classes of materials, their properties, structures and imperfections

COB4:To aid the teaching learning process through relevant illustrations, animations, web content and practical examples

MODULE I CLASSIFICATION OF MATERIALS 6

Concept of amorphous, single crystals and polycrystalline materials, crystallinity and its effect on physical properties, metal, ceramic, polymers, classification of polymers, structure and properties, additives for polymer products, effect of environment on materials, composites

MODULE II PROPERTIES OF MATERIALS 10

Mechanical Properties: Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture- Electronic Properties:Free electron theory, Fermi energy, density of states, band theory of solids, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials - Magnetic Properties: Origin of magnetism in metallic and ceramic materials, para-magnetism, diamagnetism, ferro and ferrimagnetism- Thermal Properties: Specific heat, thermal conductivity and thermal expansion, thermoelectricity- Optical Properties: Refractive index, absorption and transmission of electromagnetic radiation in solids, electro-optic and magneto-optic materials.

MODULE III CRYSTALLOGRAPHIC STRUCTURES AND IMPERFECTIONS 7

Crystal symmetry, point groups, space groups, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals.

MODULE IV THERMODYNAMICS AND KINETICS 7

Phase rule, phase diagrams, solid solutions, invariant reactions, lever rule, basic heat treatment of metals, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, temperature dependence of diffusivity.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

REFERENCES:

1. William D. Callister, Jr., David G. Rethwisch, Materials Science and Engineering, Edition 9, Wiley, 2014.
2. Michael F. Ashby, David R.H. Jones , Engineering Materials 1 An Introduction to Properties, Applications and Design · Volume 1, Elsevier Science, 2012
3. Michael F. Ashby, David R.H. Jones , Engineering Materials 2: An Introduction to Microstructures, Processing and Design · Volume 2, Elsevier Science, 2013
4. Reza Abbaschian, Robert E. Reed-Hill, Physical Metallurgy Principles - SI Version, Cengage Learning, NY, 2009
5. "Encyclopedia of Polymer Science and Technology" 3rd Edition, Vol.1-12, Wiley Interscience , 2003

COURSE OUTCOMES

At the end of the course, students will be able to

CO1. select suitable material for specific application.

CO2. analyse crystallographic structure of metals and their imperfections.

CO3. develop metal alloys with varying properties by selecting suitable heat treatment

CO4. correlate the various properties of material with their structure.

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 21.6.21	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 03	**BIOMATERIALS**	**L**	**T**	**P**	**C**
SDG: 4	*(For Biotechnology)*	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To gain basic knowledge in classification of biomaterials and their properties.

COB2: To provide a basis for understanding properties of metallic implant materials.

COB3: To enable the students to correlate theoretical principles with practical applications.

COB4:To help students understand biocompatibility & toxicological screening of biomaterials

MODULE I INTRODUCTION TO BIOMATERIALS 8

Introduction: Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Surface properties of materials, physical properties of materials, mechanical properties-Materials for biophotonic applications.

MODULE II IMPLANT MATERIALS 10

Metallic implants: Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion-ceramic implants : bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics-Polymer implants: Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin.

MODULE III BIOCOMPATIBILITY AND TOXICOLOGICAL SCREENING OF BIOMATERIALS 6

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ-implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

MODULE IV PRACTICAL ASPECTS OF BIOMATERIALS 6

Preparation of biomaterials - Microscopic study & analysis of different biomaterials- alginate – material preparation and characterization - Testing of various biomaterials- case studies on industrial and clinical applications of biomaterials.

L – 30; Total Hours –30

TEXT BOOKS:

1. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill, 2003
2. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. Implant biomaterials: A comprehensive review, World Journal of Clinical Cases, 2015

REFERENCES:

1. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, Introduction to Biomedical Engineering, Elsevier, 2005.
2. Park J.B., Biomaterials Science and Engineering, Plenum Press, 2007.
3. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,Woodhead Medical Textiles and Biomaterials for Healthcare, Publishing Limited 2006.
4. D F Williams, Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume, VCH Publishers 1992.

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: differentiate common use of biomaterials as metals, ceramics, polymers and apply them to classify its chemical structure, properties and morphology.

CO2: comprehend ideas involving general properties of implant materials and apply the same to identify the benefits of implant materials.

CO3: attain knowledge about the biocompatibility & toxicological screening of biomaterials and realize its usage in real life.

CO4: reflect upon the practical ideas of using biomaterials

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 21.6.21	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	L	L	M	M	M	L	L	L	M	-	-	-
CO3	M	L	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	M	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

		L	T	P	C
PHDX 04	**OPTICAL FIBRE COMMUNICATION** *(Common to EEE, ECE, and EIE)*	**2**	**0**	**0**	**2**

SDG: 4

COURSE OBJECTIVES:

COB1: To facilitate the knowledge about optical fibres and its transmission characteristics.

COB2: To make the students to learn about LED and laser diodes.

COB3: To make the students understand the various types of opticalReceiversand sensors.

COB4: To enrich the knowledge on optical amplifiers and networks.

MODULE I INTRODUCTION TO OPTICAL FIBRES 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers.

MODULE II FIBER OPTICAL SOURCES 7

Light Emitting Diodes (LED) – power and efficiency - double hetero LED – LED structure - LED characteristics – Semiconductor Lasers diode, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers - applications.

MODULE III FIBER OPTICAL RECEIVERS AND SENSORS 8

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode Avalanche Photodiode (APD) characteristics - APD design of detector arrays – Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells - Fiber optic sensors: Intrinsic and Extrinsic sensors, amplitude, phase, wavelength and polarization modulation.

MODULE IV OPTICAL AMPLIFIERS AND NETWORKS 8

Optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers - Optical Networks: Basic networks, SONET/SDH, WDM Networks, Nonlinear effects on network performance, Performance of WDM + EDFA systems, Solitons, Optical CDMA, Ultrahigh capacity networks.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Gerd Keiser, Optical Fiber Communication, 3rd Edition, McGraw-Hill International, Singapore, 2013.

REFERENCES:

1 Govind P. Agrawal, Fiber-Optic Communication Systems (Wiley Series in Microwave and Optical Engineering) , Wiley 4th Edition, 2010.
2 J. Senior, Optical Communication, Principles and Practice, Prentice Hall of India, 3rd Edition, 2010.
3 D. C. Agrawal, Fiber Optic Communication, S.Chand& Co Ltd., 2005.
4 Rajiv Ramaswami, KumarSivarajan, Galen Sasaki, Optical Networks: A Practical Perspective, 3rd Edition, Morgan Kaufmann, 2009.
5 B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd, 2014.

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: realize basics of optical fiber and differentiate various modes andconfigurations.

CO2: understand and assimilate the working principle of LED andDiode Laser.

CO3: select suitable photodetectors/sensorsfor different types of applications.

CO4: analyze the mechanism of optical amplifiers and analyze opticalnetworks.

Board of Studies (BoS) :

BOS of Physics was held on 21.6.21

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

		L	T	P	C
PHDX 05	**SEMICONDUCTOR PHYSICS FOR INFORMATION TECHNOLOGY**	**L**	**T**	**P**	**C**
SDG: 4	*(Common to CSE, CS, IT and AI-DS)*	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the physics of semiconductor devices

COB2: To gain knowledge on various methods involved in nano fabrication of semiconductor devices

COB2: To study the working principle of optoelectronic devices and various display devices

COB4: To get insight to different types of data storage technologies

MODULE I INTRODUCTION TO SEMICONDUCTOR DEVICES 6

Semiconductors: N and P type, PN junction diode under forward and reverse bias –– Zener diode, Schottky diode – Tunnel diode –bipolar junction transistor (BJT) - metal–oxide–semiconductor field-effect transistor (MOSFET), CMOS-concepts and fabrication.

MODULE II FABRICATION OF SEMICONDUCTOR DEVICES 6

Deposition of Semiconductor thin films – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD),magnetron sputtering,Types of lithography:Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

MODULE III OPTOELECTRONIC DEVICES 10

Light Emitting Diodes (LED) - double hetero LED structure - LED characteristics - White LED – Applications, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical detection – PIN and avalanche photodiodes, Applications: Optical mouse, traffic lights, Luminescence, Cathode Luminescence, Electro Luminescence, Transparent Conductors, Liquid crystal displays – Dynamic scattering and Twisted nematic display, Display Glasses, Organic LEDs display, Charge-coupled devices (CCD), Inorganic Semiconductor TFT Technology, Organic TFT Technology; Flexible Displays, Touch Screen Technology.

MODULE IV MEMORY STORAGE DEVICES 8

Introduction to memory storage, Resistive Random Access Memory (ReRAM), Phase Change Memory (PCM); Magnetoresistive Random Access Memory

(MRAM)- Gaint Magnetoresistance (GMR), Tunnel Magnetoresistance (TMR), Ferroelectric Random Access Memory (FeRAM); Comparison and future directions, Hardware circuits, working analysis.

L – 30; Total Hours – 30

TEXT BOOKS:

1) W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2) Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3) D. S. Dhaliwal et al., Prevail : Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.

REFERENCES:

1. V.K. Mehta, Rohit Mehta, Principles of Electronics (Multicolour Edition) S. Chand Publishers, 10th Rev. Edn. 2006 Edition
2. Albert Malvino, David J. Bates Electronic Principles (SIE), McGraw Hill, 7th Edition, 2017
3. U. Mishra, J. Singh, Semiconductor Device Physics and Design, Springer, 2014
4. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, Wiley Publishers, 3ed 2008.
5. Bhattacharya Pallab, Semiconductor Optoelectronic Devices, Second Edition, By Pearson 2017
6. Joseph A. Castellano, Handbook of Display Technology, Springer, 1992
7. Yoshio Nishi, Advances in Non-volatile Memory and Storage Technology, Elsevier 2014

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: understand the physics of semiconductor devices and identify its significance towards information technology (IT).

CO1: gain insight into various fabrication techniques towards therealization of nano-dimensional semiconductor devices.

CO2: attain knowledge on working principles of optoelectronic devices and display technologies and can recognize their importance in commercial applications.

CO4: learn the principle of data storage and its application towards futuristic memory technology.

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 06	**SENSORS AND ACTUATORS**	**L**	**T**	**P**	**C**
SDG: 4	*(For CSE-IOT)*	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the basic concept of sensors towards detection of pressure, position, velocity and temperature.

COB2: To avail knowledge on sensor which are sensitive to light, magnetic field, and acoustic waves

COB3: To study the different types of fabrication techniques towards realization of various sensors.

COB4: To get introduced towards MEMS technology and various actuators.

MODULE I INTRODUCTION TO SENSORS: PRESSURE, POSITION, VELOCITY AND TEMPERATURE 8

Introduction to sensors – working principles– classification – static and dynamic characteristics, Error Analysis, Pressure sensors – strain gauge, piezoelectric force sensor, vacuum sensors, Position sensor -Proximity sensor, Capacitive, Inductive and displacement sensor, velocity and acceleration sensors, Temperature sensor-thermocouples- thermistors-Thermo-EMF Sensors, metal Junction and metal Semiconductor junction types.

MODULE II SENSORS : LIGHT, MAGNETIC FIELD AND ACOUSTIC 8

Photocondutors- Optical Detectors - Photodiodes, Phototranistors, Optical encoder-Charge Coupled Device (CCD), Fabry Perot sensor, Hall effect, magneto resistive, magneto strictive sensors, Acoustic sensors-microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.

MODULE III SENSORS FABRICATION TECHNIQUES 7

Fabrication techniques – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD),magnetron sputtering,Types of lithography:Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

MODULE IV MICROSYSTEMS AND ACTUATORS 7

Microelectro-mechanical systems (MEMS) - RF- MEMS, Micro fabrication and Applications, Classification of transducers: electrostatic, piezoelectric, thermal, Microsystem design and fabrication.working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications Solid-state switches, relays Solenoids, D.C. Motors, A.C. Motors, Stepper motors. Shape memory alloy actuators.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jacob Fraden, Hand Book of Modern Sensors: physics, Designs and Applications, 3rd edition, Springer, New York, 2015.
2. Jon. S. Wilson, Sensor Technology Hand Book, 1st edition, Elsevier, Netherland, 2011.
3. John G Webster, Measurement, Instrumentation and sensor Handbook, 2nd edition, CRC Press, Florida, 2014.

REFERENCES:

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2. Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3. D. S. Dhaliwal et al., PREVAIL: Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.
4. Tai-Ran Hsu, MEMS & Microsystem, Design and Manufacture, 1st ed., McGraw Hill India, New Delhi, 2017.
5. MassoodTabibArar, Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures, 1st ed., Kluwer Academic publishers, New York, 2014.

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: get exposed to various types of sensors and apply the ideas to distinguish between pressure, position, velocity and temperature based sensors

CO2: familiarize towards light, magnetic field, and acoustic based sensors and recognize their importance in commercial applications.

CO3: gain insight into various fabrication techniques towards the realization of sensors

CO4: apply the ideas to conceptualize MEMS technology and different actuators in engineering field

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	L	L	M	M	M	L	L	L	M	-	-	-
CO3	M	L	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	M	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 07	**FUNDAMENTALS OF NANOTECHNOLOGY AND ITS APPLICATIONS**	**L**	**T**	**P**	**C**
SDG: 4		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of Nanoscience through quantum mechanical theories and solid state physics.

COB2: To provide knowledge about the various synthesis methods applicable to different nano materials

COB3: To enrich the knowledge of students in various characterisation techniques.

COB4: To provide knowledge on applications of poymer based nano materials in various fields.

MODULE I BASICS OF NANO SCIENCE 7

Introduction to Nanoscience & Nanotechnology: Review of classical mechanics – overview Quantum Mechanics. Background to nanoscience and nanotechnology - scientific revolutions - nanosized effects – surface to volume ratio – atomic structure – molecular and atomic size - quantum effects - formation of nano sized particles – energy at the nanoscale.

MODULE II SYNTHESIS OF NANOMATERIALS 8

Nanomaterial Fabrication: Bottom-up vs. top-down - Preparations of Nanomaterials by mechanical and physical methods : – High energy ball milling – melt quenching and annealing – vapour deposition – Pulsed laser deposition – Magnetron sputtering - Microwave plasma evaporation. Chemical Methods of Preparation : Sol-gel method –Electrodeposition – Electrospinning. Arc method for carbon nanotubes – nanofibres and rods – synthesis of Graphene- Handling of nano particles - Health hazards – Precautions.

MODULE III CHARACTERIZATION OF NANOMATERIALS 8

Characterisation of Nanomaterials: XRD – particle size determination - SEM - FESEM - TEM – AFM – Nanoindentor – UV-VIS spectroscopy – FTIR, FT-Raman, Photoluminescence, NMR, ESR - Dielectric characterization – Magnetic characterization.

MODULE IV APPLICATION OF NANO MATERIALS 7

Applications of Carbon based nanomaterials (CNT, CNF, Graphene) - Biosensor (principle, component, types, applications) - agriculture (nano-fertilizers, herbicides, nano-seed science, nano-pesticides) and food Systems (encapsulation of functional foods, nano-packaging) – Nano - electronics, Nano-optics.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

REFERENCES:

1 Nanotechnology: basic science and emerging technologies by Mick Wilson, Kamali Kannangara, Geoff Smith, and Michelle Simmons, Chapman & Hall/CRC; I edition, 2002.

2 Handbook of NanoScience, Engineering and Technology by Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., CRC Press, 2012.

3 Nanocomposite Science and Technology by P. M. Ajayan, L. S. Schadler, P. V. Braun, WILEY-VCH Verlag GmbH, 2003.

4 Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: understand basic principles of nanomaterials and apply them todifferentiate the significance of nanomaterials compared to bulk materials.

CO2: familiarize the various synthesis methods of nanomaterials andcompare them with the preparation of materials in bulk form.

CO3: get useful ideas about characterization techniques and differentiatedifferent techniques.

CO4: understand the various applications of nanomaterilas and realize the role of nanomaterials in various fields

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 21.6.21	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

MATHEMATICS ELECTIVE
(SEMESTER III)

		L	T	P	C
MADX 02	**DISCRETE MATHEMATICS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To introduce logical and mathematical ability to deal with abstraction

COB2: To acquaint with the concepts of predicate calculus.

COB3: To introduce the notations and concepts used in set theory

COB4: To apply and use the terms function, domain, codomain, range, image, inverse image and composition

COB5: To introduce basic concepts from abstract algebra, especially the essential concepts in group theory

MODULE I PROPOSITIONAL CALCULUS 9+3

Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and contradictions – Contrapositive – Logical equivalences and implications – DeMorgan's Laws – Normal forms – Principal conjunctive and disjunctive normal forms – Rules of inference – Arguments – Validity of arguments.

MODULE II PREDICATE CALCULUS 9+3

Predicates – Statement function – Variables – Free and bound variables – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

MODULE III SET THEORY 9+3

Basic concepts –Notations-Subset –Algebra of sets –The power set – Ordered pairs and Cartesian product- Relations on sets – Types of relations and their properties – Relational matrix and the graph of a relation – Partitions –Equivalence relations –Partial ordering –Poset – Hasse diagram – Lattices and their properties– Boolean algebra – Homomorphism.

MODULE IV FUNCTIONS 9+3

Functions – Classification of functions –– Composition of functions – Inverse functions – Binary and n–ary operations – Characteristic function of a set –

Hashing functions – Recursive functions – Permutation functions.

MODULE V ALGEBRAIC SYSTEMS 9+3

Groups, Cyclic Groups, Subgroups, Cosets, Lagrange's theorem, Normal subgroups – Codes and group codes – Basic notions of error correlation – Error recovery in group codes.

L – 45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011.
2. Kenneth H.Rosen, "Discrete Mathematics and its Applications:, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011

REFERENCES:

1. Ralph.P.Grimaldi, "Discrete and Combinatorial Mathematics: An Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Thomas Koshy, "Discrete Mathematics with Applications", Elsevier Publications, 2006.
3. C.L.Liu, D.P.Mohapatra, "Elements of Discrete Mathematics", 4th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2012.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Form truth tables and write principal normal forms

CO2: Write the negation of a quantified statement involving either one or two quantifiers.

CO3: Prove that a proposed statement involving sets is true, or give a counterexample to show that it is false.

CO4: Compute the connection between bijective functions and inverses. Be able to find the inverse of an invertible function.

CO5: Give intrinsic structure of groups both abstract and specific examples illustrating the mathematical concepts involved.

Board of Studies (BoS) :

12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M														
CO 2	M														
CO 3	H														
CO 4	M														
CO 5	M														

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

Learning of various mathematical techniques will lead to knowledge of applications in Communication Engineering

MADX 03	**PROBABLITY AND STATISTICS**	**L**	**T**	**P**	**C**
SDG:4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To impart knowledge on the basic concepts of probability

COB2: To understand random variables and distribution functions

COB3: To acquaint with joint density function and generating functions

COB4: To introduce sampling techniques and estimation

COB5: To perform hypothesis testing and draw inference

MODULE I PROBABILITY 9+3

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye's theorem - Descriptive Statistics.

MODULE II RANDOM VARIABLE AND DISTRIBUTION FUNCTIONS 9+3

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III TWO DIMENSIONAL RANDOM VARIABLES 9+3

Joint, marginal, conditional probability distributions –covariance, correlation - transformation of random variables- Generating functions.

MODULE IV SAMPLING AND ESTIMATION 9+3

Sampling distributions – basic knowledge on Random , simple random , stratified and cluster samplings – Test of Hypotheses - concepts- Point estimation and Interval estimation.

MODULE V THEORY OF INFERENCE 9+3

Large sample tests – test for single and difference on proportions, single mean, difference of means, difference of variances – confidence intervals. Small sample tests – Student's t test, F test and Chi square test on theory of goodness of fit and analyses of independence of attributes

L –45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. T.Veerarajan, "Probability and Statistics", Tata McGraw-Hill New Delhi, 2008.

2. Miller, I., Miller, M.,Freund, J. E., “Mathematical statistics”, 7th Edition, Prentice Hall International, New Jersey 1999.
3. S.P.Gupta, “Applied Statistics”, Sultan Chand & Sons 2015

REFERENCES:

1. S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, Elesvier 2016
2. S.C.Gupta and V.K.Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons New Delhi 2012
3. Arora and Arora, “Comphrensive Statistical Methods”, S. Chand, New Delhi 2007

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Do problems on probability, Baye’s theorem and descriptive statistics.

CO2: Evaluate moment generating functions and calculate probabilities using distributions.

CO3: Calculate probabilities and derive the marginal and conditional distributions of bivariate random variables

CO4: Classify random samplings and calculate point and interval estimates

CO5: : Make an informed decision, based on the results of inferential procedures

Board of Studies (BoS) :
12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M	L													
CO 2	M	L													
CO 3	M	L													
CO 4	M	L		M											
CO 5	H	L		M											

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all

Learning of various statistical methods will lead to knowledge of applications in Electronics and communication Engineering

MADX 04	**RANDOM PROCESSES**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To acquire knowledge of the theory of probability, Baye's theorem and Tchebechev inequality

COB2: To understand random variables and discrete and continuous probability distributions

COB3: To demonstrate the techniques of two dimensional random variables and its distributions

COB4: To introduce the random process, stationary, Markov process and the study of correlation functions

COB5: To study spectral analysis and Weiner-Khinchine theorem

MODULE I PROBABILITY 9+3

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye's theorem - Tchebychev's inequality.

MODULE II RANDOM VARIABLES AND ROBABILITY DISTRIBUTIONS 9+3

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III TWO DIMENSIONAL RANDOM VARIABLES 9+3

Joint, marginal, conditional probability distributions - covariance, correlation and regression lines - transformation of random variables.

MODULE IV RANDOM PROCESSES 9+3

Classification of Random process - Stationary process - WSS and SSS processes - Poisson process – Markov Chain and transition probabilities-Autocorrelation function and its properties - Cross Correlation function and its properties.

MODULE V SPECTRAL DENSITY 9+3

Linear system with random inputs – Ergodicity-Power spectral Density Function - Properties - System in the form of convolution - Unit Impulse

Response of the System – Weiner-Khinchine Theorem - Cross Power Density Spectrum.

L –45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Veerarajan T., “Probability, Statistics and Random Processes”, Tata McGraw Hill,3rd edition, New Delhi, 2008.
2. Papoulis, “Probability, Random Variables and Stochastic Processes”, 4th Edition, Tata McGraw Hill Company, New Delhi,2002.
3. S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, John Wiley & Sons, New Jersey 2007

REFERENCES:

1. Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,London,2009.
2. Trivedi K S, “ Probability and Statistics with reliability, Queueing and Computer Science Applications”,Prentice Hall of India, 2nd edition, New Delhi, 200

COURSE OUTCOMES: At the end of the course students will be able to

CO1: evaluate probability, apply Baye’s theorem and calculate bounds using Tchebechev inequality

CO2: calculate probabilities and expected values for distributions

CO3: calculate probabilities and derive the marginal and conditional distributions of bivariate random variables

CO4: evaluate stationary process, compute correlation functions and related identities

CO5: compute power spectral density functions and apply Weiner-Khinchine theorem

Board of Studies (BoS) :

12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H	L													
CO 2	M	L													
CO 3	M	L													
CO 4	H	M													
CO 5	H	M													

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9 : Sustainable Industry, innovation and Infrastructure

Learning of various techniques in Random Processes will lead to knowledge required for applying in many projects.

MADX 05	**NUMERICAL METHODS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To familiarize with the methods of solving equations numerically

COB2: To introduce interpolation techniques and finite difference concepts

COB3: To acquire knowledge on Numerical differentiation and integration

COB4: To solve ordinary differential equations numerically

COB5: To solve partial differential equations numerically

MODULE I NUMERICAL SOLUTIONS OF EQUATIONS 9+3

Bisection method - Regula Falsi method – Secant method - Fixed point iteration method - Newton's Raphson method –Gauss Elimination method - Gauss-Jordon method – Gauss Jacobi method - Gauss-Seidel method.

MODULE II INTERPOLATION 9+3

Finite difference operators – Gregory Newton's forward and backward interpolations – Cubic spline interpolation - Lagrange interpolation - Newton's divided difference formula.

MODULE III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Numerical differentiation using Newton's forward and backward formulae – Numerical integration : Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Gaussian Two Point and Three Point Quadrature formulae – Double integrals using Trapezoidal and Simpson's 1/3 rule.

MODULE IV INITIAL VALUE PROBLEMS FOR FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 9+3

Numerical solutions by Taylor's Series method, Euler's method, Modified Euler's Method - Runge – Kutta Method of fourth order – Milne's and Adam's Bashforth Predictor and Corrector methods.

MODULE V BOUNDARY VALUE PROBLEMS FOR PDE 9+3

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional

Laplace equation

L – 45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Grewal, B.S., "Numerical methods in Engineering and Science", 7th edition, Khanna Publishers,New Delhi, 2007.
2. Gerald C.F., P.O.Wheatley, "Applied Numerical Analysis" , Pearson Education, New Delhi, 2002.

REFERENCES:

1. Chapra S.C, Canale R.P. "Numerical Methods for Engineers", 5th Ed., McGraw Hill, New York, 2006.
2. Jain M.K., S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003
3. Sastry.S.S,"Introductory Methods of Numerical Analysis",Fifth Edition,PHI Learning Private Ltd., New Delhi, 2012

COURSE OUTCOMES: At the end of the course students will be able to

CO1: solve algebraic, transcendental and system of equations by numerical methods

CO2: apply various interpolation techniques and finite difference concepts

CO3: carry out numerical differentiation and integration using different methods whenever regular methods are not applicable

CO4: solve first order ODE using single and multi step methods

CO5: solve the boundary value problems in PDE by finite differences

Board of Studies (BoS) :

12th BOS of Mathematics and AS department held 23.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L													
CO2	M														
CO3	M	L													
CO4	M	L													
CO5	M	L													

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong opportunities for all

Learning of various methods in numerical analysis will lead to use of applications in many projects in Engineering.

HUMANITIES ELECTIVE –I
(III SEMESTER)

		L	T	P	C
SSDX 01	**ENGINEERING ECONOMICS AND**	**L**	**T**	**P**	**C**
SDG: 4, 8, 9,12	**MANAGEMENT**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To present the major concepts and techniques of engineering economic analysis that is needed in the decision making process by providing insights to the basic microeconomic concepts of demand, supply and equilibrium.

COB2: To generate theoretical knowledge and understanding of macroeconomic aggregates such as national income and inflation and the major challenges associated with the measurement of these aggregates.

COB3: To develop analytical and critical thinking skills on money, banking and public finance and use them to judge the appropriateness of economic development and policy options.

COB 4: To introduce the basic concepts of management and planning and highlight the contribution of planning to the attainment of organization's objectives.

COB 5: To apprise the students about important management concepts and create awareness about the corporate social responsibilities and ethical aspects.

MODULE I DEMAND AND SUPPLY ANALYSIS 9

Introduction to Engineering Economics – Engineering efficiency – Economic efficiency - Scope of Engineering Economics, Engineers' contributions to economic growth- Problem solving and decision making - Laws of Demand and Supply - Difference between Microeconomics and Macroeconomics - Equilibrium between Demand and Supply, Elasticity of Demand - Pricing strategies.

MODULE II NATIONAL INCOME AND INFLATION 8

Concepts of National Income and measurement – GDP Growth Rate - Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – Meaning of Inflation, its types causes and preventive measures.

MODULE III MONEY, BANKING AND PUBLIC FINANCE 10

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary Policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) – Economic Reforms in India – LPG Policy.

MODULE IV PRINCIPLES OF MANAGEMENT AND PLANNING 8

Nature of management and its process - Importance of Management-Functions and Principles of Management - Nature, Purpose and Kinds of Planning.

MODULE V ENGINEERING MANAGEMENT 10

Strategic Management-Manager and Environment - Globalization and Technology Intermediation, Corporate Social Responsibility of business - meaning, importance, arguments for and against Corporate Social Responsibility - Business Ethics- Role of Ethics in Engineering Practice-meaning, importance - State intervention in business - Pros and Cons of intervention.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Krugman, P, Wells, R, and Graddy, K., "Essentials of Economics", Worth Publishers, 4th Edition, New York, 2016.
2. Hussain, Moon Moon, "Economics for Engineers", Himalaya Publishing House, 1st Edition, New Delhi, India, 2015.

REFERENCES:

9. Andrew Gillespie, "Foundations of Economics", OUP Oxford, England, 2007.
10. Acemoglu, D., Laibson, D., & List, J., "Microeconomics", Pearson Education, 2nd Edition, Boston, 2017.
11. Brinkman John , "Unlocking the Business Environment", Routledge, 1st Edition, London, United Kingdom, 2010.(ISBN 9780340942079)
12. Cleaver Tony, "Economics: The Basics", Routledge, 3rd Edition, London, United Kingdom, 2014.
13. H. L. Ahuja, "Macroeconomics", S Chand Publishing; Twenty Edition, New Delhi, India, 2019.

14. Koutsoyiannis A, “Modern Microeconomics”, Palgrave Macmillan, 2nd Edition, U.K, 2003.
15. R.A. Musgrave and P.B. Musgrave, “Public Finance in Theory and Practice” , McGraw Hill Education India, Fifth Edition, India, 2017.
16. Mell Andrew and Walker Oliver, “The Rough Guide to Economics”, Rough Guide Ltd, 1st Edition, London, 2014.
17. R. Paneerselvam, “Engineering Economics”, PHI Publication, 2nd Edition, New Delhi, India, 2014.
18. Robbins S.P. Decenzo David A and Coulter, “Fundamentals of Management: Essential Concepts and Applications”, Pearson Education, 9th Edition, London, England, 2014.

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

CO1: Interpret the forces driving demand and supply and their impact on market conditions.

CO2: Demonstrate various dimensions of macroeconomic variables like national income, money supply, employment, etc. in analyzing the effects on business.

CO3: Explicate the different aspect of Governmental activities and their rationality and describe how they can be pursued through fiscal and monetary policy.

CO4: Develop skills to plan, organize, direct and control the resources of the organization for obtaining common objectives or goals.

CO5: Augment managerial skills and adopt ethical practices in various functional areas and engineering practices.

Board of Studies (BOS) :

5thBoS of SSSH held on 29.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1	H	H	M		H	H				H	H	H
CO2	H	M			M					H	H	H
CO3		M	M		H	H		H			H	
CO4					M	H	H	M		M	H	
CO5					M	H	H	M		M	H	

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.

SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.

SDG 12: Ensure sustainable consumption and production patterns.

Inclusive and equitable quality education can make a critical difference to production patterns, consumer understanding of more sustainably produced goods, promote inclusive and sustainable economic growth along with productive employment and decent work for all.

SSDX 02	**SOCIOLOGY OF SCIENCE AND TECHNOLOGY**	**L**	**T**	**P**	**C**
SDG: 17		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To recognize and define the basic concepts of society and the ways in which sociologists use these concepts in constructing explanations for individual and group problems.

COB2: To illustrate the convergence and divergence of sociology with engineering subjects in terms of the subject matter, nature and scope of the discipline and its approach.

COB3: To demonstrate the relationship between science, technology and society.

COB4: To understand the issues relating to science, technology and change in India both in the historical and globalization contexts.

COB5: To appraise the impact of science and technology on different socio-cultural institutions and processes.

MODULE I INTRODUCTION 8

Sociology - Definition, scope and importance, relationship with other social sciences - Major theoretical perspectives: Functionalism, Conflict Theorizing and Interactionism - Elements of social formation - Society, Community, Groups and Association - Institutions, family and kinship, religion, education, politics - Social process - Associative Social Process - Co-operation, Accommodation and Assimilation - Dissociative Social Process - Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 9

Culture - characteristics, functions, types, cultural lag and civilization - Socialization – process, stages, agencies and anticipatory socialization - Social Control - characteristics, importance, types and agencies - Social stratification. - Meaning, forms - caste and class.

MODULE III SCIENCE, TECHNOLOGY AND SOCIETY 9

Relationship between society and science and vice-versa - Science as a social system - Norms of science - Relationship between science and technology - History of modern science in India – colonial–independence and post-independence science - Science education in contemporary India – primary level to research level - Performance of universities in the development of technology - Interrelationship between industry and universities.

MODULE IV SCIENCE, TECHNOLOGY AND SOCIAL ISSUES 10

Technology, media, identity and global society - Conformity and deviance and role of science and technology - Technology and development issue - S&T and sustainable development - Role of science and technology in the creation of environmental crisis - Social inequality, social exclusion and digital divide - Science, technology and ethical issues -Gender and technology.

MODULE V GLOBALIZATION, SCIENCE, TECHNOLOGY AND CHANGE 9

Social Change - nature, direction, forms - Technology and rate of social change – Globalization - characteristics, historical and social context- Social consequences of science and technology on civil society - Globalization - Liberalization - Their impact on Indian science and technology - WTO and issues related to intellectual property rights - MNCs and Indian industry.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Giddens A. “Sociology” Wiley India Pvt. Ltd 2017.
2. Heald Haralambos, R.M “Sociology Themes and Perspectives”, Oxford, New Delhi-92. 2014
3. Sergio Sismondo. An Introduction to Science and Technology Studies Malden: Wiley Blackwell.2010
4. R.K. Merton, Sociology of Science, Theoretical and Empirical Investigations, University of Chicago Press, 1973.

REFERENCES:

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Bilton, T. et al “Introductory Sociology”, Palgrave, New York. 2002
3. Das Gupta, Samir and ‘‘An Introduction to Sociology”, Pearson, Delhi. 2012.
4. Francis Abraham M. “Contemporary Sociology: An Introduction to Concepts and Theories”, New Delhi, Oxford University Press. 2014
5. Inkless, A, “What is Sociology”, Prentice Hall, New Delhi. 1987
6. Tumin, Melvin M “Social Stratification”, Prentice Hall, New Delhi. 1969.

COURSE OUTCOMES: At the end of the course, the students will be able to

CO1: Recognize the fundamental tenets of Sociology.

CO2: Interpret the relationship between individual and society in a sociological perspective.

CO3: Categorize and constructively identify their own assumptions about the relationships among society, science and technology

CO4: Appraise the dynamics of human society with special reference to the science, technology and contemporary trends of globalization.

CO5: Able to link and reflect on current and ongoing sociological debates on development and role of technology.

Board of Studies (BOS) :

5th BoS of SSSH held on 29.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H			H	H	M	L	H	L	
CO2			M			H	H	M	H	H	M	L
CO3			H	M	H	H	M		M	H	H	M
CO4			M			H	H	L	L	M	H	H
CO5			M			H				M		L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

To inculcate knowledge and socialize youth in building participation, institutions and partnership for inclusive development for the implementation of sustainable development goals.

		L	T	P	C
SSDX 03	**INDUSTRIAL ECONOMICS AND MANAGEMENT**	**L**	**T**	**P**	**C**
SDG: 8 and 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide a wholesome idea about the concept of industrial economics and identify the classifications of firms based on ownership and control.

COB2: To impart theoretical and analytical knowledge on the different market structures, pricing practices and government policies.

COB3: To equip the students with the framework that will be useful for applying economic models in business strategy, competition policy and regulations.

COB4: To understand the importance of Industrial Policy in the development of Industries in India.

COB5: To elucidate industrial growth in India by examining its performance and problems in industrial sector.

MODULE I INTRODUCTION TO INDUSTRIAL ECONOMICS 9

Definition and scope of industrial economics - Concept and importance of industry; Concept and organization of a firm - Classification of firms based on ownership - sector (industries, formal vs. Informal) - size and use - based classification - Separation of ownership and control - Localization of industries .

MODULE II MARKET STRUCTURE 9

Perfect Competition – Imperfect Competition: Monopoly – Monopolistic – Oligopolistic Strategy, Cartels, Cournot Kinked Demand and Price Leadership – Measurement of economic concentration – Policy against monopoly and restrictive trade practices – Competition Law – Pricing Practices: Objectives – Determinants – Pricing Methods – Government Policies and Pricing.

MODULE III PRODUCTION ECONOMICS AND THEORY OF FIRM 9

Production and Production function – Types, Factor Inputs – Input-Output Analysis, Undifferentiated Products - Cournot, Stackelberg, Dominant firm model, Bertrand-Heterogeneous products - Chamberlin's small and large number case - Kinked demand curve theory - Bain's limit pricing – Production Possibility Frontier.

9

MODULE IV INDUSTRIAL POLICY

Industrial Policy: Industrial Policy in India -1948, 1956, 1977, 1980, 1990, 1991 - Industrial Performance after Independence.

MODULE V INDUSTRIAL GROWTH IN INDIA 9

Trends and prospects - Public enterprises; efficiency - Productivity and performance constrain - Small scale industries: definition, role - Policy issues and performance - Capacity utilization - Industrial sickness and Exit - Technology transfer - Privatization.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

4. Barthwal R R "*Industrial Economics: An Introductory Textbook*", New Age International Pvt. Ltd Publishers, 2017
5. P.J. Devine, N. Lee, R.M. Jones, W.J. Tyson, *"An Introduction to Industrial Economics*", Routledge.2019.

REFERENCES:

1. Ferguson, Paul R. and Glenys J. Ferguson, "*Industrial Economics - Issues and Perspectives*", Macmillan, London. 1994
2. Gregory Mankiw "*Principles of Microeconomics*", Havcourt Asia Publishers, 2001.
3. Mohanty Binode Ed. "*Economic Development Perspectives*", Vol. 3, Public Enterprises and Performance, Common Wealth Publishers, New Delhi, 1991
4. Mote and Paul "*Managerial Economics*, Tata McGraw Hill, 2001
5. Peterson and Lewis "*Managerial Economics"*, 4th Ed., Prentice Hall, 2004.

COURSE OUTCOMES:

CO1: Develop knowledge on the concept and organization of firms and the implications of the separation of ownership and control.

CO2: Acquire familiarity with various market structures and formulate appropriate pricing strategies.

CO3: Think analytically using various economic models concerning market structures and apply them to the real world of industry.

CO4: To compare the various Industrial Policies introduced in India and recognize the role of these policies in making required industrial development in India.

CO5: Clearly diagnose and illustrate the challenges in industrial economy in India and develop effective and comprehensive solution on them.

Board of Studies (BoS) :

5thBoS of SSSH held on 29.12.2021

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H	M			H		M		M	L
CO2			H		M		H		M		M	L
CO3			H				H		M		M	M
CO4			H				H		M		H	M
CO5			H				H		M		H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 8 - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.

A comprehensive and holistic approach towards the way for sustainable development and economic growth through the inclusive economic strategy and thereby to reduce the poverty, hunger among people by familiarizing them industry and its importance as survival strategy for earning decent standard of living.

SSDX 04	**DYNAMICS OF INDIAN SOCIAL STRUCTURE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

SDG: 10, 16

COURSE OBJECTIVES:

COB1: To provide knowledge on the components of the Indian social structure.

COB2: To learn the nature and contemporary structure of Indian social institutions.

COB3: To sensitize students about social stratification in Indian Society.

COB4: To create awareness about the social problems occurring in contemporary India.

COB5: To explicate the changing institutions, the processes, the agents and the interventions that brings about change in the Indian society.

MODULE I INDIAN SOCIAL STRUCTURE 9

Demographic composition - Racial, religious, ethnic and linguistic -Types of communities - rural, urban, agrarian and tribal - Social backwardness - OBC, SC, ST and EWS - Indian minorities- religious, ethnic, linguistic and LGBT.

MODULE II INDIAN SOCIAL INSTITUTIONS 9

Family - types, characteristics, functions of family - Joint Family- definition features, functions of joint family , dysfunctions of joint family, disintegration of joint family – Marriage - definition, characteristics, marriage as sacrament or contract.

MODULE III SOCIAL STRATIFICATION IN INDIA 9

Social stratification - Concept of hierarchy - inequality, meaning and characteristics - Social Stratification and Social Mobility - Functions of Social Stratification - Caste, definition, principles, contemporary changes, dominant caste, caste - Class interface - Religious minorities.

MODULE IV SOCIAL PATHOLOGY 9

Social Problem - nature, social disorganization - Population explosion- causes, effects, relationship with development - Child Labour- causes, magnitude and consequences – Unemployment - nature, types, causes and effects - Gender issues - social status of women, violence against women and women in work place - Contemporary issues - communalism, terrorism and corruption.

MODULE V SOCIAL CHANGE IN INDIA 9

Socio-cultural change - Sanskritization – Westernization - Secularization, Modernization - Processes of Social change - Industrialization – Urbanization – Globalization - Social movement - concept, characteristics, functions - New social movement-Women and Environment movement.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Sharma,K.L., “Indian Social Structure and Change”, Jaipur: Rawat Publications, 2008.
2. Ahuja Ram., “Social Problems in India”, Rawat Publication: New Delhi, 2014.
3. Ahuja Ram., “Society in India”, Rawat Publication: New Delhi, 2014.

REFERENCES:

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Dube S.C., “India's Changing Villages: Human Factors in Community Development”, London, Routledge and Kegan Paul, 2003.
3. Hasnain N., “Indian Society: Themes and Social Issues”, Mc Graw Hill, 2019.
4. Jayapalan, N., **“**Indian Society and Social Institutions” Atlantic Publishers, 2001.
5. Pandey Vinita., “Indian Society and Culture”, Rawat Publications, New Delhi, 2016
6. Rao Sankar., “Sociology of Indian Society”, S.Chand Publisher, New Delhi, 2004.

COURSE OUTCOMES: At the end of the course, the students will be able to

CO1: explain about the social structure and social institutions that constitute society in India.

CO2: differentiate the various categories of inequalities and their challenges.

CO3: describe the social stratification and its impact in society.

CO4: A

nalyze the social problems encountered in contemporary India.

CO5: Correlate the various forms and trends of the social change in Indian society and realize the relevance of their role in bringing about development.

Board of Studies (BoS) :
5th BoS of SSSH held on 29.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H			H	M			M		
CO2			M			M	H	L				H
CO3			M			M	H	L				H
CO4			H			H	H		M			M
CO5			H		H	M	H	M		H		H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 10: Reduce inequality within and among countries.
SDG16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

To sensitize and impart pertinent knowledge to youths to combat the contemporary issues and challenges facing Indian society in order to remedy its social pathos and injustices in the path of achieving sustainable development in India.