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 September 2024, as per 22nd Academic Council)

B.Tech.
(Electronics and Communication Engineering)

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Crescent
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REGULATIONS 2021

CURRICULUM AND SYLLABI
(Updated upto September 2024, as per 22nd Academic Council)

B.TECH. ELECTRONICS AND COMMUNICATION 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 ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION

VISION

Department of Electronics and Communication Engineering envisions to be a leader in providing state of the art education through excellence in teaching, training, and research in contemporary areas of Electronics and Communication Engineering and aspires to meet the global and socio economic challenges of the country.

MISSION

- The Department of Electronics and Communication Engineering endeavours to produce globally competent Engineers prepared to face challenges of the society.
- To enable the students to formulate, design and solve problems in applied science and engineering.
- To provide excellent teaching and research environment using state of the art facilities.
- To provide adequate practical training to meet the requirement of the Electronics & communication industry.
- To train the students to take up leadership roles in their career or to pursue higher education and research.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING)

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Solve real world problems in Electronics and Communication Engineering with acquired knowledge in Basic Sciences and Engineering.

PEO 2: Become a creative, innovative and successful professional Engineer / Entrepreneur in core and related engineering disciplines both nationally and internationally.

PEO 3: Demonstrate professional, ethical behavior and engage in lifelong learning to develop socially relevant products

PEO 4: Pursue Higher Education to choose career path in teaching and research.

PEO 5: Attain leadership roles in industry and capable of handling large cross-functional teams.

PROGRAMME OUTCOMES

On successful completion of the programme, the graduates will be able to:

- **Engineering knowledge:** Apply the knowledge of Mathematics, Science and Electronics & communication Engineering fundamentals to solve the complex engineering problems.
- **Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principle of Mathematics, Electronics and Communication Engineering sciences.
- **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
- **Conduct investigations of complex problems:** 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.
- **Modern tool usage:** 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.
- **The Engineer and Society:** 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.
- **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Design and develop Electronics and communication subsystem to address complex engineering problems.

PSO2: Analyze and evolve solutions using signal processing, communication, networking, VLSI and embedded systems for contemporary applications

PSO3: Apply modern tools and appropriate techniques to work as an individual/team in multi-disciplinary domains.

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

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

<table>
<tr><th>Sl. No.</th><th>Minor Degree</th><th>Eligible Major Degree Programmes (from other Departments)</th></tr>
<tr><td>1.</td><td>Artificial Intelligence and Machine Learning</td><td rowspan="5">Mechanical Engineering
Aeronautical Engineering
Polymer Engineering
Automobile Engineering
Civil Engineering
Biotechnology
Electrical and Electronics Engineering
Electronics and Instrumentation Engineering</td></tr>
<tr><td>2.</td><td>Block Chain</td></tr>
<tr><td>3.</td><td>Cyber Security</td></tr>
<tr><td>4.</td><td>Data Science</td></tr>
<tr><td>5.</td><td>Internet of Things (IoT)</td></tr>
<tr><td>6.</td><td>Virtual and Augmented Reality</td><td>Mechanical Engineering
Aeronautical Engineering
Polymer Engineering
Automobile Engineering
Civil Engineering
Biotechnology
Electrical and Electronics Engineering
Electronics and Instrumentation Engineering
Electronics and Communication Engineering</td></tr>
</table>

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 AND TECHNOLOGY

B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING CURRICULUM & SYLLABI, REGULATIONS 2021

(Choice Based Credit System)

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BSC	PHD1182	Engineering Physics *	3	0	2	4
2.	BSC	CHD1182	Chemistry for Electrical and Electronic Engineering *	3	0	2	4
3.	BSC	MAD1181	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 Practice 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 1281	English for Engineers	3	0	0	3
2.	BSC	MAD 1283	Partial Differential Equations and Transforms	3	1	0	4
3.	ESC	GED 1201	Engineering Mechanics	3	1	0	4
4.	ESC	GED 1204	Basic Electrical and Instrumentation Engineering *	3	0	2	4
5.	PCC	ECD 1201	Electron Devices	3	0	0	3
6.	PCC	ECD 1202	Circuit and Network Analysis *	2	0	2	3
7.	PCC	ECD 1203	Electron Devices Laboratory **	0	0	2	1
8.	MC	GED 1206	Environmental Sciences	2	0	0	2
			Credits				**24**

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	ECD 2101	Analog Electronic Circuits	3	0	0	3
4.	PCC	ECD 2102	Digital Electronics	3	0	0	3
5.	PCC	ECD 2103	Electromagnetics and Transmission Line Theory	3	0	0	3
6.	PCC	ECD 2104	Signals and Systems *	3	0	2	4
7.	PCC	ECD 2105	Analog Electronic Circuits Laboratory **	0	0	2	1
8.	PCC	ECD 2106	Digital Electronics Laboratory **	0	0	2	1
9.	HSC	GED 2101	Essential Skills and Aptitude for Engineers	0	0	2	1
			Credits				**23**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	ECD 2201	Communication Theory and Systems	3	0	0	3
2.	PCC	ECD 2202	Linear Integrated Circuits *	2	0	2	3
3.	PCC	ECD 2203	VLSI Design	3	0	0	3
4.	PCC	ECD 2204	Digital Signal Processing	3	1	0	4
5.	PCC	ECD 2205	Microcontroller Architecture and Programming	3	0	0	3
6.	PCC	ECD 2206	Microcontroller Programming Laboratory **	0	0	2	1
7.	PCC	ECD 2207	VLSI Design Laboratory **	0	0	2	1
8.	PCC	ECD 2208	Digital Signal Processing Laboratory **	0	0	2	1
9.	PEC	-	Professional Elective Courses	3	0	0	3
10.	MC	GED 2202	Indian Constitution and Human Rights	2	0	0	0
11.	HSC	GED 2201	Workplace Skills and Aptitude for Engineers **	0	0	2	1
			Credits				**23**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	ECD 3101	Python programming for Electronics Engineers *	1	0	2	2
2.	PCC	ECD 3102	Digital Communication	3	1	0	4
3.	PCC	ECD 3103	Computer Networks	3	0	0	3
4.	PCC	ECD 3104	Embedded Systems Design	3	0	0	3
5.	PCC	ECD 3105	Computer Networks Laboratory **	0	0	2	1
6.	PCC	ECD 3106	Analog and Digital Communication Laboratory **	0	0	2	1
7.	PCC	ECD 3107	Embedded Systems Design Laboratory **	0	0	2	1
8.	PEC	-	Professional Elective Courses				6
9.	HSC	GED 3101	Communication Skills for Career Success **	0	0	2	1
10.	PROJ	ECD 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 3181	Fundamentals of Entrepreneurship	3	0	0	3
2.	BSC		Physics Elective	2	0	0	2
3.	HSC		Humanities Elective II	2	0	0	2
4.	OEC		Open Elective I	3	0	0	3
5.	PCC	ECD 3201	Antennas and Wave Propagation	3	0	0	3
6.	PCC	ECD 3202	High Frequency Communication Laboratory **	0	0	2	1
7.	PEC	-	Professional Elective				6
8.	HSC	GED 3201	Reasoning and Aptitude for Engineers **	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
2.	OEC		Open Elective III				3
3.	PCC	ECD 4101	Wireless Communication	3	0	0	3
4.	PEC	-	Professional Elective Courses				9
5.	PROJ	ECD 4102	Internship II ###				1
6.	HSC	GED 4101	Employability Skills $	0	0	2	1
			Credits				**19**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PROJ	ECD 4201	Project Work			18	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.

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PROFESSIONAL ELECTIVE COURSES

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	ECDX 001	Computer Architecture	3	0	0	3
2.	PEC	ECDX 002	Control Systems	3	0	0	3
3.	PEC	ECDX 003	Data structure and its algorithms *	2	0	2	3
4.	PEC	ECDX 004	Sensors and Actuators	3	0	0	3

For 5th to 7th Semester professional electives are under 'Four' different streams;

1. **RF COMMUNICATION AND SIGNAL PROCESSING**
2. **VLSI AND EMBEDDED SYSTEMS**
3. **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**
4. **AUTOMOTIVE ELECTRONICS AND ROBOTICS**

SEMESTER V TO VII

RF COMMUNICATION AND SIGNAL PROCESSING

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	SEM
1.	PEC	ECDX 005	Image Processing	2	0	2	3	5
2.	PEC	ECDX 006	Introduction to Artificial Intelligence	2	0	2	3	5
3.	PEC	ECDX 007	Fundamentals of IoT	3	0	0	3	5
4.	PEC	ECDX 008	Multimedia Compression Techniques	3	0	0	3	5
5.	PEC	ECDX 009	Biomedical Signal Processing	3	0	0	3	5
6.	PEC	ECDX 015	Introduction to Satellite Communication	3	0	0	3	6
7.	PEC	ECDX 016	Electromagnetic Interference & Compatibility	3	0	0	3	6

8.	PEC	ECDX 017	Introduction to PCB Design	3	0	0	3	6
9.	PEC	ECDX 018	Radar & Navigational Aids	3	0	0	3	6
10.	PEC	ECDX 019	Advanced DSP	3	0	0	3	6
11.	PEC	ECDX 033	Remote Sensing	3	0	0	3	7
12.	PEC	ECDX 034	MIMO Communication	3	0	0	3	7
13.	PEC	ECDX 035	GPU Architecture and Programming	3	0	0	3	7
14.	PEC	ECDX 036	Nanoelectronics	3	0	0	3	7
15.	PEC	ECDX 037	RF MEMS Circuit Design	3	0	0	3	7
16.	PEC	ECDX 038	Cognitive Radio Network	3	0	0	3	7
17.	PEC	ECDX 039	Advanced Antenna Design	3	0	0	3	7
18.	PEC	ECDX 040	5G Communication	3	0	0	3	7
19.	PEC	ECDX 041	Cyber Security	3	0	0	3	7
20.	PEC	ECDX 042	Microwave and RF Engineering	3	0	0	3	7
21.	PEC	ECDX 061	Graphical Programming Based System Design	2	1	0	3	5
22.	PEC	ECDX 065	Quantum Computing	3	0	0	0	3

VLSI AND EMBEDDED SYSTEMS

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	SEM
1.	PEC	ECDX 005	Image Processing	2	0	2	3	5
2.	PEC	ECDX 006	Introduction to Artificial Intelligence	2	0	2	3	5
3.	PEC	ECDX 007	Fundamentals of IoT	3	0	0	3	5
4.	PEC	ECDX 010	Advanced Digital Logic System Design	3	0	0	3	5
5.	PEC	ECDX 011	ARM Architecture and Programming	3	0	0	3	5
6.	PEC	ECDX 020	Introduction to System Verilog for Verification	2	0	2	3	6
7.	PEC	ECDX 021	Digital VLSI Testing	3	0	0	3	6
8.	PEC	ECDX 022	Introduction to RTOS	3	0	0	3	6
9.	PEC	ECDX 023	Introduction to Embedded Linux	3	0	0	3	6

10.	PEC	ECDX 024	Mechatronics	3	0	0	3	6
11.	PEC	ECDX 035	GPU Architecture and Programming	3	0	0	3	7
12.	PEC	ECDX 036	Nanoelectronics	3	0	0	3	7
13.	PEC	ECDX 041	Cyber Security	3	0	0	3	7
14.	PEC	ECDX 043	Automotive Networking and Protocols	3	0	0	3	7
15.	PEC	ECDX 044	Embedded Machine Learning	3	0	0	3	7
16.	PEC	ECDX 045	CMOS Analog IC Design	3	0	0	3	7
17.	PEC	ECDX 046	Multicore Architecture and Parallel Programming	3	0	0	3	7
18.	PEC	ECDX 047	Introduction to Cloud Computing and Edge Computing	3	0	0	3	7
19.	PEC	ECDX 048	Nanoscale Devices and Circuit Design	3	0	0	3	7
20.	PEC	ECDX 060	Programming In Embedded Systems	3	0	0	3	6
21.	PEC	ECDX 061	Graphical Programming Based System Design	2	1	0	3	5

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	SEM
1.	PEC	ECDX 005	Image Processing	2	0	2	3	5
2.	PEC	ECDX 006	Introduction to Artificial Intelligence	2	0	2	3	5
3.	PEC	ECDX 007	Fundamentals of IoT	3	0	0	3	5
4.	PEC	ECDX 012	Neural Networks and Fuzzy Logic	3	0	0	3	5
5.	PEC	ECDX 013	Principles of Robotics	3	0	0	3	5
6.	PEC	ECDX 025	R Programming	3	0	0	3	6
7.	PEC	ECDX 026	Machine Learning	2	0	2	3	6
8.	PEC	ECDX 027	Computer Vision	2	0	2	3	6
9.	PEC	ECDX 029	Data Science	3	0	0	3	6
10.	PEC	ECDX 035	GPU Architecture and Programming	3	0	0	3	7
11.	PEC	ECDX 041	Cyber Security	3	0	0	3	7
12.	PEC	ECDX 044	Embedded Machine Learning	3	0	0	3	7

13.	PEC	ECDX 047	Introduction to Cloud Computing and Edge Computing	3	0	0	3	7
14.	PEC	ECDX 050	Pattern Recognition	3	0	0	3	7
15.	PEC	ECDX 051	AI for IoT	3	0	0	3	7
16.	PEC	ECDX 052	Deep Learning	3	0	0	3	7
17.	PEC	ECDX 053	Natural Language Processing	3	0	0	3	7
18.	PEC	ECDX 054	Autonomous Vehicle	3	0	0	3	7
19.	PEC	ECDX 061	Graphical Programming Based System Design	2	1	0	3	5

AUTOMOTIVE ELECTRONICS AND ROBOTICS

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	SEM
1.	PEC	ECDX 005	Image Processing	2	0	2	3	5
2.	PEC	ECDX 006	Introduction to Artificial Intelligence	2	0	2	3	5
3.	PEC	ECDX 007	Fundamentals of IoT	3	0	0	3	5
4.	PEC	ECDX 013	Principles of Robotics	3	0	0	3	5
5.	PEC	ECDX 014	Fundamentals of Automotive Electronics	3	0	0	3	5
6.	PEC	ECDX 024	Mechatronics	3	0	0	3	6
7.	PEC	ECDX 027	Computer Vision	3	0	0	3	6
8.	PEC	ECDX 031	Programming for Robotics	3	0	0	3	6
9.	PEC	ECDX 035	GPU Architecture and Programming	3	0	0	3	7
10.	PEC	ECDX 041	Cyber security	3	0	0	3	7
11.	PEC	ECDX 043	Automotive Networking and Protocols	3	0	0	3	7
12.	PEC	ECDX 054	Autonomous Vehicles	3	0	0	3	7
13.	PEC	ECDX 055	Automotive Embedded Systems	3	0	0	3	7

14.	PEC	ECDX 056	Introduction to Robotic Operating System	3	0	0	3	7
15.	PEC	ECDX 057	Augmented Reality and Virtual Reality	3	0	0	3	7
16.	PEC	ECDX 058	Industrial Robotics	3	0	0	3	7
17.	PEC	ECDX 059	AI for Robotics	3	0	0	3	7
18.	PEC	ECDX 061	Graphical Programming Based System Design	2	1	0	3	5

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

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

PHYSICS ELECTIVES – VI 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

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 Suply Chain Management	3	0	0	3	CSB
18.	GEDX 220	Optimization Techniques	3	0	0	3	EEE
19.	GEDX 221	Polymers for Different Transportation	3	0	0	3	Polymer
20.	GEDX 222	Programming Language Principles	3	0	0	3	CSE
21.	GEDX 223	Public Speaking and Rhetoric	2	1	0	3	English
22.	GEDX 224	Python Programming	2	0	2	3	IT
23.	GEDX 226	Smart Sensors for Healthcare Applications	3	0	0	3	EIE
24.	GEDX 227	Total Quality Management	3	0	0	3	Mech.
25.	GEDX 228	Value Education	3	0	0	3	Commerce
26.	GEDX 229	Waste Water Management	3	0	0	3	Civil
27.	GEDX 231	Electronics for Mechanical Systems	3	0	0	3	ECE
28.	GEDX 232	Renewable Energy Engineering					EEE
29.	GEDX 233	Nuclear Hazard and Disarmament	3	0	0	3	Physics

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 105	Building Repair Solutions	3	0	0	3	Civil
5.	GEDX 106	Cloud Services and Management	3	0	0	3	CA
6.	GEDX 108	Cyber Law and Ethics	3	0	0	3	CSL
7.	GEDX 110	Deep Learning Essentials /	3	0	0	3	CSE
8.	GEDX 111	Drone Technologies	2	0	2	3	Aero
9.	GEDX 112	Electric Vehicle	3	0	0	3	EEE
10.	GEDX 113	Emerging Technologies in Mobile Networks	3	0	0	3	ECE
11.	GEDX 114	Fundamentals of Data Science and Machine Learning	3	0	0	3	IT
12.	GEDX 115	Genetic Engineering	3	0	0	3	SLS
13.	GEDX 116	Green Design and Sustainability	3	0	0	3	Civil
14.	GEDX 117	Image Processing and its Applications	3	0	0	3	ECE
15.	GEDX 118	Industrial Automation and Control	3	0	0	3	EIE
16.	GEDX 119	Industrial Safety	3	0	0	3	Mech.
17.	GEDX 120	Industry 4.0	3	0	0	3	Mech.
18.	GEDX 121	Introduction to Artificial Intelligence	3	0	0	3	IT
19.	GEDX 122	Introduction to Artificial Intelligence and Evolutionary Computing	3	0	0	3	EEE
20.	GEDX 123	Motor Vehicle Act and Loss Assessment	3	0	0	3	Automobile
21.	GEDX 126	Personal Finance and Investment	3	0	0	3	Commerce
22.	GEDX 127	Soft Computing Techniques	3	0	0	3	CSE
23.	GEDX 128	Value Analysis and Engineering	3	0	0	3	Mech.
24.	GEDX 129	Vehicle Maintenance	3	0	0	3	Automobile
25.	GEDX 130	Graphical Programming Based System Design	3	0	0	3	ECE

SEMESTER I

PHD 1182	ENGINEERING PHYSICS	L	T	P	C
		3	0	2	4

SDG: 4

COURSE OBJECTIVES:

COB1: To equip the students on the knowledge of crystal structures.

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

COB3: To introduce the basics of optics and lasers.

COB4: To equip the students to understand the knowledge on solids.

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

MODULE I CRYSTAL PHYSICS 9

Crystalline and amorphous solids – Unit Cell – Seven Crystal Systems – Bravais Lattice – Miller Indices – Interplanar Spacing – Characteristics of Unit Cell - Calculation of Number of atoms per unit cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP structures –Defects in crystals-Point defects –Edge and screw dislocations and their significance - Surface Defects.

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 OPTICS AND LASERS 9

Interference - 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 –CO_2 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 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 – 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 particle size of lycopodium powder using semiconductor laser.

L – 45; P – 15 ; TOTAL HOURS –60

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. Serway R.A. and Jewett, J.W., Physics for Scientists and Engineers with Modern Physics, Brooks/cole Publishing Co., 2010.
2. Tipler P.A. and Mosca, G.P., Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.

3. Markert J.T., Ohanian. H. and Ohanian, M., Physics for Engineers and Scientists, W.W. Norton & Co., 2007.
4. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.

COURSE OUTCOMES:

CO1: express the knowledge of crystal structures.

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

CO3: grasp ideas related to interference phenomenon, apply it to understand optical based devices and classify the different laser systems used for various applications.

CO4: express the knowledge on solids.

CO5: understand the principles of physics behind semiconductors, Hall effect and apply the same to identify type of any semiconductor sample, evaluate no. of charge carriers.

Board of Studies (BoS) :
13th BoS of Physics held on 14.09.2023

Academic Council:
21st AC held on 20.12.2023

	PO1	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	M	M	M
CO2	H	M	M	L	L	M	L	L	L	L	L	M	M	M	M
CO3	H	M	M	L	L	L	L	L	L	L	L	M	M	M	M
CO4	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M
CO5	H	M	M	L	M	M	M	L	L	L	M	M	M	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.

CHD 1182	**CHEMISTRY FOR ELECTRICAL AND ELECTRONIC ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**2**	**4**

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 - Society of the Plastics Industry (SPI)' Code.

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) :

13th BoS of Chemistry held on 08.09.2023

Academic Council:

21st AC held on 20.12.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
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.

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 Cengagelearning, 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: 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	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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 matrices and calculus will lead to knowledge of applications in Communication Engineering

GED 1101	**ENGINEERING GRAPHICS**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**2**	**3**

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

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**
SDG: 9		**0**	**0**	**2**	**1**

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 onsand mould 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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	L	-	-	-	-	-	-	-	-	-	-	-	-	-
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 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**	**L**	**T**	**P**	**C**
SDG: 8	**PROBLEM SOLVING**	**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.

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. Input / 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

L – 15; P – 30 ; Total Hours– 45

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) :	**Academic Council:**
18th BoS of CSE held on 26.07.2021	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

END 1281	**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,Stephen2011. 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) :

13thBoS of 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
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.

MAD 1283	**PARTIAL DIFFERENTIAL**	**L**	**T**	**P**	**C**
SDG: 4	**EQUATIONS AND TRANSFORMS**	**3**	**1**	**0**	**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) :	**Academic Council:**
12th BOS of Mathematics & AS held on 23.06.2021	17th AC held on 15.07.2021

	PO1	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**
SDG: 9		**3**	**1**	**0**	**4**

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):
18th BOS 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	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.

GED 1204	**BASIC ELECTRICAL AND**	**L**	**T**	**P**	**C**
SDG: 3, 5, 8, 12	**INSTRUMENTATION ENGINEERING**	**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To make the students understand the basic calculations and measurements in DC circuits.
COB2: To provide the basic knowledge on AC circuit calculations and measurements.
COB3: To familiarize with working and characteristics of different DC and AC machines.
COB4: To impart knowledge on the fundamentals of measuring electrical quantities.
COB5: To expose the students to various sensors and transducers to measure non-electrical quantities.

MODULE I DC CIRCUITS AND MEASUREMENTS 13

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 – Star-delta transformation - Mesh and nodal analysis of resistive circuits – simple problems - Measurement ofvoltage, current and power in DC circuits.

MODULE II AC CIRCUITS AND MEASUREMENTS 17

Sinusoidal voltage - RMS, average, peak value, peak factor and form factor - single phase RL, RC and RLC circuits –phasor representation - complex power – power factor - simple problems - Resonance in RLC circuits – 3 phase balanced circuit calculations– star and delta connections - Principles of measurement of AC voltage, current, power and energy - Measurement of three phase power - Protection of AC circuits: Fuse and Miniature Circuit Breakers(MCB)

MODULE III ELECTRICAL MACHINES 18

Construction, principle of operation, basic equations, characteristics and applications of DC generators, DC motors, single phase transformers and three phase induction motors. Working principle of BLDC Motor and its applications in home appliances.
(Qualitative treatment only).

MODULE IV ELECTRICAL MEASUREMENTS 14

Functional blocks of a measurement system - types of measurements - Direct and indirect measurements – Classification of instruments – Induction type – dynamometer type wattmeters - Types of indicating Instruments Principles of Electrical Instruments – Multimeters, Oscilloscopes - Static and Dynamic characteristics of an instrumentation system – Errors in Measurement – Calibration and Standards.

MODULE V TRANSDUCERS AND SENSORS 13

Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect – electromagnetic flow transducers - Level transducers – Ultrasonic and fiber optic transducers – Smart transducers - Types of sensors – elastic sensors – viscosity – moisture and pH sensors – sensors based on semiconductor junctions - charge coupled and CMOS image sensors – Biosensors.

PRACTICALS

List of Experiments

1. Verification of KCL and KVL (ii) Measurement of voltage, current and power in DC circuits.
2. Resonance of RLC series circuit (ii) Measurement of voltage, current, power and power factor in single phase & three phase AC circuits.
3. Magnetization characteristics of DC generator (ii) Characteristics of DC shunt motor, single phase transformer and three phase induction motor.
   (i) Measurement of AC voltages and currents in CRO – magnitudes, time period, frequency and phasor difference
   (ii) Capturing the transients in RC / RL / RLC circuits in a storage oscilloscope.
4. Characteristics of resistive, inductive and capacitive transducers.

L – 45 ; P – 30 ; Total Hours– 75

REFERENCES:

1. D P Kothari and I.J Nagarath, “Basic Electrical and Electronics Engineering”, McGraw HillEducation(India) Private Limited, Third Reprint,2016.
2. Giorgio Rizzoni, “Principles and Applications of Electrical Engineering”, McGraw HillEducation(India) Private Limited, 2010.

3. S.K.Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson India, 2011.
4. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2015.
5. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013.
6. Rajendra Prasad, "Fundamentals of Electrical engineering", Prentice Hall of India, 2006.
7. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, 24th reprint 2016.
8. Sawhney, A. K., and Puneet Sawhney "A Course in Electrical and Electronic Measurements and Instrumentation" Dhanpat Rai & Company, 2016.

COURSE OUTCOMES:

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

CO1: perform the basic calculations in DC circuits and measure the various quantities associated with DC circuits.

CO2: measure and compute the rms current and voltage, power, power factor and energy in AC circuits.

CO3: choose appropriate motor for specific applications based on the motor characteristics.

CO4: use the CRO and other measuring devices for measuring electrical quantities.

CO5: select appropriate transducer or sensor for applications involving non-electrical quantities.

Board of Studies (BoS) :

15th meeting of BoS of EEE held on 25.06.2021

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		H	L	M		M		L	L	M	L	-	-	-
CO 2	H		H	L	M		M		L	L	M	L	-	-	-
CO 3	H		H	L			M		L	L	M	L	-	-	-
CO 4	H		H	L			M		L	L	M	L	-	-	-
CO 5	H		H	L			M		L	L	M	L	-	-	-

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

ECD 1201	**ELECTRON DEVICES**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 **:** To describe fundamental concepts of semiconductors and electronic components

COB2 **:** To discuss about various semiconductor devices and its applications

COB3 **:** To explain the process of PCB design

COB4 **:** To use different types of power control devices in a appropriate applications.

COB5 **:** To analyze the characteristics of optoelectronic and nano electronic devices

PREREQUISITES:

- Fundamentals of Semiconductor physics

MODULE I **INTRODUCTION TO DIODES AND PCB DESIGN** **9**

Overview of Electronic components- Semiconductors – Construction, Characteristics and applications of PN junction diode: Rectifiers - Construction, Characteristics and applications of Special purpose diodes: Zener Diode, Varactor Diode, Tunnel Diode, Schottky Diode -Process of PCB design: Schematic and Layout.

MODULE II **BIPOLAR JUNCTION TRANSISTORS** **9**

Construction, Configurations and Characteristics of BJT - Current components - Hybrid Model - Biasing of BJT - Transistor switching times -Applications of BJT.

MODULE III **FIELD EFFECT TRANSISTORS** **9**

Construction, Configuration and Characteristics of JFET - JFET biasing - Applications of JFET. Construction, Configuration and Characteristics of MOSFET -MOSFET biasing –Types of FET - Applications of MOSFET.

MODULE IV **POWER CONTROL DEVICES** **9**

Construction, characteristics, and applications: UJT, SCR, TRIAC and DIAC - IGBT - Power MOSFET.

MODULE V OPTOELECTRONIC AND NANOELECTRONICS DEVICES 9

Optoelectronic devices- Laser diodes,Photoresistors,Photo diodes, Solar cell, Display Devices: Liquid Crystal Display, LED, OLED, AMOLED – Nano electronic Devices.

L – 45; Total Hours– 45

TEXT BOOKS:

1. J.Millman, C.C.Halkias, and Satyabratha Jit, "Electronic Devices and Circuits" Tata McGraw Hill, 2nd Ed., 2010.
2. Thomas L. Floyd ,"Electronic Devices", Global Edition, Pearson Education, 2017.
3. Pallab Bhattacharya, "Semiconductor Optoelectronic Devices", 2017, 2ndEdition, Pearson Education, India.
4. William Liu, "Fundamentals of III-V Devices: HBTs, MESFETs, and HFETs/ HEMTs", Wiley-Interscience; 1st edition ,1999.
5. Byung-Gook Park, Sung Woo Hwang, Young June Park," Nano electronic devices", Stanford publishing, 2012.

REFERENCES:

1. Donald A.Neaman, "Semiconductor Physics and Devices" 3rd Ed., Tata McGraw Hill 2003.
2. Nandita Das Gupta and Amitava Das Gupta, "Semiconductor Devices – Modeling and Technology", Prentice Hall of India, 2004.
3. David A Bell, 'Electronic Devices and Circuits', 5th edition, Oxford University Press, 2008.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : recall the classification of electronic components and concepts of semiconductors.

CO2 : identify the applications of PN junction diode and various special diodes.

CO3 : apply the process of PCB design.

CO4 : analyze the characteristics of Bipolar junction transistor and Field effect transistor.

CO5 : choose various power control devices, switches and nanoelectronic devices for different applications.

CO6 : summarize the characteristics of optoelectronic and display devices.

Board of Studies (BoS) :

21st BOS of ECE held on 23.6.2021

Academic Council:

17th Academic council 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	PSO1	PSO2	PSO3
CO1	M	M	M	-	-	-	-	-	M	-	-	M	L	L	H
CO2	M	H	M	-	-	-	-	-	M	-	-	M	L	L	H
CO3	M	H	M	-	H	-	-	-	M	-	-	M	H	L	H
CO4	L	L	L	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	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 the basic characteristics of electronic components, method of biasing, applications helps for lifelong learning of newer technologies and concepts related to the electronic devices.

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

Statement: Able to apply the theoretical concepts of electronic devices for the various application of electronic sub domains.

ECD 1202	**CIRCUIT AND NETWORK ANALYSIS**	**L**	**T**	**P**	**C**
SDG: 4, 8,9		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1 : To apply the fundamental theorems of electrical circuit and network

COB2 : To discuss the concepts of steady state and transient analysis in RL, RC and RLC circuits.

COB3 : To analyze the significance of two port networks

COB4 : To design and analyze the circuits using simulation tools.

PREREQUISITES:

- Mathematical knowledge in linear algebra and Matrix theory.
- Basic knowledge about voltage, current and power relationship.

MODULE I NETWORK THEOREMS 8+8

Thevenin’s Theorem - Norton’s Theorem - Superposition theorem - Maximum power transfer theorem- Substitution theorem-Reciprocity theorem.

Laboratory Practice: Circuit Simulation of verification of Thevenin’s Theorem-Norton’s Theorem - Maximum power transfer theorem.

MODULE II ANALYSIS OF NETWORKS 8+6

Mesh analysis and nodal analysis of circuits - Formation of matrix equations and analysis.- introduction to network topology: Tree and co-tree- Twigs and links-Incidence matrix

Laboratory Practice: Circuit Simulation of Mesh analysis and Nodal analysis methods.

MODULE III TRANSIENT ANALYSIS 8+10

Steady state and transient response – DC response of an RL, RC and RLC circuits -Sinusoidal response of an RL, RC and RLC circuits.

Laboratory Practice: Circuit Simulation of DC response of an RL, RC, RLC circuits and Sinusoidal response of RL, RC and RLC circuits.

MODULE IV TWO PORT NETWORKS 6+6

Open circuit Impedance (Z) Parameters - short Circuit Admittance(Y) Parameters, Transmission (ABCD) Parameters and Inverse Transmission Parameters-Hybrid (h) Parameters and Inverse Hybrid Parameter Conversion between parameters-interconnection of two-port networks

Laboratory Practice: Study the network parameters for various types of network connections using simulation

L – 30; P – 30; Total Hours– 60

TEXT BOOKS:

1. William H.Hayt, Jr, J.E.Kemmerly& Steven M.Durban, "Engineering Circuit Analysis" 9th Edition, Mc Graw Hill, 2020
2. A.Sudhakar &ShyammohanS.Palli "Circuits &Network; Analysis& Synthesis", 5th Edition, Tata Mc Graw Hill, 2017
3. Someshwar C. Gupta, Jon W. Bayless, Behrouz Peikari, “Circuit Analysis - with computer applications to problem-solving", WileyEastern Ltd., 1991
4. Van Valkenburg, "Network Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, 2015.

REFERENCES:

1. M.L Soni & J.C. Gupta, "Electric Circuit Analysis", Dhanpat Rai& Sons, New Delhi, 1999.
2. Joseph Edminister, "Electric Circuits", Schaum's Outline Series, Mc Graw Hill 5th Edition, 2011

COURSE OUTCOMES:

CO1 : Describe and apply fundamental concepts of networks in solving and analyzing different electrical networks.

CO2 : Reconstruct the electrical networks using graph theory

CO3 : Analyze the electrical networks using various network reduction techniques.

CO4 : Apply appropriate theorems and techniques for solving electrical networks

CO5 : Analyze networks in steady state and transient conditions.

CO6 : Use simulation tools for the analysis of circuits.

Board of Studies (BoS) :

21st BOS of ECE held on 23.6.2021

Academic Council:

17th Academic council 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	PSO1	PSO2	PSO3
CO1	M	H	H	M	M	L	L	M	M	M	M	M	H	H	H
CO2	M	M	M	M	M	L	L	M	M	M	M	M	H	H	H
CO3	M	M	3	M	M	L	L	M	M	M	M	M	H	H	H
CO4	M	M	3	M	H	L	L	M	M	M	M	M	H	H	H
CO5	M	M	3	M	M	L	L	M	M	M	M	M	H	H	H
CO5	M	L	3	M	H	L	L	M	H	M	M	M	H	H	H

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

SDG 4: Analysis and design circuits and networks promote Engineering skills and quality education.

SDG 8: Development of new technologies with circuits and networks provides sustainable economic growth and productive employment.

SDG 9: Analysis of circuits and networks fosters innovation and sustainable industrialization.

Statement: Analysis and design of circuits promote sustained economic growth.

ECD 1203	**ELECTRON DEVICES**	**L**	**T**	**P**	**C**
SDG: 4 & 9	**LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To identify various electronic components and devices

COB 2: To apply the PCB design process

COB3: To analyze the working characteristics and applications of various Semiconductor Devices

PRACTICALS

List of Experiments:

1. Study Of Electronic Components, Data Sheet and Equipments
2. PCB Design Process - Schematic capture, Simulation, Schematic to layout transfer
3. PN junction diode characteristics and its application
4. Zener Diode characteristics and its application
5. Bipolar Junction Transistor (BJT) characteristics and its application
6. Field Effect Transistor (FET) characteristics and its application
7. Silicon Controlled Rectifier (SCR) characteristics and its application
8. Light Dependent Resistor(LDR) characteristics and its application

P – 30; Total Hours– 30

TEXT BOOKS:

1. David Bell. Fundamentals of Electronic Devices and Circuits Lab Manual,Oxford University Press 22, November 2009
2. J.Millman, C.C.Halkias, and Satyabratha Jit, “Electronic Devices and Circuits” Tata McGraw Hill, 2nd Ed., 2010.
3. Thomas L. Floyd ,”Electronic Devices”, Global Edition, Pearson Education, 2017.

REFERENCES:

1. Donald A.Neaman, “Semiconductor Physics and Devices” 3rd Ed., Tata McGraw Hill 2003.
2. Nandita Das Gupta and Amitava Das Gupta, “Semiconductor Devices – Modeling and Technology”, Prentice Hall of India, 2004.
3. David A Bell, ‘Electronic Devices and Circuits’ , 5th edition, Oxford University Press, 2008.

COURSE OUTCOMES:

CO1: Construct electronic circuits using simulation software and obtain their characteristics

CO2: Apply the process of PCB design

CO3: Test and troubleshoot various semiconductor devices

CO4: Apply various electronic components and devices in circuit design for practical applications

CO5: Associate with a team and implement applications using electronic devices

CO6: Use device and components data sheet to select the appropriate components.

Board of Studies (BoS) :

21st BOS of ECE held on 23.6.2021

Academic Council:

17th Academic council held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	M	M	M						M			M	H	M	H
CO2	H	M	H						M			M	H	M	H
CO3	H	H	H						M			M	H	M	H
CO4	H	H	H						M			M	H	M	H
CO5	H	M	H						H			M	M	L	M
CO6	H	H	H	M	M				H			M	H	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 practically the basic VI characteristics of electronic devices, method of biasing, applications and helps for lifelong learning of newer technologies and concepts related to the electronic devices.

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

Statement: Able to apply the practical concepts of electronic devices and its applications in various fields of electronic sub domains.

GED 1206	**ENVIRONMENTAL SCIENCES**	**L**	**T**	**P**	**C**
SDG: All		**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

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Board of Studies (BoS) :	**Academic Council:**
11^{th} BoS of Chem held on 17.06.2021	17^{th} 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	-	M	-	-
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

ECD 2101	ANALOG ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

SDG: 4,9

COURSE OBJECTIVES:

COB1: To design and analyze the performance of BJT and FET amplifiers

COB2: To design and test the feedback amplifiers and oscillators

COB3: To design and estimate tuned amplifiers and power amplifiers.

COB4: To apply and analyze the concepts of Multivibrator circuits.

COB5: To design and analyze the blocking oscillator & Time base generating circuits.

PREREQUISITES:

Fundamentals of Semiconductor physics, Electron Devices.

MODULE I SMALL SIGNAL ANALYSIS AND FREQUENCY RESPONSE OF AMPLIFIERS 9

Small signal models of BJT and MOSFET, Small signal Analysis of Common Emitter, Common Collector and common Base amplifiers. Small signal analysis of FET amplifiers, Differential amplifiers. Low frequency response of BJT and FET amplifiers-high frequency response of BJT and FET amplifiers.

MODULE II FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Basic feedback concepts - Properties of Negative feedback -Four feedback topologies with amplifier circuit - Analysis of series - shunt feedback amplifiers. Oscillators: Barkhausen criteria for oscillator - Analysis of RC oscillators - LC oscillators - Crystal Oscillator.

MODULE III POWER AMPLIFIERS AND TUNED AMPLIFIERS 9

Classification of large signal amplifiers – Class A amplifier– Class B amplifier – Class AB amplifier– Class C amplifier and Efficiency – Analysis of Single tuned amplifier - Double tuned amplifier - Synchronously tuned amplifiers.

MODULE IV MULTIVIBRATOR CIRCUITS 9

Collector coupled and Emitter coupled Astable multivibrator – Monostable multivibrator- Bistable multivibrators. Triggering methods: Storage delay and calculation of switching times - Speed up capacitors - Schmitt trigger circuit.

MODULE V BLOCKING OSCILLATORS AND TIME BASE GENERATORS 9

Pulse transformers - Monostable Blocking Oscillators using Emitter and base timing - Astable blocking oscillator - Voltage sweep generators - Current sweep generators

L – 45; Total Hours– 45

TEXT BOOKS:

1. Boylested and Nashlesky, Electronic Devices and Circuit theory, 11th edition, Prentice Hall of India, 2015.
2. Donald .A.Neamen, Electronic Circuit Analysis and Design, 2nd edition, Tata McGraw Hill, 2009.
3. Millman .J. and Halkias C.C, Integrated Electronics, McGraw Hill, 2nd Edition, 2017.
4. Robert Boylestad , Introductory Circuit Analysis, Pearson; 13th edition, 2015.

REFERENCES:

1. Adel.S.Sedra, Kenneth C. Smith, Micro Electronic circuits, 8th Edition, Oxford University Press, 2020.
2. David A. Bell,Electronic Devices and Circuits, Oxford Higher Education press, 5th Edition, 2010
3. David A. Bell, "Solid State Pulse Circuits", 4th edition, Eastern economic edition, Prentice Hall of India, 2010.
4. Millman J. and Taub H., "Pulse Digital, Switching waveform", 3rd Edition, McGraw-Hill International, 2017.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Design and analyze the BJT and FET amplifiers

CO2: Classify and construct the feedback amplifiers and oscillators.

CO3: Design and analysis of tuned amplifiers and power amplifiers

CO4: Design and develop circuits to generate non-sinusoidal waveforms

CO5: Design the circuits to generate Time base waveforms.

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	PSO 3
CO 1	H	H	H	L	M	L	L	M	M	M	M	M	L	L	H
CO 2	H	H	H	M	M	L	L	M	M	M	M	M	L	L	H
CO 3	H	H	H	H	M	L	L	M	M	M	M	M	L	L	H
CO 4	H	H	H	H	M	L	L	M	M	M	M	M	L	L	H
CO 5	H	H	H	H	M	L	L	M	M	M	M	M	L	L	H

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

SDG 4: Quality Education.

Statement: It is a fundamental course, which explains the basics of electronic circuit design and its applications. It is essential to understand the modern electronic systems and industrial automation in turn provides quality education.

SDG 9: Industry, Innovation and Infrastructure

Statement: This course will deliver the concepts to design and invent electronic circuits for modern electronic devices which will enhance quality of life and to meet industry requirements.

ECD 2102 **DIGITAL ELECTRONICS**

SDG: 4, 8, 9

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

COB1 : To discuss the methods for simplifying Boolean expressions.

COB2 : To design and analyze the combinational circuits.

COB3 : To design and test the performance of sequential circuits.

COB4 : To characterize and select the memories and programmable logic devices.

COB5 : To analyze the digital circuits using simulation tools.

PREREQUISITES:

- Fundamentals of Boolean Algebra
- Knowledge on Number System

MODULE I DIGITAL FUNDAMENTALS 9

Number systems - Binary codes-Boolean algebra and theorems- Logic gates - Boolean functions - Karnaugh map and Quine - McCluskey Method- Implementations of Logic functions using universal gates.

MODULE II DESIGN OF COMBINATIONAL CIRCUIT 9

Analysis and design procedures- Circuits for arithmetic operations –Magnitude comparator-Multiplexer- Demultiplexer- Encoder-decoder - Parity generator and checker- Code converters.

MODULE III SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 10

Analysis and Design of synchronous sequential circuits -Flip flops- SR, JK, T, D, Master slave FF-Counters-Shift registers –-Design of rolling display-Moore and Mealy circuits.

MODULE IV ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 8

Analysis and Design of Asynchronous sequential circuits- Fundamental mode sequential circuits- Pulse mode sequential circuits-cycles and races-Hazards - Design of Hazard free circuits.

MODULE V MEMORY DEVICES AND VERILOG HDL 9

Basic memory structure- Programmable Logic Devices — Programmable Logic Array (PLA) — Programmable Array Logic (PAL) — Field Programmable Gate Arrays (FPGA) — Implementation of combinational logic circuits using PROM, PLA and PAL. Introduction to Verilog HDL-Types of Modeling.

L – 45 ; Total Hours– 45

TEXT BOOKS:

1. M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", Pearson Education, New Delhi, 6th edition, 2017.
2. D. P. Kothari and J. S Dhillon, "Digital Circuits and Design", Pearson Education, New Delhi, 2016.

REFERENCES:

1. Charles H.Roth and J.S.Dhillon, "Fundamentals of logic design", Cengagei, 7th edition, 2019.
2. Donald D. Givone, "Digital Principles and Design", Tata McGraw Hill, New Delhi, 2003.
3. Thomas L. Floyd, "Digital Fundamentals", Pearson Education, New Delhi, 10th Edition 2008
4. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, New Delhi, 4th Edition, 2010.
5. Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", Tata McGraw Hill, New Delhi, 6th Edition, 2009.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Apply the concepts and terminology of digital electronics

CO2 : Formulate and employ Karnaugh map and tabulation method to reduce Boolean expressions

CO3 : Analyze and design combinational circuits

CO4 : Design different types of sequential circuits.

CO5 : Implement combinational logic circuits using programmable logic devices.

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	PSO 3
CO1	M	M	L	L	L	L	L	L	M	M	M	L	M	M	H
CO2	H	H	H	H	M	L	L	L	M	M	M	L	M	M	H
CO3	H	H	H	H	M	L	L	L	M	M	M	L	M	M	H
CO4	H	H	H	H	M	L	L	L	M	M	M	L	M	M	H
CO5	M	M	H	L	M	L	L	L	M	M	M	L	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.
Statement: Understanding of the digital electronics course will bring a global impact on quality education.

SDG 8: Development of new technologies provides sustainable economic growth and productive employment.
Statement: Analysis and design of digital circuits promote sustained economic growth.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
Statement: Able to apply the design concepts of digital circuits in IC based design.

		L	T	P	C
ECD 2103	**ELECTROMAGNETICS AND TRANSMISSION LINE THEORY**	**3**	**0**	**0**	**3**

SDG: 4, 7, 9, 11

COURSE OBJECTIVES:

COB1 : To apply the basic laws and theorems of Static electric and magnetic fields.

COB2 : To interpret the relation between the fields under time varying conditions

COB3 : To analyze principles of propagation of uniform plane waves.

COB4 : To discuss about the propagation of signals through transmission lines

COB5 : To analyze the characteristics of transmission lines and waveguides

PREREQUISITES:

- Fundamentals of Engineering Mathematics
- Fundamentals of Semiconductor physics.

MODULE I ELECTROMAGNETIC FIELDS 8

Coulomb's Law - Electric Field - Electric Scalar Potential-Gauss Law- Biot-Savart Law - Magnetic Field intensity - Ampere's circuital law. Displacement current - Modified form of Ampere's circuital law- Maxwell’s Equation.

MODULE II ELECTROMAGNETIC WAVES 9

Poynting Vector and Poynting Theorem - Derivation of Wave Equation - Uniform Plane Waves - Skin effect. Linear, Elliptical and circular polarization - Reflection Plane Waves - normal and oblique incidence. Dependence on Polarization. Brewster angle.

MODULE III TRANSMISSION LINE THEORY 9

General theory of Transmission lines – The infinite line -Wavelength, velocity of propagation – Input and transfer impedance – the distortion-less line – Loading and different methods of loading – Reflection coefficient – Open and short circuited lines – reflection factor and reflection loss.

MODULE IV HIGH FREQUENCY TRANSMISSION LINES 10

Transmission line equations at radio frequencies – Line of Zero dissipation – Standing Waves, Standing Wave Ratio – Input impedance– Open and short circuited lines – Power and impedance measurement on lines – Reflection losses – Measurement of VSWR and wavelength. Impedance matching– Smith chart.

MODULE V WAVEGUIDES 9

Planar waveguides, TE and TM waves - characteristics, velocities of propagation, Rectangular waveguides - TE and TM waves – characteristics, dominant mode, cut-off wavelength, phase velocity, group velocity, and characteristic impedances.

L – 45 ; Total Hours- 45

TEXT BOOKS:

1. M.N.O.Sadiku: "Elements of Engineering Electromagnetics", 6th Edition, Oxford University Press, 2016.
2. John D Ryder, "Networks, Lines and Fields", 2nd Edition, Pearson India, 2015.
3. William H.Hayt "Engineering Electromagnetics", 8th Edition, Tata McGraw - Hill, 2014.

REFERENCES:

1. Edward C. Jordan and Kenneth G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice Hall Int., 2015.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas and Wave Propagation", 5th Edition, Tata McGraw Hill, 2017.
3. David M.Pozar, "Microwave Engineering", 4th Edition, John Wiley, 2013.
4. Ramo, Whinnery and Van Duzer: "Fields and Waves in Communications Electronics", 3rd Edition, John Wiley & Sons, 2003.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Apply and analyze the basic laws of Electromagnetic theory

CO2 : Solve the static and time varying electric and magnetic fields for practical applications.

CO3 : Characterize the EM waves in free space and at different boundaries.

CO4 : Explain the basic concepts of Transmission lines and waveguides.

CO5 : Analyze the wave propagation in different mediums.

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	PSO1	PSO2	PSO3
CO1	H	H	M	L	L	L	L	L	L	L	L	L	H	L	M
CO2	H	H	H	L	L	L	M	L	L	L	M	M	H	L	M
CO3	H	H	H	H	L	L	L	M	L	L	L	L	H	H	H
CO4	H	H	H	H	H	L	L	L	L	L	L	L	H	M	H
CO5	H	H	H	H	H	L	L	L	L	H	M	M	M	L	M

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

SDG 4: Quality Education

Statement: A fundamental concept of electromagnetic properties and its characteristic analysis provides a global impact on quality education in the area of RF & Communication.

SDG 7: Affordable and Clean Energy

Statement: Practical applications of static and time varying electromagnetic fields offers an impact on affordable and clean energy in overall environment.

SDG 9: **Industry, Innovation and Infrastructure**

Statement: Build resilient Infrastructure; promote inclusive and sustainable industrialization through EM wave propagation within the industry.

SDG 11: Sustainable Cities and Communities

Statement: The resilient communication through EM wave propagation signifies the efficient mode of information transmission across the world and within the smart city.

ECD 2104	**SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 3, 9		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To analyze the concepts of Signals and Linear Time-Invariant Systems

COB2: To execute various Transform analysis such as Fourier, Laplace, Z-Transform for a specific signal processing applications

COB3: To apply transforms in the analysis of LTI Systems.

COB4: To construct discrete-time LTI systems for applications.

COB5: To interpret the signals and it's processing through computer simulation.

PREREQUISITES:

- Fundamentals of Engineering Mathematics
- Basic knowledge in computer programming

MODULE I INTRODUCTION TO SIGNALS 8

Time-Domain Representation of Continuous-Time (CT) and Discrete-Time (DT) signals. Standard elementary signals - and complex signal. Basic Time-Domain operations on signals. Energy, Power and Correlation of signals. Signal Classification and Symmetry. Periodicity of discrete-time signals. Synthesis of simple signals.

MODULE II INTRODUCTION TO LTI SYSTEMS 8

Continuous-Time and Discrete-Time Systems. Characteristics of Systems. Linear and Time-Invariant (LTI) Systems and its Properties. Impulse Response, convolution sum and convolution integral. Interconnection of LTI Systems. Differential and Difference Equation representation of LTI systems.

MODULE III TRANSFORM ANALYSIS OF CT SIGNALS 10

Fourier Series representation of signals. Properties of Fourier Series. Continuous Time Fourier Transform and its properties. Frequency Response of CT-LTI Systems.

Unilateral and Bilateral Laplace Transform. Region of Convergence (ROC), Properties of Laplace Transforms. Poles and Zeros. Inverse Laplace Transformation. The Transfer Function and Frequency Response of CT-LTI Systems.

MODULE IV TRANSFORM ANALYSIS OF DT SIGNALS 10

Discrete-Time Fourier Transform (DTFT) and its properties. Discrete Fourier Transform (DFT) and its properties.

Z-Transform - Z-Plane and ROC. Properties of Z-Transform. Poles and Zeros. Methods for Inverse Z-Transform. Transfer Function of DT-LTI Systems. Causality and Stability.

MODULE V APPLICATION OF TRANSFORMS 9

Application of Fourier Transform to communication systems - Spectrum of AM, DSB and SSB AM. Sampling Theorem, Computational Structures for Implementing Discrete-Time LTI systems using z-Transform.

PRACTICALS 30

1. Generation of standard Continuous-Time and Discrete-Time Signals using MATLAB
2. Determination of Energy & Power Estimation of signals.
3. Extraction of Even and Odd Components of signals.
4. Estimation of Auto Correlation and Cross Correlation of CT and DT signals
5. Convolution of Discrete-Time signals
6. Functional Implementation of a given LTI System
7. DFT of CT and DT signals
8. Fast Fourier Transform
9. Estimation of Power Spectral Density
10. Implementation of First Order Low-Pass and High Pass-Filters
11. Study of Laplace & Inverse Laplace Transforms
12. Plotting of poles and zeros of Laplace Transforms
13. Determination and plotting of Z- Transform for Time limited signals
14. Plotting of poles and zeros of Z-Transform.
15. Impulse response of given DT Systems.

L –45 ; P – 30 ; Total Hours – 75

TEXT BOOKS:

1. Alan V. Oppenheim, Alan S. Willsky, with S. Hamid Nawab, "Signals and Systems", 2nd Edition, Pearson Education, 2015.
2. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India Pvt Ltd., 2007.
3. Won Young Yang, "Signals and Systems with MATLAB", 1st Edition, Springer, 2011.

REFERENCES:

1. Hwei P. Hsu, "Signals And Systems", 3rd Edition,Schaum's Outlines, McGraw Hill Education, 2017.
2. Luis Chaparro & Aydin Akan, "Signals and Systems using MATLAB", 3rd Edition, Academic Press, (2018)
3. Simon Haykin & Michael Moher, “Communication Systems”, 5th Edition, Wiley India Pvt Ltd., 2009.
4. John G. Proakis & Dimitris G Manolakis, “Digital Signal Processing : Principles, Algorithms, and Applications”, 4th Edition, Pearson India, 2007.

COURSE OUTCOMES:

CO1: Mathematically represent and classify the different types of signals.

CO2: Evaluate and manipulate signals mathematically.

CO3: Identify, and characterize common LTI Systems.

CO4: Apply the tools such as Fourier Transform, Laplace Transform, and Z-Transform in signal processing problems.

CO5: Synthesize discrete-time systems from basic component blocks.

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	PS O1	PSO 2	PS O3
CO1	H	H	M	L	L	L	L	L	L	L	L	L	L	H	L
CO2	M	H	H	M	L	L	L	L	L	L	L	L	L	H	L
CO3	M	H	H	M	L	L	L	L	L	L	L	L	L	H	L
CO4	L	M	H	H	M	L	L	L	L	L	L	L	L	H	L
CO5	L	L	L	M	H	L	L	L	L	L	L	L	L	H	L

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

SDG 3 : Good Health and Well-Being

Statement: Signal processing plays a major role in medical instrumentation. A sound knowledge in these could lead to a substantial research and development in health and well being.

SDG 9 : Industry, Innovation and; Infrastructure

Statement: Signals and its processing forms the basis of control systems and automation.

ECD 2105	**ANALOG ELECTRONIC**	**L**	**T**	**P**	**C**
SDG: 4, 9	**CIRCUITS LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1 : To analyze the characteristics of common emitter and common collector amplifiers

COB2 : To obtain the frequency analysis of various amplifiers

COB3 : To design and analyze characteristics of feedback amplifiers.

COB4 : To design multistage amplifiers and oscillators.

COB5 : To use modern tools for PCB layouts of electronic circuits

PREREQUISITE:

- Electron Devices Lab

LIST OF EXPERIMENTS:

1. To design and test the Emitter follower and Common Emitter amplifier (BJT) using voltage divider bias and determine input, output impedance, gain and bandwidth.
2. To design, test and plot the frequency response of Common Source and Common drain JFET/MOSFET amplifier, and to determine its bandwidth.
3. Determination of frequency response, input impedance and output impedance of two stages RC Coupled Amplifier.
4. Determination of CMRR of Differential amplifier.
5. Design and Analysis of Feedback Amplifiers
6. Design of Class C Single Tuned Amplifier
7. To design and test the RC and LC Oscillator using BJT for the given frequency.
8. Design of Multi vibrator.
9. Simulation of above experiments using Multisim/Cadence/or any EDA tools.

P – 30; Total Hours – 30

TEXT BOOKS:

1. Paul Horowitz and Thomas C. Hayes, "Learning the Art of Electronics: A Hands-On Lab Course Book", Cambridge university press, first edition, 2016.
2. S.V. Subramanian, "Experiments in Electronics Paperback" New Central Book Agency Pvt Ltd, 2011.

REFERENCES:

1. K. A. Navas, “Electronics Lab Manual”, Volume II, PHI, 6th Edition, 2015.
2. S.Poorna Chandra, B.Sasikala, “Electronics Laboratory Primer: A Design Approach”, S Chand, 2nd edition, 2005.

COURSE OUTCOMES:

The Students will be able to

CO1 : Design the circuit to obtain the frequency response for BJT and FET circuits for the given specifications

CO2 : Design RC coupled amplifier and Darlington amplifiers for better gain values

CO3 : Design RC and LC type oscillators for different frequency.

CO4 : Design tuned amplifier for any given frequency

CO5 : Simulate the circuit to meet the given specifications.

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	PSO 1	PSO 2	PSO 3
CO1	M	M	L	L	M	M	L	L	L	L	L	L	L	L	H
CO2	M	M	L	L	M	M	L	L	L	L	L	L	L	L	H
CO3	M	M	L	L	M	M	L	L	L	L	L	L	L	L	H
CO4	M	M	L	L	M	M	L	L	L	L	L	L	L	L	H
CO5	M	M	L	L	M	M	L	L	L	L	L	L	L	L	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 explains the basics of electronic circuits design and its applications which provides impact on quality education

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

Statement. This course will deliver the concepts to design and innovate electronic circuits for modern electronic devices which will enhance quality of life and to meet industry requirements.

ECD 2106	DIGITAL ELECTRONICS	L	T	P	C
SDG: 4, 8, 9	LABORATORY	0	0	2	1

COURSE OBJECTIVES:

COB1: To perform the design of Combinational circuits.

COB2: To verify the functionalities of Flip-flops.

COB3: To design and implement counters.

COB4: To design and analyse the function of shift registers

COB5: To simulate the Verilog programs.

PREREQUISITE:

- Fundamentals of Boolean Algebra
- Knowledge on Number System

PRACTICALS

1. Design and implementation of combinational circuits using logic gates
2. Design and implementation of binary Adder/ subtractor and BCD adder
3. Design and implementation of Magnitude Comparator using logic Gates & 8 Bit magnitude Comparator.
4. Design and implementation of odd/even parity checker generator.
5. Verification of R-S flip-flop, J-K flip-flop, T Flip-Flop, D Flip-Flop Using logic gates.
6. Design and implementation of asynchronous circuits.
7. Design and implementation of synchronous circuits.
8. Design and Implementation of shift registers using Flip - flops.
9. Design and implementation of a simple digital system
10. Simulation of digital circuits using Verilog HDL.
11. Mini project

P – 30 ; Total Hours – 30

TEXT BOOKS:

1. M. Morris R. Mano, Michael D. Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Pearson Education, New Delhi, 6th edition, 2017.
2. D. P. Kothari and J. S Dhillon, “Digital Circuits and Design”, Pearson Education, New Delhi, 2016.

REFERENCES:

1. Charles H.Roth and J.S.Dhillon, “Fundamentals of logic design”, Cengagei, 7th edition, 2019.
2. R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill, New Delhi, 4th Edition, 2010.

COURSE OUTCOMES:

CO1: Analyze and design digital logic circuits. encoder and decoder.

CO2: Design combinational circuits containing logic gates, multiplexer, demultiplexer

CO3: Design sequential circuits containing latch and flip-flops.

CO4: Identify, formlate and solve engineering problems in the area of digital logic circuit design.

CO5: Use the techniques, skills and modern engineering tools like Verilog HDL

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	PSO 3
CO1	H	H	H	H	H	L	M	L	H	M	H	M	L	M	H
CO2	H	H	H	H	H	L	M	L	H	M	H	M	L	M	H
CO3	H	H	H	H	H	L	M	L	H	M	H	M	L	M	H
CO4	H	H	H	H	H	L	M	L	H	M	H	M	L	M	H
CO5	M	M	H	H	H	L	M	L	H	M	H	M	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: Understanding of the digital electronics course will bring a global impact on quality education.

SDG 8: Development of new technologies provides sustainable economic growth and productive employment.

Statement: Analysis and design of digital circuits promote sustained economic growth.

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

Statement: Able to apply the design concepts of digital circuits in IC based design.

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

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
CO1										H					
CO2									M	H					
CO3					L	L									
CO4		M		L											
CO5															

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

ECD 2201	**COMMUNICATION THEORY**	**L**	**T**	**P**	**C**
SDG: 2,3,4,8,11,15,17	**AND SYSTEMS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To describe various continuous wave modulation techniques

COB2: To analyze different types of modulation techniques.

COB3: To compare the performance of communication system with and without noise.

COB4: To Distinguish various pulse modulation and Multiplexing techniques.

COB5: To analyze the effect of multiplexing in the RF chain

PREREQUISITES:

- Basic Mathematics
- Fundamentals of electron devices and circuits.
- Knowledge on Signals and Systems and Random Process

MODULE I AMPLITUDE MODULATION 10

Overview of communication systems-electromagnetic spectrum-ranges and application areas. Need for modulation, Principles of amplitude modulation. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.

MODULE II SSB AND VSB MODULATION 9

Single side-band modulation - Phase discrimination method for generating an SSB modulated wave, Demodulation of SSB waves. Vestigial side band modulation - Generation of VSB modulated wave, Envelop detection of VSB wave plus carrier, Frequency translation, Frequency division multiplexing, Application: Radio broadcasting, AM radio.

MODULE III ANGLE MODULATION 9

Introduction to angle modulation - Frequency modulation, transmission bandwidth of FM signals, frequency spectrum, phase modulation, relationship between FM&PM, narrow band FM & wide band FM. Generation of FM waves: direct method, indirect method. Detection of FM waves: Balanced frequency discriminator, Zero crossing detectors, Phase locked loop, Superhetrodyne Receivers, Fosterseely discriminator, ratio detector. Noise in FM receivers, Threshold effect, Capture effect, FM Threshold reduction.

MODULE IV NOISE THEORY 9

Sources of noise - shot noise, thermal noise, white noise, Noise bandwidth, Noise temperature, Noise figure - Measurement of noise figure, Signal in presence of noise, Narrow band noise. Noise in continuous wave modulation - Noise in SSB and DSB - SC receiver, Noises in AM receiver threshold effect.
Pre-emphasis and De-emphasis.

MODULE V PULSE MODULATION AND MULTIPLEXING TECHNIQUES 8

Sampling of Signals- Pulse modulation - Generation and detection of PAM, PWM and PPM. Multiplexing- TDM, FDM.

L – 45 ; Total Hours – 45

TEXT BOOKS:

1. Simon Haykin, "Communication System", 5th Edition, John Wiley & Sons, 2009.
2. A. Bruce Carlson, Paul B. Crilly, “Communication Systems” McGraw-Hill , 5th Edition, 2011
3. Taub & Schilling, Gautam Sahe, "Principles of Communication Systems", 4th Edition, TMH, 2012.
4. Wayne Tomasi, "Electronic Communication Systems: Fundamentals Through Advanced", 6th Edition, Pearson Education, 2007.

REFERENCES:

1. Roddy and Coolen, "Communication Systems", 4th Edition, PHI learning, New Delhi, 2003.
2. George Kennedy and Bernard Davis, "Electronic Communication Systems", 4th Edition, Tata McGraw Hill, 2008.
3. K.N.Hari Bhat & Ganesh Rao, "Analog communications", 2nd Edition, Pearson Publication, 2008.
4. R.R. Gulati “Modern Television Practice: Principles, Technology and Servicing” 2nd edition, New Age International Publications – 2011

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

CO1: Analyze the need for modulation in Communication systems.

CO2: Choose appropriate modulation based on application.

CO3: Estimate the performance of communication system with and without noise.

CO4: Analyze the effect of multiplexing in communication.

CO5: Recommend the suitable broadcast system based on its performance measures.

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	PSO 3
CO1	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO2	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO3	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO4	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO5	H	H	M	H	L	M	L	L	L	H	H	M	H	M	H

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

SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

Statement: The holistic understanding of communication engineering leads to a connected world with better communication across the globe. This ensures essential meteorological and geo information to farmers at the right time helping those who are facing famine or adverse effects of nature like storm or flood and plan well. Advanced communication techniques help the farmers across the globe to share agriculture ideas to increase production.

SDG3: Ensure healthy lives and promote well-being for all.

Statement: The real understanding of this basic course on communication engineering will make the students to innovate better technologies. This leads to a doctor in New York perform operation for a patient in rural areas of India.

SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Statement: The holistic understanding of the course will bring global impact on quality education. Advanced communication technology can improve the quality of life style.

SDG8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: The understanding of the Communication engineering course helps in providing Safe and inclusive work environment for professionals during pandemic period.

SDG11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: the principles of communication engineering help to develop systems and processes globally, it ensures safety, and security across engineered systems by connecting all through wired or wireless.

SDG15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss.

Statement: The course will lay strong foundation to develop advanced communication techniques like solar operated sensors that can communicate the environmental (forest/trees) conditions to take precautionary steps and avoid forest fire and deforestation.

SDG17 Strengthen the means of implementation and revitalize the global partnership for sustainable development

Statement: The holistic understanding of the course will enable the engineers to design sustainable solutions on telecommunications.

		L	T	P	C
ECD 2202	**LINEAR INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
SDG: 4, 9		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1: To describe the characteristics and internal circuit of op-amps**.**

COB2: To design the various linear and non-linear applications of op-amps.

COB3: To design and characterize the data converters and active filters.

COB4: To explain and characterize the Timer IC and PLL.

COB5: To explain and characterize the special purpose ICs like voltage regulators, switched capacitor filters.

PREREQUISITES:

- Comprehensive knowledge in Network Analysis and Synthesis
- Basics of Electronic circuits

MODULE I INTRODUCTION AND CIRCUIT CONFIGURATION OF LINEAR ICS 5

OP-AMP fundamentals, ac and dc characteristics, basic building blocks of OP-AMP. Op-Amp functionality: virtual ground, Inverting and non-inverting modes.

MODULE II APPLICATIONS OF OPERATIONAL AMPLIFIERS 8

Linear circuits: adder, subtractor, difference amplifier; Differentiator, Integrator, V to I converter and I to V converter, Instrumentation Amplifier, sine wave Oscillators. Non-linear circuits: Precision rectifier, Comparator, Schmitt trigger, Multivibrators, Triangular wave generator, Multiplier and phase detector.

MODULE III CONVERTERS AND FILTERS 9

Analog switches, High speed Sample and Hold circuit. DAC techniques: Weighted Resistor, R-2R ladder, Inverted R-2R ladder, ADC techniques: Flash type, Counter type, Successive approximation, Single slope and Dual slope.DAC and ADC specifications - Linearity, accuracy, Monotonicity, Settling time and stability.

Active filters: First order and Second order LPF and HPF

MODULE IV TIMER IC AND SPECIAL PURPOSE ICS 8

555 timer IC, Applications: Astable and Monostable operation, Active filters, PLL and Closed loop analysis of PLL, Applications of PLL: IC Voltage regulators – General purpose, variable regulator Switched capacitor filter- IC MF10, Frequency to Voltage and Voltage to Frequency converters.

PRACTICALS

1. Inverting and Non-Inverting Amplifiers and Voltage follower – Application as Buffer/Isolator.
2. Adder, Subtractor, Difference amplifier, Integrator, Differentiator – Application of Analog computation.
3. Instrumentation Amplifier – Signal extraction from sensor and measurement of CMRR
4. Active Butterworth Filters – As distortion eliminators in Audio amplifiers
5. Multivibrators and Schmitt Trigger using operational amplifier – Function generator
6. Phase shift and Wien bridge oscillators using operational amplifier – Variable low frequency generator.
7. Design of Multivibrators using 555 timer – Clock Pulse generator.
8. PLL characteristics and its application as Frequency Multiplier.
9. DC power supply using LM317 and LM723.
10. Simulation using PSpice, Netlist of above experiments
    Mini project using above experiments

L –30 ; P – 30 ; Total Hours – 60

TEXT BOOKS:

1. D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", 5th Edition, New Age International Pvt. Ltd., 2018.
2. Gray and Meyer, 'Analysis and Design of Analog Integrated Circuits', 4th Edition, Wiley International, 2009.
3. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, TMH. 2007.

REFERENCES:

1. Ramakant A. Gayakwad, 'OP-AMP and Linear IC's', 4th Edition, Prentice Hall / Pearson Education,2015.
2. Millman.J. and Halkias.C.C. 'Integrated Electronics', 2ndEdiiton, McGraw-Hill, 1972.
3. William D.Stanely, 'Operational Amplifiers with Linear Integrated Circuits'.4th Edition, Pearson Education, 2004.
4. Sedra & Smith, "Micro Electronic Circuits", 5th Edition, Oxford University Press, 2004.

COURSE OUTCOMES:

CO1: Determine the difference between ideal and practical AC & DC characteristics of an Operational Amplifier.

CO2: Differentiate linear and non-linear applications of operational amplifiers

CO3: Design a circuit to generate waveforms using Op-Amp.

CO4: Apply IC 555 and PLL for different applications

CO5: Identify the special purpose ICs

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	PSO3
CO1	H	H	M	L	L	L	L	L	L	L	L	L	H	L	M
CO2	H	H	H	L	H	L	H	L	M	L	L	M	H	L	M
CO3	H	H	M	M	M	L	L	L	M	L	L	L	H	L	M
CO4	H	H	M	M	M	L	M	L	M	L	L	L	H	L	M
CO5	H	H	M	H	H	M	L	M	H	L	M	M	H	L	H

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

SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Statement: The holistic understanding of the course will bring global impact on quality education. Integrated circuit design and analysis can improve the quality of life style.

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
Statement: Able to apply the design concepts of linear integrated circuit design in designing IC technology.

ECD 2203	VLSI DESIGN	L	T	P	C
SDG: 4,9,12		3	0	0	3

COURSE OBJECTIVES:

COB1: To discuss fundamentals of MOS technology
COB2: To design the basic building blocks of digital integrated circuits.
COB3: To analyse the performance of combinational sequential logic circuits
COB4: To describe the subsystem of ASICs and FPGAs
COB5: To develop the VLSI digital system using Verilog

PREREQUISITES:

Fundamentals of Digital Electronics and its applications
Fundamentals of Electronic Devices and Circuits.

MODULE I INTRODUCTION TO VLSI DESIGN 10

VLSI design methodology, VLSI technology- NMOS, PMOS, CMOS fabrication, Layout design rules, Stick diagram, MOSFET as a switch, Threshold Voltage of MOSFET, Current-Voltage characteristics, Transfer Characteristics, Second Order Effects, Interconnect Parameters — Capacitance, Resistance, and Inductance.

MODULE II COMBINATIONAL LOGIC CIRCUITS USING CMOS 9

The Static CMOS Inverter — An Intuitive Perspective, Evaluating the Robustness of the CMOS Inverter: The Static Behavior, Performance of CMOS Inverter: The Dynamic Behavior, Power, Energy, and Energy-Delay, Static CMOS Design, Dynamic CMOS Design.

MODULE III SEQUENTIAL LOGIC CIRCUITS USING CMOS 9

Static Latches and Registers, Dynamic Latches and Registers, Pipelining: An approach to optimize sequential circuits, Non-Bistable Sequential Circuits.

MODULE IV SUB SYSTEM DESIGN 8

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, An overview of the features of FPGAs, IP cores, Soft core processors, Comparison of ASICs, FPGAs.

MODULE V DESIGN OF VLSI SYSTEMS 9

Design of MAC Unit using Verilog, Design of Vending Machine Block using Verilog, Design of FIR Filter using Verilog, Design of ALU using verilog.

L – 45; Total Hours –45

TEXT BOOKS:

1. John P. Uyemura: Introduction to VLSI Circuits and Systems, J.Wiley, 2nd Edition, New York, 2009
2. Rabaey, Jan M., Anantha P. Chandrakasan, and Borivoje Nikolić. Digital integrated circuits: a design perspective. Prentice Hall of India, 3rd edition,New Jersey, 2014.
3. Smith, Michael John Sebastian. Application-specific integrated circuits. Vol. 7.MA: Addison-Wesley, 1997.
4. Samir Palnitkar, Verilog HDL, A guide to digital design and synthesis, PHI, 2010.

REFERENCES:

1. Neil H. E Weste, David Harris, Ayan Banerjee,CMOS VLSI Design – A Circuits and Systems Perspective, 4th Ed, Pearson Education,Noida, India, 2014.
2. Sung-Mo (Steve) Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis & Design 3rd Edition, Mc Graw-Hill 2003.J.
3. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004
4. Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, “Essentials of VLSI circuits and systems” , PHI, 2005.
5. Frank Vahid, Roman Lysecky, “Verilog for Digital Design”, Wiely, 2007
6. Joseph Cavanagh, Digital Design and Verilog HDL fundamentals, CRC Press, 2007.

COURSE OUTCOMES:

CO1: Describe the techniques used for VLSI fabrication

CO2: Analyse the characteristics of VLSI circuits and its performance measures

CO3: Implementation of combinational and sequential logic circuits at the transistor level

CO4: Design the subsystem blocks for processor

CO5: Develop the Verilog programs for VLSI systems

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	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	H	H	L	M	M	H	L	H	M			H
CO2	H	L	M	M	L	L	M	M	H	L	H	M			H
CO3	H	L	M	M	L	L	M	M	H	L	H	M			H
CO4	H	L	H	M	L	L	M	M	H	L	H	M			H
CO5	H	H	H	M	H	L	M	M	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.

SDG 12 : Responsible Consumption and Production
Statement: Understand the market needs based on current technology trends in Integrated circuits market.

ECD 2204	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
SDG: 3, 9		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To use the discrete Fourier transform in digital Filter design.

COB2: Familiarize on design of FIR and IIR Digital filters.

COB3: To analyse the concept of quantization noise and its effects in digital system design.

COB4: To discuss signal processing concepts in systems having more than one sampling frequency.

COB5: To describe the architecture and features of digital signal processors

PRE-REQUISITES:

Knowledge on Signals and systems

MODULE I DISCRETE FOURIER TRANSFORM 9+3

Introduction to Discrete Fourier Transform, Direct computation of DFT and Inverse DFT, Properties of DFT, Radix-2 FFT algorithms -Decimation in Time, Decimation in Frequency algorithms, Applications of FFT- IFFT in LTE and 5G-NR

MODULE II DESIGN AND IMPLEMENTATION OF IIR AND FIR FILTERS 12+3

Design of Low Pass Butterworth filters - analog to analog transformation - Analog to digital transformation, Bilinear transformation - Impulse invariant transformation. Frequency response of FIR filters, Linear phase filters - Windowing techniques for design of Linear phase FIR filters Application

MODULE III FINITE WORD LENGTH EFFECTS 9+3

Representation of numbers - Fixed point and binary floating point number representation - comparison, errors due to truncation and rounding- off, Quantization noise - derivation for quantization noise power at the input and output of a digital filter, Coefficient quantization error -product quantization error, Round-off effects in digital filters, Limit cycle oscillation.

MODULE IV MULTIRATE DIGITAL SIGNAL PROCESSING 9+3

Interpolation and Decimation, Decimation by an integer factor, Interpolation by an integer factor, Sampling rate conversion by a rational factor, Time and frequency domain descriptions - Quadrature Mirror Filter banks - Sub-band Coding.

MODULE V DIGITAL SIGNAL PROCESSORS 6+3

Introduction to DSP processor, Architecture of TMS320C5X and C54X, Blackfin Processor, Overview of instruction set of DSP processor.

L – 45; T-15; Total Hours – 60

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. B.Venkataramani, M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application", 2nd Edition, TMH 2002.

REFERENCES:

1. Emmanuel C. Ifeachor, Digital Signal Processing A Practical Approach, 2011, 2nd edition reprint, Prentice Hall, New Jersey, US.
2. Oppenhiem V.A.V and Schaffer R.W, Discrete – time Signal Processing, 2013, 3rd edition, Prentice Hall, New Jersey, US.
3. Richard G Lyons and D.Lee Fugal, The Essential Guide to Digital Signal Processing, 2014, Prentice Hall, New Jersey, US.

COURSE OUTCOMES:

CO1: Apply the transform on discrete-time signals

CO2: Analyze the basic forms of FIR and IIR filters and, to design filters with desired frequency responses.

CO3: Analyze the effect of finite word length in the DSP systems.

CO4: To apply sampling rat of finite word length in the DSP system.

CO5: Apply digital signal processing concepts in audio, video signals.

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	PSO 3
CO1	H	H	M	L									L	H	L
CO2	M	H	H	M	L									H	
CO3	M	H	H	M	L								L	H	
CO4		M	H	H	M									H	
CO5				M	H								L	H	

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

SDG 3 : Good Health and Well-Being

Statement : Digital signal processing plays a major role in medical instrumentation. A sound knowledge in these could lead to a substantial research and development in health and well-being.

SDG 9 : Industry, Innovation & Infrastructure

Statement : Signals and its processing forms the basis of control systems and automation.

ECD 2205	**MICROCONTROLLER**	**L**	**T**	**P**	**C**
SDG: 4, 9	**ARCHITECTURE AND PROGRAMMING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To analyze the internal organization, addressing modes and instruction sets of 8086 processor

COB2:To describe the programming concepts and interfacing techniques of 8086 microprocessor

COB3: To explain the basic concepts and programming of 8051 microcontroller

COB4:To analyze peripheral devices and interfacing with 8051 microcontroller

COB5: To describe ARM processor architecture and its instructions sets

PREREQUISITES:

- Digital Electronics

MODULE I 8086 MICROPROCESSOR 9

8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Timing Diagram, interrupts of 8086.

MODULE II PROGRAMMING in 8086 9

Addressing modes - Instruction set – Data transfer instructions, Arithmetic Instructions, Logical instructions, String manipulation instructions and control

transfer instructions - Assembly language Programming- interfacing with 8255 PPI.

MODULE III 8051 MICROCONTROLLER 9

Architecture of 8051 – Special Function Registers (SFRs) – I/O Ports and Memory organization – Instruction set – Addressing modes – Assembly language programming.

MODULE IV INTERFACING WITH 8051 MICROCONTROLLER 9

Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing-External Memory Interface- Stepper Motor interface.

MODULE V ARM PROCESSOR 9

ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions, Program status register instructions, loading constants, conditional execution, Introduction to Thumb instructions.

L – 45 ; Total Hours - 45

TEXT BOOKS:

1. Barry B.Brey, "The Intel Microprocessors: Architecture, Programming, and Interfacing", Pearson Education India; 8th edition, 2008.
2. Kenneth. J. Ayala, "The 8051 Microcontroller Architecture Programming and Application", Cengage Learning, 3rd Ed, 2004.
3. Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, University of Manchester, Addison-Wesley Professional, 2001.

REFERENCES:

1. Doughlas V. Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012.
2. Mohammed Ali Mazidi and Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education Asia, New Delhi, 2003.
3. Stephen Smith, "Programming with 64-Bit ARM Assembly Language: Single Board Computer Development for Raspberry Pi and Mobile Devices", Apress; 1st ed. Edition 2020.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Analyze the organization of registers and memory in microprocessors and microcontroller

CO2: Prioritize interrupts for executing the respective ISR.

CO3: Identify the addressing mode and calculate the number of T- states required for the execution of an instruction

CO4: Develop assembly language programs suitable for real time applications using microprocessors / microcontroller.

CO5: Design and develop applications using Microcontroller boards

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	PSO 3
CO1	M	M	M	-	-	-	-	-	M	-	-	M	L	L	H
CO2	M	H	M	-	-	-	-	-	M	-	-	M	L	L	H
CO3	M	H	M	-	H	-	-	-	M	-	-	M	H	L	H
CO4	L	L	L	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	M	L	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 assembly language programming concepts of microprocessor and microcontrollers helps for lifelong learning of newer technologies and concepts related to the microcontroller based system.

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

Statement: Able to apply the programming concepts of microcontroller based system for the various real time applications.

ECD 2206	MICROCONTROLLER PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

SDG: 4, 9

COURSE OBJECTIVES:

COB1: To apply the concept of Assembly Language Programming (ALP)

COB2: To develop skills in assembly language programming to program using 8086 instruction sets.

COB3: To analyze the microcontroller programming and interfacing of 8051 Microcontroller.

COB4: To access and program on chip peripherals in 8051

COB5: To select and use the advanced microcontroller boards in appropriate electronic systems.

PREREQUISITES:

- Knowledge on Digital Electronics
- Instruction sets of 8086 Microprocessor & 8051 Microcontroller

PRACTICALS:

List of Experiments:

1. Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations using 8086
2. Interfacing 8255 PPI with 8086
3. Arithmetic, Logical and bitwise operation using 8051
4. I/O Port programming in 8051
5. Programming 8051 Timers and Counters
6. Programming onchip UART
7. Sensor Interfacing with 8051
8. Interface 8279 with 8051
9. Stepper motor interfacing with 8051
10. Interfacing Traffic Light Control System with 8051
11. Study on Atmel AVR, PIC and ARM Processor boards.

P – 30; Total Hours – 30

REFERENCES:

1. Doughlas V.Hall, “Microprocessors and Interfacing, Programming and Hardware”, TMH, 2012.
2. Mohammed Ali Mazidi and Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education Asia, New Delhi, 2003.
3. Subrata Ghoshal, “8051 Microcontroller: Internals, Instructions, Programming & Interfacing”, Pearson Education,2010.

COURSE OUTCOMES:

CO1: Develop the assembly language program for the basic arithmetic and logical operations of 8086 Microprocessor and 8051 Microcontroller.

CO2: Interface different peripheral devices with Microprocessor / Microcontroller

CO3: Interface Microcontroller and PC.

CO4: Analyze the 16 bit and 32bit microcontroller boards

CO5: Develop applications using Microprocessor/Microcontroller based systems.

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	PSO 3
CO1	M	M	M	-	-	-	-	-	M	-	-	M	L	L	H
CO2	M	H	M	-	-	-	-	-	M	-	-	M	L	L	H
CO3	M	H	M	-	H	-	-	-	M	-	-	M	H	L	H
CO4	L	L	L	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	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 the architecture of microprocessor and microcontrollers, Instructions sets, Memory mapping, addressing modes, applications helps for lifelong learning of newer technologies and concepts related to the design of electronic products.

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

Statement: Able to apply the theoretical and programming concepts of different microcontrollers for the various real time application.

ECD 2207	**VLSI DESIGN LABORATORY**	**L**	**T**	**P**	**C**
SDG: 4,9,12		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To test the function of combinational and sequential circuits using Verilog HDL

COB2: To simulate and synthesis on FPGAs.

COB3: To estimate power and delay of logic circuits in FPGAs

COB4: To design CMOS circuits for functional verification

COB5: To estimate power and delay of logic circuits in full custom design

PREREQUISITES:

- Principles of Digital Electronics and its systems
- VLSI Design

PRACTICALS

List of Experiments:

1. Design, simulate and synthesis of adders and subtractors using HDL.
2. Design, simulate and synthesis of Multiplexers & demultiplexers using HDL.
3. Design, simulation and synthesis of multipliers using HDL.
4. Design, simulation and synthesis of flip flops using HDL.
5. Design, simulation and synthesis of shift registers and counters using HDL.
6. Design, simulation and synthesis of Simple Processor Design using HDL.
7. EDA Tool Demonstration for front end design
8. Design of Basic Cell structure (NMOS & PMOS) using conventional MOS using EDA tool
9. Design of CMOS inverter using EDA tool.
10. Adder Design using conventional CMOS using EDA tool.
11. Multiplier using conventional CMOS using EDA tool.
12. Design and Analysis of CMOS circuits (Analysis: Power, Delay, NM, PDP)

P – 30 ; Total Hours – 30

TEXT BOOKS:

1. Samir Palnitkar, Verilog HDL, A guide to digital design and synthesis, PHI, 2010.
2. John P. Uyemura: Introduction to VLSI Circuits and Systems, J.Wiley, 2nd Edition, New York, 2009

REFERENCES:

1. Rabaey, Jan M., Anantha P. Chandrakasan, and Borivoje Nikolić. Digital integrated circuits: a design perspective. Prentice Hall of India, 3rd edition, New Jersey, 2014.
2. Digital Design: With an Introduction to the Verilog HDL, 5th Edition by M Morris Mano and Michael Ciletti, Pearson publications, 2013.
3. Fundamentals of Digital Logic with Verilog Design, Third Edition, Stephen Brown, Mc, Graw Hill, 2014

COURSE OUTCOMES:

CO1: Write Verilog code for combinational circuits and sequential circuits

CO2: Simulate the combinational circuits and sequential circuits using Xilinx ISE

CO3: Synthesize the designed digital circuits using Spartan FPGA kits.

CO4: Implement the full custom design of VLSI circuits in EDA tools.

CO5: Estimate the power and delay of the digital circuit

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	PSO 3
CO1	H	H	M	H	H	L	M	M	H	L	H	M			H
CO2	H	L	M	M	L	L	M	M	H	L	H	M			H
CO3	H	L	M	M	L	L	M	M	H	L	H	M			H
CO4	H	L	H	M	L	L	M	M	H	L	H	M			H
CO5	H	H	H	M	H	L	M	M	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.

SDG 12 : Responsible Consumption and Production

Statement: Understand the market needs based on current technology trends in Integrated circuits market

.

ECD 2208	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
SDG: 3, 9	**LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To implement digital signal processing systems in the time domain.

COB2: To Compute convolution and the discrete Fourier transform (DFT) of discrete-time signals.

COB3: To design digital filters

COB4: To evaluate the multi rate signal processing

COB5: To analyse the architecture of DSP processor and implement digital systems using the DFT

PREREQUISITES:

- Basic concepts of Signals and systems
- Fundamentals of various transforms

PRACTICALS

LIST OF EXPERIMENTS USING SIMULATION TOOL

1. Frequency response of LTI system.
2. Linear convolution/Circular convolution
3. Discrete Fourier Transform & Fast Fourier Transform
4. Design of IIR filter using Impulse invariant and Bilinear transformation
5. Design of FIR filter using windows
6. Sampling and reconstruction of a signal
7. Sampling rate conversion-interpolation & decimation.

LIST OF EXPERIMENTS USING DSP PROCESSOR

8.Linear convolution using TMS320C54X

9.Circular convolution using TMS320C54X

10. Discrete Fourier Transform using TMS320C54X

11. Inverse Discrete Fourier Transform using TMS320C54X

12. Mini project

P – 30 ; Total Hours – 30

TEXT BOOKS:

1. S.K.Mitra, "Digital Signal Processing- A Computer based approach", 4th Edition Tata McGraw-Hill, New Delhi, 2013.

REFERENCES:

1. Nasser kehtarnavaz and Namjin Kim, “Digital Signal processing system-level design using LabVIEW”, Newnes- Elsevier,2005.
2. B.Venkataramani, M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application", 2nd Edition, TMH 2002.

COURSE OUTCOMES:

CO1: Use DSP tools to analyze discrete time signals and systems

CO2: Analyze the properties of discrete time signals and systems and identify its implication for practical systems.

CO3: Evaluate the discrete Fourier transform (DFT) & FFT of a sequence

CO4: Design digital IIR and FIR filter.

CO5: Implement convolution using DSP processor.

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	PSO 3
CO1	H	H	M	L									L	H	L
CO2	M	H	H	M	L									H	
CO3	M	H	H	M	L								L	H	
CO4		M	H	H	M									H	
CO5				M	H								L	H	

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

SDG 3 : Good Health and Well-Being

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 9 : Industry, Innovation & Infrastructure

Statement : Signals and its processing forms the basis of control systems and automation.

GED 2201	**WORKPLACE SKILLS AND APTITUDE**	**L**	**T**	**P**	**C**
SDG: 8	**FOR ENGINEERS**	**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	PO11	PO12	PSO1	PSO2	PSO3
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.

		L	T	P	C
GED 2202	**INDIAN CONSTITUTION AND HUMAN RIGHTS**				
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) :	**Academic Council:**
4^{th}BoS of SSSH held on 28.06.2021	17^{th} 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.

PROFESSIONAL ELECTIVES

IV SEMESTER

		L	T	P	C
ECDX 001	**COMPUTER ARCHITECTURE**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To discuss the characteristics of functional units of computer system and its operations

COB2: To apply the concept of memory interfacing and various I/O devices

COB3: To select the specific hardware components and analyze its performance

COB4: Apply the algorithms to implement arithmetic and logic operations

COB5: To analyze the concepts of pipelining and the hierarchy of memory system

MODULE I INTRODUCTION 9

Classes of Computing Applications and Their Characteristics, Eight Great Ideas in Computer Architecture, High-level language to the language of hardware, Under the covers, Function and structure of a computer, Functionality of computer hardwares, Communicating with other computers, Technologies for building Processors and memory, Performance, the power wall, the switch from uniprocessors to multicore processors.

MODULE II ARITHMETIC OPERATIONS 9

Addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic: Subword parallelism, streaming SIMD Extensions and Advanced Vector Extensions in x86.

MODULE III PROCESSOR SUBSYSTEMS 9

Logic Design Conventions, Building a Datapath, A Simple Implementation Scheme, An Overview of Pipelining, Pipelined Datapath and Control, Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions, ARM Cortex-A8 and Intel Core i7 Pipelines

MODULE IV MEMORY ORGANIZATION 9

Memory Technologies, Basics of Caches, Measuring and Improving Cache Performance, Dependable Memory Hierarchy, Virtual Machines, Virtual Memory, Parallelism and Memory Hierarchies: Cache Coherence

MODULE V OVERVIEW OF OPERATING SYSTEM 9

Computer-System Organization-Operating-System Structure -Operating-System Operations - Process Management - Memory Management -Storage Management - Protection and Security - Kernel Data Structures - Computing Environments - Operating system structures - System Calls – OperatingSystem Design and Implementation - Operating-System Debugging - Operating-System Generation .

L – 45 ; Total Hours – 45

TEXT BOOKS:

1. C.Hamacher Z. Vranesic and S. Zaky, "Computer Organization", McGraw-Hill, 2002.
2. W. Stallings, "Computer Organization and Architecture - Designing for Performance", Prentice Hall of India, 2002.

REFERENCES:

1. William Stallings, "Computer Organization & Architecture - Designing for Performance", 6th Edition, Pearson Education, 2003 reprint.
2. David A. Patterson and John L.Hennessy, "Computer Organization & Design, the hardware / software interface", 2nd Edition, Morgan Kaufmann, 2002
3. John P.Hayes, "Computer Architecture & Organization", 3rd Edition, McGrawHill, 1998.

COURSE OUTCOMES:

CO1: Apply the basic knowledge of digital concept to the functional components of a Computer System.

CO2: Analyze the addressing mode concepts and design the instruction set Architecture

CO3: Identify the functions of various processing units within the CPU of a Computer System

CO4: Analyze the function of the memory management unit and create suitable memory interface to the CPU.

CO5: Recognize the need for recent Bus standards and I/O devices.

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	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M				M		L	L		M	H			H
CO2	M	M				M		L	L		M	H			H
CO3	M	M				M		L	L		M	H			H
CO4	M	M				M		L	L		M	H			H
CO5	M	M				M		L	L		M	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: This course discusses about the basic electronics of computer system and its structure. This knowledge provides quality education and promotes lifelong learning opportunities for all.

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

Statement: It proves the performance improvement in hardware and software of computer architecture.

ECDX 002	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

SDG: 4,7,9

COURSE OBJECTIVES:

COB1 : To describe the modeling of control systems.

COB2 : To analyze the properties of control system in time domain & frequency domain.

COB3 : To design feedback controllers and compensators

COB4 : To analyze the stability of the control system.

COB5 : To discuss about the state variable representation of physical systems and define the effect of state feedback

MODULE I CONTROL SYSTEM MODELING 8

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques - Signal flow graph.

MODULE II TIME RESPONSE ANALYSIS 10

Time response analysis - First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors – P, PI, PD and PID Compensation, Analysis using MATLAB.

MODULE III FREQUENCY RESPONSE ANALYSIS 10

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol‟s Chart - Use of Nichol‟s Chart in Control System Analysis.

MODULE IV STABILITY ANALYSIS & DESIGN OF COMPENSATORS 10

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability, Series, Parallel, series-parallel Compensators - Lead, Lag, and Lead Lag Compensators.

MODULE V STATE VARIABLE ANALYSIS 7

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability – State space representation for Discrete time systems. Sampled Data control systems – Sampling Theorem – Sampler & Hold – Open loop & Closed loop sampled data systems.

L – 45 ; Total Hours – 45

TEXT BOOKS:

1. FaridGolnaraghi, Benjamin C. Kuo," Automatic Control Systems", McGraw Hill Professional, Tenth Edition, 2017.
2. Katsuhiko Ogata," Modern Control Engineering" Prentice Hall, 5e, 2010.
3. J. Nagrath, M. Gopal Control Systems Engineering, Anshan, 5e, 2008
.

REFERENCES:

1. William S. Levine, "The Control Handbook, Second Edition: Control System Fundamentals" CRC Press, 2010.
2. Jesus C. De Sosa, "Control Systems: Analysis and Realization ", iUniverse, 2010

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 : develop mathematical models of control components and systems

CO2 : design controllers for systems

CO3 : analyze the system in time and frequency domain

CO4 : use the Root Locus method, Routh Hurwitz array and Nyquist stability criterion to find stability of a system

CO5 : obtain and manipulate state space representation of systems

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	PSO1	PSO2	PSO3
CO1	H	H	M	L	L	L	L	L	L	L	L	L	H	L	M
CO2	H	H	H	L	L	L	M	L	L	L	M	M	H	L	M
CO3	H	H	H	H	L	L	L	M	L	L	L	L	H	H	H
CO4	H	H	H	H	H	L	L	L	L	L	L	L	H	M	H
CO5	H	H	H	H	H	L	L	L	L	H	M	M	M	L	M1

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

SDG 4: Quality Education

Statement: A fundamental concept of control system and its characteristic analysis provides a global impact on quality education in the industries.

SDG 7: Affordable and Clean Energy

Statement: Practical applications of control system model offer an impact on affordable and clean energy in overall machine operations.

SDG 9: **Industry, Innovation and Infrastructure**

Statement: Build resilient Infrastructure; promote inclusive and sustainable industrialization through EM wave propagation within the industry.

ECDX 003	DATA STRUCTURE AND ITS	L	T	P	C
SDG: 4,9	ALGORITHMS	2	0	2	3

COURSE OBJECTIVES:

COB1: To describe the fundamental concepts of data structure.
COB2: To analyze the basic operations of stacks and queues for real time scenario.
COB3: To comprehend the significance of sorting algorithms.
COB4: To demonstrate the understanding of various searching algorithms.

MODULE I INTRODUCTION 6

Basic Terminology, Classification, Operations, Abstract Data Type, Algorithms- characteristics and Building blocks of algorithm, Time and Space Complexity, Big O Notation, Omega Notation (Ω), Theta Notation (Q), Array-Declaration of Arrays- Operations on Arrays- Multi-dimensional Arrays

MODULE II LINEAR DATA STRUCTURES 8

Linked Lists- Basic Terminologies- operations- types-Applications of Linked Lists, Introduction to Stacks- Array and Linked List Representation of Stacks-Operations on a Stack- Applications of Stacks- Introduction to Queues- Array and Linked List Representation of Queues - Operations on a Queues -Types-Applications of Queues

MODULE III NON LINEAR DATA STRUCTURES 8

Basic Terminology of trees-Types- Binary Tree, Threaded Binary Trees, AVL Trees- Traversing a Tree-operation-Heap - Graph Terminology-types-Matrix and List representation of Graph- Graph Traversal Algorithms- Shortest Path Algorithms- Hash and Collision

MODULE IV SEARCHING AND SORTING 8

Introduction to Searching- Linear Search, Binary Search- Introduction to Sorting- Bubble Sort- Selection Sort-Insertion Sort- Merge Sort- Quick Sort-Heap Sort.

PRACTICALS

List of Experiments

1. Basics of C Programming language

2.Implementation of Linear Data Structures
3.Implementation of Non Linear Data Structures
4.Implementation of Searching algorithm
5.Implementation of Sorting algorithm
6.Problem solving Application using Data structure algorithms

L –30 ; P – 30 ; Total Hours – 60

TEXT BOOKS:

1. Mark A.Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 2010.
2. Reema Thareja, “Data Structures Using C”, Second Edition , Oxford University Press, 2019

REFERENCES:

1. Salaria R S, “Data Structues and Algorithms using C”, Fifth Edition, Khanna Book Publishing, New Delhi, 2012
2. Venkatesan R and Lovelyn Rose S, “Data Structures”, Wiley India Pvt.Ltd., New Delhi, 2015.
3. Karumanchi Narasimha, ”Data Structures and Algorithms Made Easy”, Fifth Edition, CareerMonk Publication, 2016
4. Seymour Lipschutz,”Data Structures using C”, First Edition, McGraw Hill Education, 2017.

COURSE OUTCOMES:

CO1: Apply linear and non-linear data structures like stacks, queues, linked list etc.
CO2: Compare between different data structures. Pick an appropriate data structure for a design situation.
CO3: Analyze, evaluate and choose appropriate abstract data types and algorithms to solve particular problems.
CO4: Analyze and evaluate the efficiency of searching and sorting algorithms.
CO5: Formulate new solutions for programming problems or improve existing code using learned algorithms and data structures.

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	PSO3
CO1	M	M				M		L	L		M	H			H
CO2	M	M				M		L	L		M	H			H
CO3	M	M				M		L	L		M	H			H
CO4	M	M				M		L	L		M	H			H
CO5	M	M				M		L	L		M	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: Data structures is a basic building block for real time Problem solving and Artificial intelligence

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

Statement : Able to apply the data structure concepts and algorithms for the various applications.

ECDX 004	SENSOR AND ACTUATOR	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: Acquire knowledge on Data Acquisition Systems

COB2: To gain knowledge on characteristics of sensors and measurement errors.

COB3: Get exposed to different types of resistive, inductive and capacitive sensors

COB4: Analyze the static and dynamic characteristics of sensors

COB5: To impart knowledge on programming and interfacing of sensors with microcontroller

MODULE I DATA ACQUISITION AND CHARACTERISTICS OF SENSORS 8

Data Acquisition, Transfer Functions-Mathematical Models, Calibration, Computation of Parameters and Stimulus, Sensor Characteristics-Sensors for Mobile Communication Devices, Full-Scale I/O, Accuracy, Calibration Error, Dynamic Models of Sensor Elements-Reliability.

MODULE II PHYSICAL PRINCIPLES OF SENSING 8

Electric Charges, Fields, and Potentials-Capacitance-Magnetism-Induction-Resistance-Piezoelectric Effect-Pyroelectric Effect-Hall Effect-Thermoelectric Effects-Sound Waves-Temperature and Thermal Properties of Materials-Heat Transfer.

MODULE III OPTICAL AND ELECTRONIC CIRCUITS FOR SENSOR 8

Light-Energy of Light Quanta, Light Polarization and Scattering-Radiometry-Photometry-Mirrors-Lenses-Optical Efficiency-Signal Conditioners-Sensor Connections and excitation circuits -Integrated Interfaces-Data Transmission-Noise in Sensors and Circuits-Batteries for Low-Power Sensors.

MODULE IV TYPES OF SENSORS 8

IR sensor, Proximity sensor, Accelerometer, Temperature sensor, Flow sensor, Ultrasonic sensor, LDR, Gas sensor, piezoelectric sensor, Bio sensors-Pressure sensor.

MODULE V APPLICATION DESIGN USING SENSORS 8

Introduction to Atmega328 microcontroller and on-chip peripherals - Arduino IDE -API programming –Interfacing and calibrating–Digital & Analog sensor – Case Study.

L – 45 ; Total Hours – 45

TEXT BOOKS:

1. Jacob Fraden, “Handbook of Modern Sensors: Physics, Design and Applications”, 5th Edition, Springer, USA,2016,
2. Margolis, Michael, Brian Jepson, and Nicholas Robert Weldin, “Arduino cookbook: recipes to begin, expand, and enhance your projects”, O'Reilly Media, 2020.

REFERENCES:

1. Kevin James, “PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control”, Newnes, 2000
2. Doebelin E.O. and Manik D.N., “Measurement Systems”, 6th Edition, Tata McGraw-Hill Education Pvt. Ltd., 2011
3. John P. Bentley, “Principles of Measurement Systems”, 4th Edition, Pearson Education, 2004.
4. McRoberts, Michael. “Beginning Arduino”, A press, 2011.

COURSE OUTCOMES:

CO1: Describe the mathematical fundamentals of sensors

CO2: Design data acquisition systems for practical applications.

CO3: Examine the measurement metrics of sensors

CO4: Select the suitable sensor for a real time application

CO5: Develop the application using sensors and microcontrollers

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	PSO3
CO1	H	H	M	L	L	-	-	-	-	-	-	-	L	-	-
CO2	H	M	M	L	L	-	-	-	-	-	-	-	L	-	-
CO3	H	M	L	L	L	-	-	-	-	-	-	L	L	-	-
CO4	H	H	M	L	L	L	L	-	-	-	-	L	L	-	-
CO5	H	M	H	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 Life long learning opportunities for all.

Statement: This course enables the student to understand the basic concepts of Data Acquisition, Characteristics of sensors, physical principles of sensing and applications helps for lifelong learning of newer technologies and concepts related to the sensors.

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

Statement : Able to apply the theoretical concepts of sensors and designing concepts for the various applications using sensors.

MATHEMATICS ELECTIVE
(SEMESTER III)

		L	T	P	C
MADX 01	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**				
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To formulate and solve partial differential equations 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 analytic solutions of PDEs by using Fourier series

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 APPLICATIONS OF FOURIER SERIES 9+3

Applications of Fourier series to solution of PDEs having constant coefficients with special reference to Heat & Wave equations, Discrete and point Spectrum and Single pulse.

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 using different methods

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 partial differential equations by using Fourier series

CO5: solve difference equations using Z-transform

Board of Studies (BoS) :	**Academic Council:**
12th BOS of Mathematics & AS held on 23.06.2021	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	PSO 1	PSO 2	PSO 3
CO1	M														
CO2	M														
CO3	H														
CO4	M														
CO5	M														

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 Computer Science

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
CO1	M														
CO2	M														
CO3	H														
CO4	M														
CO5	M														

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

		L	T	P	C
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
CO1	M	L													
CO2	M	L													
CO3	M	L													
CO4	M	L		M											
CO5	H	L		M											

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.

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
CO1	H	L													
CO2	M	L													
CO3	M	L													
CO4	H	M													
CO5	H	M													

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													

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 – III SEMESTER

SSDX 01	**ENGINEERING ECONOMICS AND MANAGEMENT**	**L**	**T**	**P**	**C**
SDG: 4, 8, 9,12		**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:

1. Andrew Gillespie, “Foundations of Economics”, OUP Oxford, England, 2007.
2. Acemoglu, D., Laibson, D., & List, J., “Microeconomics”, Pearson Education, 2nd Edition, Boston, 2017.
3. Brinkman John , “Unlocking the Business Environment”, Routledge, 1st Edition, London, United Kingdom, 2010.(ISBN 9780340942079)
4. Cleaver Tony, “Economics: The Basics”, Routledge, 3rd Edition, London, United Kingdom, 2014.
5. H. L. Ahuja, “Macroeconomics”, S Chand Publishing; Twenty Edition, New Delhi, India, 2019.
6. Koutsoyiannis A, “Modern Microeconomics”, Palgrave Macmillan, 2nd Edition, U.K, 2003.
7. R.A. Musgrave and P.B. Musgrave, “Public Finance in Theory and Practice”, McGraw Hill Education India, Fifth Edition, India, 2017.

8. Mell Andrew and Walker Oliver, “The Rough Guide to Economics”, Rough Guide Ltd, 1st Edition, London, 2014.
9. R. Paneerselvam, “Engineering Economics”, PHI Publication, 2nd Edition, New Delhi, India, 2014.
10. 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) :

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	PO 10	PO11	PO 12
CO1		H	H	M		H	H				H	H
CO2		H	M			M					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**	**L**	**T**	**P**	**C**
SDG: 17	**TECHNOLOGY**	**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. Ltd2017
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	PO 10	PO11	PO 12
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:

1. Barthwal R R “Industrial Economics: An Introductory Textbook”, New Age International Pvt. Ltd Publishers, 2017
2. 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	PO 10	PO11	PO 12
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.

		L	T	P	C
SSDX 04	**DYNAMICS OF INDIAN SOCIAL**				
SDG: 10, 16	**STRUCTURE**	**3**	**0**	**0**	**3**

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: analyze 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

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
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.

SEMESTER V

ECD 3101	**PYTHON PROGRAMMING FOR ELECTRONICS ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 4, 9		1	0	2	2

COURSE OBJECTIVES:

COB1: To discuss the basics of python language

COB2: To construct functions and I/O operations efficiently in python

COB3: To inspect files and errors in python program

COB4: To design graphical user interfaces in Python

COB5: Able to write programs and solve specific problems

MODULE I FUNDAMENTALS OF PYTHON 5

Introduction to Python, Installation Python IDE, Basic Operators, Data types- String, List, tuple, array, set, Dictionary, Control statements – Decision making statements - Modules

MODULE II FUNCTIONS AND FILE HANDLING 5

Defining user defined Functions - Functions with default arguments, Interchanging the default and non-default arguments, Call a function with & without keyword arguments, positional arguments-arbitrary arguments -Python built-in-functions, File I/O, Manipulating the file

MODULE III ERROR HANDLING AND PYTHON PACKAGES 5

Writing Python Scripts, testing and debugging-handling errors and exception Python Packages - Array, Matrix operations-Image processing, Plotting the charts , GUI development- Python libraries to design the electronic circuits

PRACTICALS 30

List of Experiments

1. Program to perform different arithmetic and logical operations in python.
2. Program to demonstrate sequential and non-sequential data types in python
3. Program to implement user defined function, recursive and built in function
4. Program to read, write and manipulate the files in python
5. Create a library module, import and test in python
6. Implement exception and error handling mechanism in Python
7. Program to implement image manipulation using array
8. Statistical Analysis using python
9. Design a Graphical user interface using python
10. Design the electronics circuits using python

L – 15 ; P – 30 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Mark Lutz, "Learning Python", Fifth Edition, O,Reilly, 2013
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
3. Adnan Aziz, "Elements of Programming Interviews in Python" Amazon Digital Services-2016.
4. Eric Matthes, "Python Crash Course, A Hands-On, Project-Based Introduction To Programming" -2nd Edition: 2019
5. John M Zelle,"Python Programming: An Introduction to Computer Science", 2016

REFERENCES:

1. Jason Cannon, "Python Programming for Beginners" O,Reilly, 2012.
2. David Beazley, Brain K Jones "Python CookBook" Third edition,2013
3. Eli Bressert, " SciPy and NumPy", O'Reilly,2012

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1: Create programs using collection of data types

CO2: Apply appropriate python control flow structure

CO3: Able to create python library module, import and test in python

CO4: Develop a graphical user interface using python

CO5: Build the applications using python packages

Board of Studies (BoS):

23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H
CO2	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H
CO3	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H
CO4	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H
CO5	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H

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

SDG No: 4 - Quality Education

This course delivers the basic programming concepts of “Python” language which is mostly used in Artificial Intelligence.

SDG No: 9 - Industry, Innovation and Infrastructure

Python programming plays a major role in industry and modern infrastructures. Innovative ideas can be implemented by programming for automation.

		L	T	P	C
ECD 3102	**DIGITAL COMMUNICATION**	**L**	**T**	**P**	**C**
SDG: 2,3,4,8,9		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1 : To describe the building blocks of digital communication systems.

COB2 : To identify digital modulation schemes and its types.

COB3 : To analyze the effect of ISI in communication systems.

COB4 : To classify the source coding and channel coding in digital communication.

COB5 : To discuss the spread spectrum communications schemes.

MODULE I DIGITAL PULSE MODULATION 9

Elements of digital communication systems, Elements of PCM, Companding in PCM systems. Differential PCM systems (DPCM). Delta Modulation: Delta modulation, its drawbacks, adaptive delta modulation, comparison of PCM and DM systems, Noise in PCM and DM systems.

MODULE II BASEBAND TRANSMISSION AND RECEPTION 9

Line Codes: Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ — Bipolar NRZ — Manchester, ISI, Nyquist criterion for distortion less transmission, Pulse shaping, Correlative coding, Eye pattern, Matched Filter, Correlation receiver, Adaptive Equalization

MODULE III DIGITAL MODULATION SCHEME 10

Geometric Representation of signals - IQ modulation and demodulation - Generation, detection, PSD & BER of Coherent BPSK, BFSK , QPSK, Principles of MSK and QAM - Structure of Non-coherent Receivers - Principle of DPSK.ML and MAP detection.

MODULE IV INFORMATION THEORY AND CHANNEL CODING 10

Entropy, Information rate, Mutual information, Source Coding: Hartley Shannon's theorem, Huffman coding, Shanon- Fano coding, Channel coding theorem - Block codes - Cyclic codes - Convolutional codes - Viterbi Decoder- Low density parity check codes – Turbo codes.

MODULE V SYNCHRONIZATION AND SPREAD SPECTRUM TECHNIQUES 7

Importance of Synchronizations – carrier synchronization, Symbol synchronization, Frame synchronization, Network synchronization. Spread Spectrum Codes - PN sequence - Direct Sequence Spread Spectrum - Code synchronization, Frequency Hop Spread Spectrum.

L – 45; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Simon Haykin, "Communication System", 5th Edition, Wiley India Pvt Ltd, 2009.
2. Simon Haykin, “Digital Communication System”, John Wiley & Sons, 4^{th} Edition, 2014.
3. John G. Proakis, MasoudSalehi "Digital Communication", 5^{th} Edition, McGraw Hill Higher Education, 2016.

REFERENCES:

1. Bernard Sklar, Fred Harris "Digital Communications: Fundamentals and Applications", 3rd Edition, Prentice Hall, 2021.
2. B. P. Lathi, Zhi Ding "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press Publication, 2017.
3. Roger L. Peterson, David E. Borth and Rodger E. Ziemer, "Introduction to Spread Spectrum Communications", Pearson Education India, 1st edition, 2013.
4. Monica Borda, “Fundamentals in Information Theory and Coding” Springer, 2011.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 : Analyze the performance of digital pulse modulation schemes.

CO2 : Discuss the effect of Inter-symbol interference (ISI) and mitigation mechanisms.

CO3 : Choose different digital modulation schemes for a specific application.

CO4 : Apply suitable source coding and channel coding techniques in digital communication systems.

CO5 : Elaborate spread spectrum techniques in secured communication

Board of Studies (BoS) :
23^{rd} BoS of ECE held on 13.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	H	H	H	H	M								H	H	L
CO2	H	H	H	H	M								H	H	L
CO3	H	H	H	H	M								H	H	L
CO4	H	H	H	H	M								H	H	L

CO5	H	H	H	H	M								H	H	L

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

SDG 2 : End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

Statement : The holistic understanding of digital communication leads to a connected world with better communication across the globe. This ensures essential meteorological and geo information to farmers at the right time helping those who are facing famine or adverse effects of nature like storm or flood and plan better. Advanced digital communication techniques help the farmers across the globe to share agriculture ideas to increase production.

SDG 3 : Ensure healthy lives and promote well-being for all.

Statement: The real understanding of this basic course on digital communication will make the students to innovate better technologies. This leads to a doctor in any part of the world perform operation for a patient in rural areas of India.

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

Statement: The holistic understanding of the course will bring global impact on quality education. Advanced communication technology can improve the quality of life style.

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

Statement: The understanding of the Communication engineering course helps in providing Safe and inclusive work environment for professionals during pandemic period.

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

Statement: Implement wireless communication solutions addressing the industrial problems.

		L	T	P	C
ECD 3103	**COMPUTER NETWORKS**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 **:** To define the flow of information from one node to another node in the network.

COB2 **:** To Identify the component required to build different types of networks

COB3 **:** To analyze the different error coding schemes.

COB4 **:** To distinguish different protocols of network layer, transport layer and application layer.

COB5 **:** To apply contemporary knowledge in Cryptography and Security.

PREREQUISITES:

Fundamentals of analog and digital Communications, Digital electronics, & Signals and Systems

MODULE I DATA COMMUNICATION AND NETWORK MODELS 9

Data Communication, Networks-WAN,RAN,MAN,CAN,LAN,PAN,BAN, Protocols and Standards, Standards Organizations. Line Configuration, Topology, Transmission Modes, Transmission impairment, Categories of Networks - OSI and TCP/IP protocol suite: The Model, Functions of the layers- Modem - RS232 Interfacing sequences.

MODULE II DATA LINK LAYER 10

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, Wired LAN: IEEE 802.3, IEEE 802.4 and IEEE 802.5, Wireless LAN: IEEE 802.11- IEEE 802.15 - Bluetooth, LoRa, IEEE 802.16-WiMAX

MODULE III NETWORK LAYER 8

Packet Switching – Network layer performance, Internet protocol, IPv4& IPv6 Addresses, IPsec, Mobile IP, Routing algorithms - Distance Vector Routing - Link State Routing – Path vector routing- Unicast routing protocols- Routing Information Protocol, Open Shortest Path First (OSPF) – Destination Sequenced Distance Vector Routing (DSDV)

MODULE IV TRANSPORT LAYER & APPLICATION LAYER 8

Transport layer: Duties of transport layer-User Datagram Protocol (UDP) - Transmission Control Protocol (TCP) - Stream Control Transmission Protocol

(SCTP) – Socket-Quality of services (QOS).Application Layers: Client server programming- Iterative programming using UDP and TCP- WWW and HTTP, FTP, Electronic mail, TELNET, DNS,SIP,H.323

MODULE V CRYPTOGRAPHY AND NETWORK SECURITY 10

Cryptography: Symmetric-Key Ciphers, Asymmetric-Key Ciphers, Network layer security, transport layer security, application layer security, Firewalls-Cloud Computing - Cloud Security and its issues.

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, 10thEdition, 2017.

REFERENCES:

1. James F.Kurose, Keith W.Ross,"Computer Networking- A top-down approach",6th Edition, Pearson Education,2017.
2. Andrew S.Tanenbaum, Davis J.Whetherall,"Computer Networks", 5thEdition, Pearson Education,2013.
3. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufmann Publishers Inc., 2011.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Discuss data communication systems and its components.

CO2 : Classify the layer functionalities of OSI model and TCP/IP

CO3 : Analyze the error detection and correction techniques in data communication & networks

CO4 : Compare the operations and features of application layer protocol.

CO5 : Apply cryptography techniques in data communication and networks

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO2	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO3	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO4	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M

CO5	H	H	M	H	L	M	L	L	L	H	H	M	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 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

ECD 3104	**EMBEDDED SYSTEMS DESIGN**	**L**	**T**	**P**	**C**
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To explain the concepts of embedded systems

COB2: To build the software development skills

COB3: To demonstrate the key concepts of embedded systems

COB4: To elaborate the embedded networking system

COB5: To define the concepts of process and its communication

MODULE I EMBEDDED COMPUTING PLATFORM 9

Embedded computing – classification, characteristics and challenges – embedded system design process- overview of processors and hardware units in an embedded system- Embedded application.

MODULE II EMBEDDED SOFTWARE DEVELOPMENT TOOLS 9

Development and debugging - Host and target machines- Debugging Techniques and Challenges-Model of programs - Assembly, Linking and Loading - Program optimization - software performance optimization-Analysis and optimization of program size - Program validation and testing.

MODULE III EMBEDDED C 9

Basics of Embedded C - Introducing the 16/32 bit microcontroller family-simulation and debugging in IDE-I/O port programming- serial communication-Timer –Interrupt programming.

MODULE IV EMBEDDED NETWORKING 9

Multiprocessor systems-distributed embedded system - I2C bus - CAN bus - Ethernet - Bluetooth- Zigbee, LoRa - Overview of IoT – IoT supported hardware platforms,

MODULE V REAL TIME OPERATING SYSTEMS (RTOS) 9

Overview of Operating Systems (OS) concepts – Real time systems –Types - Need for RTOS in Embedded Systems -Compare OS and RTOS- Multiple Tasks and Multiple Processes-Priority-Based Scheduling- Real time scheduling algorithm – Inter process Communication Mechanisms- Case study

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Marilyn Wolf, "Computers as components", Elsevier 4th edition 2016.
2. Qing Li and Caroline, “Real Time Concepts for Embedded Systems”, CRC PRESS, 2017.
3. Michael J Pont, "Embedded C", Pearson Education Ltd, 2011

REFERENCES:

1. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003.
2. Rajkamal, "Embedded Systems Architecture, Programming and Design",3rd Edition, Tata McGraw-Hill, 2017.
3. Steve Heath, "Embedded System Design", 2nd Edition, Elsevier, 2004.
4. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & sons, 2006.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Choose appropriate software and hardware components for embedded systems

CO2: Apply code optimization and debugging techniques for host & target based embedded system

CO3: Elaborate the basics of microcontroller architecture and programming the peripherals with C Language.

CO4: Create the communication in a distributed embedded system.

CO5: Discuss the application development using RTOS

Board of Studies (BoS):	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO2	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO3	M	M	L	M	L	L	L	-	-	-	-	L	L	-	H
CO4	H	H	M	M	L	L	L	L	-	-	-	L	L	-	H
CO5	H	H	M	M	L	L	L	-	-	-	-	L	L	-	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 concepts of embedded systems, classification, Design process and applications helps for lifelong learning of newer technologies and concepts related to the embedded systems.

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

Statement: Able to apply the theoretical and design concepts for the various applications in embedded domain.

		L	T	P	C
ECD 3105	**COMPUTER NETWORKS LABORATORY**	**L**	**T**	**P**	**C**
SDG: 4, 9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1	**:**	To explain the components and devices in a computer network
COB2	**:**	To evaluate the performance of different LAN protocols by using hardware and network simulator tools
COB3	**:**	To analyze LAN configuration for wired and wireless networks
COB4	**:**	To choose different algorithms for finding shortest path between any nodes
COB5	**:**	To demonstrate the working of wireless sensor nodes

PRACTICALS :

List of Experiments:

1. Study of Network devices and crimping of Ethernet cable.
2. Configure a Network topology using Packet tracer software.
3. Simulation of ALOHA protocol using C.
4. Performance analysis of CSMA/CSMA-CD and Token Bus/Token ring access method between nodes in a network.
5. Performance analysis of Stop & wait /Go-back N flow control protocols between nodes in a network
6. Establishment of wired LAN and transfer files in a LAN environment
7. Establishment of wireless LAN and its throughput measurement
8. Traffic Analysis using Packet Analyzer software
9. Simulation of shortest path using Distance Vector Routing Protocol and Link State Routing protocol using network simulator
10. Simulation of RSA algorithm using C
11. Configuration of Routers for Firewall settings
12. Case study: Interfacing of Wireless sensor node with Zigbee

P – 30; TOTAL HOURS –30

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.

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. CCNA Security 2.0 Instructor Packet Tracer Manual, Cisco Systems,2015.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Explain the fundamental principles of computer networking devices

CO2 : Apply different LAN protocols and test the performance

CO3 : Develop Wired & Wireless LAN network

CO4 : Select an appropriate simulator tools for networking protocols

CO5 : Adapt Wireless sensor node for different networking applications

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO2	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO3	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO4	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO5	H	H	M	H	L	M	L	L	L	H	H	M	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: Knowing the basic networking devices and protocol implementation makes the student equipped for lifelong learning in this field.

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

Statement: Understanding and implementing different wired and wireless LAN protocols using hardware & software simulator tools enables the student to cope-up with industry scenario.

ECD 3106	ANALOG AND DIGITAL COMMUNICATION LABORATORY	L	T	P	C
SDG: 3		0	0	2	1

COURSE OBJECTIVES:

COB1	**:**	To experiment with the analog and digital modulation / demodulation techniques.
COB2	**:**	To apply the principles of multiplexing techniques
COB3	**:**	To analyze the time and frequency domain characteristics of AM and FM signal
COB4	**:**	To choose the digital pulse modulation scheme based on the requirement.
COB5	**:**	To develop RF blocks for specific applications.

PRACTICALS

List of Experiments:

1. Amplitude modulation and demodulation.
2. Frequency modulation and demodulation.
3. Design of Pre Emphasis - De Emphasis circuits.
4. Frequency Division Multiple Access.
5. Time Division Multiple Access.
6. Generation and detection of PAM, PWM and PPM.
7. Verification of Sampling Theorem.
8. Generation of Unipolar NRZ, Polar NRZ, Unipolar RZ and Polar RZ line code.
9. Generation and detection of ASK and FSK systems
10. Generation and detection of QPSK systems
11. Implementation of RF chain with basic blocks.
12. Study of FM receiver.

P – 30; TOTAL HOURS – 30

TEXT BOOKS:

1. Simon Haykin, “Digital Communication System”, John Wiley & Sons, 4^{th} Edition, 2014.
2. John G. Proakis,MasoudSalehi "Digital Communication", 5^{th} Edition, McGraw Hill Higher Education, 2016.

REFERENCES:

1. Bernard Sklar, Fred Harris "Digital Communications: Fundamentals and Applications", 3rd Edition, Prentice Hall, 2021.
2. B. P. Lathi,Zhi Ding "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press Publication, 2017.
3. Roger L. Peterson, David E. Borth and Rodger E. Ziemer, "Introduction to Spread Spectrum Communications", Pearson Education India, 1st edition, 2013.
4. Monica Borda, “Fundamentals in Information Theory and Coding” Springer, 2011.

COURSE OUTCOMES:

CO1 : Identify and analyze methods of digital pulse modulation and compare. their performance

CO2 : Choose a different digital modulation scheme based on the application.

CO3 : Analyze and design the multiplexer and demultiplexer circuits.

CO4 : Apply the techniques, skills and modern engineering tools necessary for engineering practice.

CO5 : Develop secure communication using spread spectrum techniques.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H
CO2	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H
CO3	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H
CO4	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H
CO5	H	H	H	H	M	H	L	L	M	L	M	M	H	H	H

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

SDG3: Ensure healthy lives and promote well-being for all.

Statement: The real understanding of this course on communication will make the students to innovate better technologies. This leads to a doctor in any part of the world performing an operation for a patient in rural areas of India.

ECD 3107	**EMBEDDED SYSTEMS DESIGN LABORATORY**	**L**	**T**	**P**	**C**
SDG: 4, 9		0	0	2	1

COURSE OBJECTIVES:

COB 1:	To develop a program, simulate and debug 16/32 bit Microcontrollers
COB 2:	To program on chip peripherals of 16/32 bit Controllers
COB 3:	To apply the display devices and sensors with Microcontrollers
COB 4:	To discuss the principles of a real-time operating system
COB 5:	To design embedded applications using hardware and software components.

PRACTICALS

1. List of Experiments:
2. I/O Programming using 16/32 bit microcontroller
3. Programming on chip Timer / PWM /Interrupt using 16/32 microcontroller
4. Serial communication using 16/32 bit microcontroller
5. Interfacing Sensor with 16/32 bit microcontroller
6. Stepper/DC motor interfacing with 16/32 bit microcontroller
7. Programming LCD / Keypad with 16/32 bit microcontroller
8. Design a Embedded network with 16/32 bit microcontroller
9. Implementation of multitasking using Real Time Operating Systems.
10. Implementation of scheduling algorithms using Real Time Operating Systems.
11. Design and implementation of embedded applications.

P – 30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Michael J Pont, “Embedded C”, Pearson Education, 2011.
2. Steve Oualline, ‘Practical C Programming 3rd Edition’, O’Reilly Media, Inc, 2006
3. Seal, David, “ARM architecture reference manual” ,Pearson Education, 2005.

REFERENCES:

1. Stephen Kochan, “Programming in C”, 4th Edition, Sams Publishing, 2015
2. Designing Embedded Systems with PIC Microcontrollers: principles and applications by Tim Wilmshurst, Elsevier.
3. Bollow, Friedrich, Matthias Homann, and Klaus-Peter Köhn, “C und C++ for Embedded Systems”, mitpVerlags GmbH & Co. KG, 2009.
4. Yiu, Joseph, “Definitive Guide to Arm Cortex-M23 and Cortex-M33 Processors”, Newnes, 2020.
5. Mazidi, Muhammad Ali, Rolin D. McKinlay, and Danny Causey, "PIC microcontroller and embedded systems: using Assembly and C for PIC18”, Pearson, 2008.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1: Develop and debug the programs using Keil μ vision IDE

CO2: Test programs for I/O ports, timers, serial ports using 16/32 bit microcontroller

CO3: Demonstrate display interfacing with microcontroller

CO4: Develop the application using on- chip peripherals of 16/32 bit microcontrollers.

CO5: Design a real time embedded applications

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO2	M	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO3	M	M	L	M	L	L	L	-	-	-	-	L	L	-	H
CO4	H	M	M	M	L	L	L	L	-	-	-	L	L	-	H
CO5	H	H	M	M	L	L	L	-	-	-	-	L	L	-	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 concepts of embedded systems, classification, Design process and applications helps for lifelong learning of newer technologies and concepts related to the embedded systems.

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

Statement: Able to apply the theoretical concepts of embedded systems and designing concepts for the various applications in embedded domains.

ECD 3108	INTERNSHIP I	L	T	P	C
SDG: 4, 9		0	0	0	1

OBJECTIVES:

COB1: To use relevant hardware and software to address industry/research problem

COB2: To choose the components and devices during design of circuits

COB3: To apply the design skills in prototype and modeling

COB4: To develop the industry skill set of core industries

COB5: Able to work in a team and manage projects in multidisciplinary environments

GUIDELINES:

1. The students shall be encouraged to do their internship in core industries to develop an experimental skill on any of the topics in electronics and communication engineering.
2. The students shall undergo training for a period of 15 days during the summer vacation of second year in any industry relevant to the field study.
3. The students are also permitted to undergo internship at research organizations / eminent academic institutions for the period of 15 days during the summer vacation, in lieu of Industrial training.
4. The student shall also submit an internship completion certificate issued by the industry / research / academic organization.
5. 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.
6. Department will constitute an Evaluation Committee to review the progress of internship periodically.
7. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively
8. This internship has to be taken up at a stretch.

OUTCOMES:

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

CO1: Design and analyze an electronic systems

CO2: Develop an electronic system/device for prototype and modeling

CO3: Make use of the skills to solve the industry issues

CO4: Improve the presentation and documentation skills

CO5: Develop working model and its demonstration.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO2	M	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO3	M	M	L	M	L	L	L	-	-	-	-	L	L	-	H
CO4	H	M	M	M	L	L	L	L	-	-	-	L	L	-	H
CO5	H	H	M	M	L	L	L	-	-	-	-	L	L	-	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: Internship enables the student to implement the basic concepts of theory learnt, design process and applications helps for lifelong learning of newer technologies and concepts related to industrial/societal requirement.

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

Statement: Internship develops the professional aptitude promotes sustainable industrialization and foster innovation.

SEMESTER VI

MSD 3181 SDG: All 1-17.	FUNDAMENTALS OF ENTREPRENEURSHIP	L	T	P	C
		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

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

ECD 3201	**ANTENNAS AND WAVE PROPAGATION**	**L T P C**
SDG: 4,9		**3 0 0 3**

COURSE OBJECTIVES:

COB1: To define the basic terminology and concepts of Antennas.

COB2: To explain radiation mechanism of different types of antennas and their usage in real time field

COB3: To analyze the electric and magnetic field emission from various basic antennas with mathematical formulation of the analysis.

COB4: To discuss various methods and techniques for experimental measurements of antennas

COB5: To choose appropriate propagation techniques for the free space environment structure.

PREREQUISITES:

Basic knowledge on Electromagnetic theory and Transmission Lines

MODULE I ANTENNA BASICS 9

Introduction, Basic Antenna Parameters, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam widths, Directivity, Effective Area and Effective Height. Loop Antennas - Introduction, Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances and Directivities of Small and Large Loops.

MODULE II ANTENNA ARRAYS AND MEASUREMENTS 9

Point Sources - Definition, Pattern, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays - Broadside Arrays, End fire Arrays, General Considerations and Binomial Arrays,

Antenna Measurements: Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Sources of Errors. Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements.

MODULE III VHF, UHF AND MICROWAVE ANTENNAS 9

Arrays with Parasitic Elements, Yagi - Uda Arrays, Folded Dipoles & their characteristics, Helical Antennas - Helical geometry, Helix Modes, Practical Design Considerations for Monofilar Helical Antenna in Axial and Normal Modes. Horn Antennas - Types, Fermat's Principle, Horn Types, Design Considerations of Pyramidal Horns.

MODULE IV VHF, UHF AND MICROWAVE ANTENNAS - II 9

Microstrip Antennas - Rectangular Patch Antennas - Geometry and Parameters, Characteristics of Microstrip Antennas, Impact of Different Parameters on Characteristics, Reflector Antennas - Introduction, Flare Sheet and Corner Reflectors, Paraboloidal Reflectors - Geometry, Pattern Characteristics, Feed Methods, Reflector Types - Related Features, Illustrative Problems. Lens Antennas - Introduction, Geometry of Non-metallic Dielectric Lenses, Zoning, Tolerances, Applications.

MODULE V WAVE PROPAGATION 9

Different Modes of Wave Propagation-Ground Wave Propagation, Wave Tilt, Curved Earth Reflections.

Space Wave Propagation - Introduction, Duct Propagation, Scattering Phenomena, Tropospheric Propagation.

Sky Wave Propagation - Introduction, Structure of Ionosphere, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and skip Distance, Multi-hop Propagation.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. C A Balanis, Antenna Theory: Analysis and Design, John Wiley & Sons publications, 4th edition, 2016.
2. Edward C. Jordon, Keith G. Balmain, “Electromagnetic Waves and Radiating Systems”, Pearson Education, 4th edition, 2017.

REFERENCES:

1. K.D. Prasad, SatyaPrakashan, “Antennas and Wave Propagation”, Tech India Publications, New Delhi, 2009.
2. John D. Kraus, “Antennas” McGraw-Hill (International Edition), 5th Ed, 2017.
3. Joseph J.Carr, “Practical Antenna Handbook”, McGraw-Hill, 5th edition, 2012.
4. Ramesh Garg, Prakash Bhartia, Inder J. Bahl, A. Ittipiboon, “Microstrip antenna”, Artech House, 2001

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Define various antenna parameters

CO2: Analyze radiation patterns of antennas

CO3: Evaluate antennas for given specifications

CO4: Discuss the techniques for antenna parameter measurements

CO5: Design antennas for specific applications and analyze different wave propagation.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	L	-	-	-	-	-	-	L	L	H	H	-
CO2	H	H	H	L	-	-	-	-	-	-	M	M	H	H	-
CO3	H	H	H	H	-	-	-	-	-	-	L	L	H	H	-
CO4	H	H	H	H	-	-	-	-	-	-	L	L	H	H	-
CO5	H	H	H	H	-	-	-	-	-	-	M	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.

Statement: This course enables the student to discuss the basic characteristics of antennas, reflectors, measurement techniques and applications for newer technologies.

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

Statement: Able to apply the theoretical concepts of antenna and wave propagation techniques for various applications and sustainable industrialization.

ECD 3202	**HIGH FREQUENCY COMMUNICATION LABORATORY**	**L**	**T**	**P**	**C**
SDG: 4,9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To discuss the characteristics of various microwave and optical sources.

COB2: To interpret the gain and radiation pattern of various microwave antennas.

COB3: To design antennas and filters for wireless applications

COB4: To measure microwave parameters using RF testing devices

COB5: To develop matching networks for RF circuits

PRACTICALS

List of Experiments:

1. Characteristics of microwave sources.
2. Determine of guide wavelength, VSWR, frequency and impedance measurement.
3. Radiation Pattern of Horns, parabolic antenna.
4. Measurement of Dielectric constants.
5. Design of Wire antennas
6. Simulation, fabrication and testing of antennas and filters
7. Matching network design
8. Power divider network design
9. Characterization of microwave components using spectrum and network analyzer.
10. Characteristics of optical sources and detectors
11. Characteristics of optical fiber

P – 30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Annapurna Das, Sisir K. Das, “Microwave Engineering”, Mc Graw Hill, 3rd Edition, 2017
2. David M. Pozar, “Microwave Engineering: Theory and Techniques”, Wiley – An Indian Adaption, 2020
3. G.S.Raghuvanshi and M.L.Sisodia, "Basic Microwave Techniques And Laboratory Manual" New Age International Private Limited, 2nd Edition, 2009..

REFERENCES:

1. Samuel Y.Liao, “Microwave Devices and Circuits”, Pearson, 3rd Edition, 2003.
2. Gerd Keiser, "Optical Fiber Communication", 5th Edition, Mcgraw Higher

Education, 2013.

COURSE OUTCOMES:

CO1: Apply the theoretical principles underlying microwave devices and network.

CO2: Analyze radiation patterns for various types of wire, aperture antennas and parabolic reflectors.

CO3: Demonstrate the methodologies on the design of antennas and filters

CO4: Use the techniques, skills and modern engineering tools such as network analyzer and simulation tools, for solving problems in microwave systems

CO5: Design matching networks for RF circuits and devices.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	M	M	-	-	M	M	-	-	-	-	-	-	H	L	M
CO2	M	M	-	-	M	M	-	-	-	-	-	-	H	L	M
CO3	M	M	-	-	M	M	-	-	-	-	-	-	H	L	M
CO4	M	M	-	-	M	M	-	-	-	-	-	-	H	L	M
CO5	M	M	-	-	M	M	-	-	-	-	-	-	H	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 the basic characteristics of microwave and optical components, devices with its characteristics and parameters.

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

Statement: Able to practically verify the characteristics of various microwave and optical devices

GED 3201 SDG: 4	REASONING AND APTITUDE FOR ENGINEERS	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 Quantitative Ability 07

Data Interpretation (charts, graphs, tables, data sufficiency, etc.) – Time and work- Pipes and Cisterns-Venn Diagrams-Mensuration

L – ; 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) :

13thBoS 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
CO1										M		
CO2										H		
CO3										L		
CO4												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.

SEMESTER VII

ECD 4101	WIRELESS COMMUNICATION	L	T	P	C
SDG: 2,3,4,8,9		3	0	0	3

COURSE OBJECTIVES:

COB1	**:**	To apply the concepts of wireless communication systems.
COB2	**:**	To analyze the effect of path loss in wireless communication systems.
COB3	**:**	To describe the fading concepts in wireless communication
COB4	**:**	To select the suitable data transmission techniques for wireless communication.
COB5	**:**	To discuss the recent trends in wireless communication.

PREREQUISITE:

- Basic knowledge of analog and digital communication
- Fundamentals of probability, random process and information theory

MODULE I INTRODUCTION TO WIRELESS COMMUNICATION 9

Overview of Wireless Communication, Evolution of Wireless Communication - 1G, 2G, 3G, 4G and 5G, Types of wireless communication systems, Cellular concepts-Frequency reuse, Channel assignment, hand-off strategies, Co-channel and Adjacent channel Interference, Blocking, Improving coverage & capacity in cellular system, call establishment.

MODULE II RADIO WAVE PROPAGATION 9

Radio Wave Propagation: Path Loss and Shadowing – Free space propagation model, propagation mechanisms – Reflection, Diffraction and scattering, Path loss models, outdoor and indoor propagation models. Modes of propagation.

MODULE III STATISTICAL MULTIPATH CHANNEL MODELS 9

Small-Scale Multipath Propagation, Impulse response model of channel, Types of small- scale fading, Rayleigh and Ricean distribution, Statistical models for multipath fading channels.

MODULE IV ADVANCED WIRELESS COMMUNICATIONS SYSTEM 9

SISO, SIMO, MISO and MIMO communication channels, Capacity of MIMO channels , MIMO Diversity , MIMO spatial multiplexing , capacity of massive MIMO, Hardware technology for mmWave systems, SDR - Definition, hardware and software architecture, Cognitive Radio - Definitions, Cognitive theories, Cognitive radio as self controlling system, Terahertz Wireless Communication.

MODULE V WIRELESS NETWORKING 9

Introduction to wireless networks, Development of wireless network, Traffic routing in wireless network, wireless data services, common channel signaling, Integrated services digital network, Signaling System 7, Protocol for network access, Network data base.

L: 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson India, 2010.
2. Andreas F. Molisch, "Wireless Communications", 2nd Edition, Wiley, 2013.
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press 2005.

REFERENCES:

1. Andrea Goldsmith, "Wireless Communications", 1st Edition, Cambridge University Press, 2005.
2. Simon Haykin, Michael Moher, "Modern Wireless Communication", 1st Edition, Pearson India, 2011.
3. KamiloFeher, "Wireless Digital Communications: Modulation and Spread Spectrum Applications", 1st Edition, PHI Learning, 2009.
4. Hamid Jafarkhani, "Space - Time Coding: Theory and Practices", Cambridge University Press 2005.
5. MischaDohler, Jose F. Monserrat Afifosseiran" 5G Mobile and Wireless Communication Technology", Cambridge University Press 2016.
6. Mieczyslaw M Kokar, LezekLechowicz, "Cognitive Radio Interoperability through Waveform Reconfiguration" ARTECH House 2016.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1	**:**	Describe the fundamental concepts of wireless communication.
CO2	**:**	Estimate the effect of path loss in wireless communication systems
CO3	**:**	Classify channel models based on the application.
CO4	**:**	Analyze the different data transmission techniques
CO5	**:**	Discuss the data transmission in wireless networks.

Board of Studies (BoS): 23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	H	L								H	H	L
CO2	H	H	H	H	L								H	H	L
CO3	H	H	H	H	L								H	H	L
CO4	H	H	H	H	L								H	H	L
CO5	H	H	H	H	L								H	H	L

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

SDG 2 : End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

Statement : The holistic understanding of wireless and mobile communication leads to a connected world with better communication across the globe. This ensures essential meteorological and geo information to farmers at the right time helping those who are facing famine or adverse effects of nature like storm or flood and plan well. Advanced digital communication techniques help the farmers across the globe to share agriculture ideas to increase production.

SDG3 : Ensure healthy lives and promote well-being for all.

Statement : The real understanding of this basic course on wireless and mobile communication will make the students to innovate better technologies. This leads to a doctor in any part of the world perform operation for a patient in rural areas of India.

SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Statement: The holistic understanding of the course will bring global impact on quality education. Advanced wireless communication technology can improve the quality of life style.

SDG8 Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: The understanding of the wireless Communication engineering course helps in providing Safe and inclusive work environment for professionals during pandemic period.

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

Statement: Implement wireless communication solutions addressing the industrial problems.

ECD 4102 **INTERNSHIP II** **L T P C**

SDG: 4, 9 **0 0 0 1**

OBJECTIVES:

COB1: To use relevant hardware and software to address industry/research problem

COB2: To choose the components and devices during design of circuits

COB3: To apply the design skills in prototype and modeling

COB4: To develop the industry skill set of core industries

COB5: Able to work in a team and manage projects in multidisciplinary environments.

GUIDELINES:

- The students shall be encouraged to do their internship in core industries to develop an experimental skill on any of the topics in electronics and communication engineering.
- The students shall undergo training for a period of 15 days during the summer vacation of “Third year” 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 of 15 days during the summer vacation, in lieu of Industrial training.
- The student shall also submit an internship completion certificate issued by the industry / research / academic organization.
- 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.
- Department will constitute an Evaluation Committee to review the progress of internship periodically.
- The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively
- The internship II has to be taken up at a stretch.

OUTCOMES:

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

CO1: Design and analyze an electronic systems

CO2: Develop an electronic system/device for prototype and modeling

CO3: Make use of the skills to solve the industry issues

CO4: Improve the presentation and documentation skills

CO5: Develop working model and its demonstration.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO2	M	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO3	M	M	L	M	L	L	L	-	-	-	-	L	L	-	H
CO4	H	M	M	M	L	L	L	L	-	-	-	L	L	-	H
CO5	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H

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

SDG No. & Short Description

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

Statement: Internship enables the student to implement the basic concepts of theory learnt, design process and applications helps for lifelong learning of newer technologies and concepts related to industrial/societal requirement.

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

Statement: Internship develops the professional aptitude promotes sustainable industrialization and foster innovation.

SEMESTER VIII

ECD 4201	**PROJECT WORK**	**L**	**T**	**P**	**C**
SDG 4, 9		**0**	**0**	**18**	**9**

OBJECTIVES:

COB1: To improve the professional competency and research aptitude
COB2: To apply the design skills in prototype and modeling
COB3: To develop the skill set needed by the core industries
COB4: To adapt the skills towards report/documentation preparation
COB5: Able to work in a team and manage projects in multidisciplinary environments

GUIDELINES:

- Project work can be a design project/experimental project and/or computer simulation project on any of the topics of Electronics and communication Engineering.
- The project work is allotted individually or a group of students not more than 3.
- The students shall be encouraged to do their project work in the parent institute itself. If found essential (Industry oriented Projects), they may be permitted to continue their project outside the parent institute.
- Department will constitute an Evaluation Committee to review the project work.
- The Evaluation committee consists of internal guide and experts in the specified area of the project.
- Project work consists of thesis work, two reviews of the work and the submission of project report with the viva voce.
- First review would highlight the topic, objectives, methodology and expected results.
- Second review evaluates the progress of the work, draft of the project report and demo of the prototype model.

OUTCOMES:

At the end of the project the student will be able to

- Analyze the hardware and software required for the design of preliminary work.
- Select the specific devices for different application along with justification.
- Apply the practical knowledge while solving real time problems
- Implement the cost effective and efficient project models.
- Conclude the subject knowledge through proto type models.
- Develop appropriate documentations.

Board of Studies (BoS) :	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC 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	L	L	-	-	-	-	L	L	-	H
CO2	M	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO3	M	M	L	M	L	L	L	-	-	-	-	L	L	-	H
CO4	H	M	M	M	L	L	L	L	-	-	-	L	L	-	H
CO5	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H

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

SDG No. & Short Description

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

Statement: The project work enables the student to implement the basic concepts of theory learnt, design process and applications helps for lifelong learning of newer technologies and concepts related to industrial/societal requirement.

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

Statement: The project work develops the professional aptitude promotes sustainable industrialization and foster innovation.

PROFESSIONAL ELECTIVES - 5TH TO 7TH SEMESTER

ECDX 005	**IMAGE PROCESSING**	**L**	**T**	**P**	**C**
SDG: 4,9		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1 : To define basic principles of digital image processing and its performance parameters

COB2 : To design and implement algorithms to perform basic image processing

COB3 : To analyze different image enhancement, segmentation, restoration and compression techniques

COB4 : To develop and implement algorithms for the image analysis

COB5 : To choose appropriate image processing techniques for the image processing applications

PREREQUISITES:

Basics of Signal Processing

Fundamentals of transforms

MODULE I DIGITAL IMAGE FUNDAMENTALS 8

Digital Image Processing - Components of Image Processing System, Elements of Visual Perception - brightness adaptation, Mach-band effect. Image Sampling & Quantization, Spatial and Gray Level Resolution, Statistical Parameters - Mean, variance, PSNR, correlation. Fundamentals of color image processing: color models - RGB, CMY, HIS.

MODULE II IMAGE TRANSFORMS AND ENHANCEMENT 8

Significance of image transforms – Classifications-2D DFT, DCT, Hadamard, Haar transform, KL Transform, Hough and Radon transform, Wavelet transform - Image Enhancement techniques-Intensity transformation techniques – Histogram -Histogram equalization-Specification-Spatial and frequency domain-Low pass and High pass filters. Color Image Processing – Pseudo color Image Processing.

MODULE III IMAGE SEGMENTATION AND RESTORATION 8

Morphological Image Processing: Dilation, Erosion, Opening, Closing on Binary Images, Segmentation: Point, line edge detection, boundary and thresholding, Segmentation types, Restoration: Image Degradation Model, Unconstrained and constrained restoration.

MODULE IV IMAGE COMPRESSION & IMAGE PROCESSING APPLICATIONS 6

Fundamentals of image compression - Compression ratio-Compression types-Lossless and lossy compression techniques. Image Processing Applications - Medical image analysis, Remote sensing, Computer vision, Biometrics and security.

LIST OF EXPERIMENTS:

1. Read, write and displaying images
2. Image sampling and quantization
3. Extraction of basic color components from an image
4. Histogram equalization and specification
5. Image filtering using LPF and HPF
6. DFT and DCT of an image
7. Haar transform of an image
8. Dilation, Erosion, opening and closing of binary image
9. Point, line and edge detection of an image
10. Image compression using lossless & lossy techniques and find its compression ratio
11. Case study : Extracting Agricultural fields from remote sensing images, Enhancing X-ray images, Feature extraction of thermal images, etc.,

L –30 ;P – 30: TOTAL HOURS –60

TEXT BOOKS:

1. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Fourth Edition, Academic Press, 2020.
2. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
3. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
4. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

REFERENCES:

1. D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.
2. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzingimages”, O'Reilly Media, 2012.
3. Jayaraman, S.Essakirajan and T.Veerakumar “Digital Image Processing”, Tata McGraw Hill Education,5th edition,2015

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Discuss the fundamental concepts and performance parameters of digital image processing.

CO2 : Analyze various image enhancement techniques.

CO3 : Choose appropriate transforms for image processing applications

CO4 : Apply the various techniques of image segmentation and restoration.

CO5 : Adapt appropriate image compression techniques for different applications

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	H	H	M	H	-	M	-	-	-	M	M	-	M	H	M
CO2	H	H	M	H	-	M	-	-	-	M	M	-	H	H	M
CO3	H	H	M	H	-	M	-	-	-	M	M	-	M	H	M
CO4	H	H	M	H	-	M	-	-	-	M	M	-	H	H	M
CO5	H	H	M	H	-	M	-	-	-	H	H	-	M	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: This course enables the student to apply the theoretical concepts to analyze the Images for further processing and its qualitative measures.

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

Statement: To apply the image processing techniques and concepts for different applications.

ECDX 006	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	**L**	**T**	**P**	**C**
SDG: 4,9		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1 : To discuss the concepts of AI terminologies

COB2 : To choose the problem solving methods and heuristic search algorithms

COB3 : To interpret the expert systems in AI

COB4 : To identify suitable knowledge representation for solving problems

COB5 : To explain natural language processing concepts

PREREQUISITE:

Basics of Mathematics, Set theory and Digital electronics

MODULE I INTRODUCTION TO AI 5

History of Artificial Intelligence- AI problems- AI technique- philosophy and Development of Artificial intelligence- Bayes' Rule.

MODULE II PROBLEM SOLVING METHOD 8

Search process and AI-Brute force- Depth first, Breadth first search techniques-Hill Climbing-Best first search- AND/OR graphs-A* algorithm, Constraint satisfaction- Game playing mini-max algorithm, Alpha-Beta Pruning.

MODULE III EXPERT SYSTEMS & KNOWLEDGE REPRESENTATION 12

Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools - Difficulties in Developing Expert Systems – First order predicate logic, Propositional logic- Tautology-Contradiction-Normal forms -Predicate logic -Rules of inference- Resolution-Unification algorithm- Production rules – Semantic Networks. Frames – Scripts.

MODULE IV APPLICATIONS OF AI 5

Natural Language Processing- Machine Translation – Speech Recognition –Face recognition-Anomaly detection – Robot.

LAB EXPERIMENTS:

1.Basics of Programming languages and its Libraries for AI

2. Implementation of basic logic operations.

3.Implementation of prediction mechanism using Baye’s rules

4 Implementation of space searching algorithm.

5.Implementation of mini-max algorithm

6. Implementation of propositional logic.

7.Implement an application using any AI algorithm

L – 30: P- 30; TOTAL HOURS – 60

TEXT BOOKS:

1. Stuart J. Russel, Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Pearson Education India, 2015.
2. Ertel, Wolfgang Introduction to Artificial Intelligence, 2nd Edition, Springer, 2018.

REFERENCES:

1. Elaine Rich, Kevin Knight, "Artificial Intelligence", 3 rd Edition, McGraw Hill, Education, 2017
2. Waymond Rodgers, " Artificial Intelligence in a Throughput Model ", CRC Press, 2020
3. Patrick Henry Winston, "Artificial Intelligence", 3 rd Edition, PearsonEducation, 2002.
4. George F. Luger, William A. Stubblefield, " AI Algorithms, Data Structures, and Idioms in Prolog, Lisp and Java ", Pearson Education,2009.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : define the fundamentals of artificial intelligence and its functions

CO2 : Analyze the search algorithms for problem solving

CO3 : illustrate the concepts of expert system in AI

CO4 : discuss knowledge representation methods in AI

CO5 : Apply knowledge representation techniques to societal problems.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	L	M	L	H	H	L	L	L	L	-	L	H	-	M	H
CO2	L	M	L	H	H	L	L	L	L	-	L	H	-	M	H
CO3	L	M	L	H	H	L	M	L	L	-	L	H	-	M	H
CO4	L	M	L	H	H	L	L	L	L	-	L	H	-	M	H
CO5	L	M	L	H	H	-	L	L	L	-	L	H	-	M	H

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

SDG No: 4 -Quality Education

This course will deliver the basic concepts of Artificial Intelligence.

SDG No: 9 - Industry, Innovation and Infrastructure

Artificial intelligence plays major roles in industry and modern infrastructures. Innovative ideas can be implemented by programming.

ECDX 007	FUNDAMENTALS OF IOT	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB1 : To discuss the concepts, main trends and paradigm of Internet of Things.

COB2 : To analyze the characteristics of IoT sensors

COB3 : To explore communication protocols of the Internet of Things.

COB4 : To build a small low cost embedded system using embedded boards.

COB5 : To apply the concept of Internet of Things in the real world scenario.

PREREQUISITE:

Fundamentals of computer network, communication & internet technology.

MODULE I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT Platforms Design Methodology.

MODULE II IoT SENSORS AND TECHNOLOGIES 9

Sensors: Sensors-sensor characteristics-Sensorial deviations-Sensing Types-Sensing considerations-Actuators. Technologies: IEEE 802.15.4-Zigbee- Wireless HART- RFID- NFC- Z-Wave- Sigfox- LoRa- NB-IoT- Wi-Fi- Bluetooth.

MODULE III IoT COMMUNICATION PROTOCOLS 9

Infrastructure protocols-Internet Protocol version(IPv6)- LOADng- RPL-6LoWPAN- QUIC- Micro internet Protocol (uIP)- Nano internet protocol (nanoIP) - Data protocols- MQTT-MQTT-SN- CoAP- AMQP- XMPP- SOAP-REST- WebSocket.

MODULE IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks - Raspberry Pi - Board - Linux on Raspberry Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

MODULE V CASE STUDIES, CHALLENGES & FUTURE OF IOT 9

Agricultural IoT- Vechicular IoT- Healthcare IoT- Challenges- Big data- Cloud/ fog/ edge computing-5G and beyond- Artificial Intelligence/ Machine learning/ Cognitive communication networks- Software defined networks- Phantom networks.

L –45; TOTAL HOURS –45

TEXT BOOKS:

1. SudipMisra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, Cambridge University Press, 2021
2. ArshdeepBahga, Vijay Madisetti, “Internet of Things– A hands-on approach”, Universities Press, 2015.

REFERENCES:

1. Cuno P fister, Getting Started with the Internet of Things, O’Reilly Media, 2011, ISBN: 978-1-4493- 9357-1
2. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, 1 st Edition, VPT, 2014
3. Samuel Greengard, The Internet of Things, MIT Press, 2015.
4. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1 st Edition, Apress Publications, 2013.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Explain and interpret the concepts of IoT.

CO2 Discuss about IoT sensors and Technologies.

CO3 Identify the IoT communication protocols.

CO4 : build the IoT systems using embedded IoT boards.

CO5 Analyze applications of IoT in real time scenarios and explore the emerging technologies of IoT.

Board of Studies (BoS) :	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	L	L	L	H	L	L	L	L	L	L	H	L	L	L
CO2	H	H	L	L	H	L	L	L	L	L	L	H	L	L	L
CO3	H	H	L	L	H	L	L	L	L	L	L	H	L	L	L
CO4	H	H	L	L	H	L	L	L	L	L	L	H	L	L	L
CO5	H	H	H	H	H	H	M	H	H	L	L	H	H	H	H

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

SDG No: 4 -Quality Education

This course will deliver the basic concepts of IoT and it is adapted in industry automation.

SDG No: 9 - Industry, Innovation and Infrastructure

IoT plays major roles in industry and an innovative ideas can be implemented by IoT technologies and it offers modern infrastructures.

ECDX 008	**MULTIMEDIA COMPRESSION TECHNIQUES**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To classify Source coding techniques.

COB2 : To identify encoding and decoding of digital data streams based on requirement.

COB3 : To discuss about hybrid compression technique methods

COB4 : To analyze the pros and cons of existing compression techniques.

COB5 : To design an adaptive technique for given requirement

PREREQUISITE :

Knowledge on digital communication

MODULE I MULTIMEDIA COMPONENTS 9

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.

MODULE II AUDIO COMPRESSION 9

Need for compression-Sampling and Quantization of Speech (PCM) – Adaptive differential PCM – Delta Modulation – Vector Quantization- Linear predictive coding (LPC) – Code excited Linear predictive Coding (CELP)

MODULE III IMAGE AND VIDEO COMPRESSION 9

Graphics Interchange format- Tagged image file format-Digitized documents-Digitized pictures-JPEG- -Video Encoding-Motion estimation –Overview of H.263 and MPEG-2, compressed sensing.

MODULE IV TEXT COMPRESSION 9

Markov models in Text compression –Modeling and coding-Static and Dynamic Huffman coding – Shannon Fano coding Arithmetic coding –Lempel-Ziv coding – Advanced Golomb coding

MODULE V MULTIMEDIA APPLICATIONS 9

Video conferencing, DVI technology-Packet Video, DVB-T and DVB-C, Digital television, Digital Radio, Computer Animation, Morphing, TV monitor as Multimedia terminal, VOIP Technology.

L –45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Fred Halshall "Multimedia Communication - Applications, Networks, Protocols and Standards", Pearson Education, 2007
2. Tay Vaughan, "Multideai: Making it Work", 7 th Edition, TMH 2008
3. Kurose and W.Ross" Computer Networking "a Top down Approach, Pearson Education 2005.

REFERENCES:

1. Marcus Goncalves "Voice over IP Networks", Mc Graw Hill 1999.
2. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007.
3. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education Ranjan Parekh, "Principles of Multimedia", TMH 2007.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1	**:**	Explain the various components of multimedia communication.
CO2	**:**	Identify various compression techniques available for image, audio and video data.
CO3	**:**	Choose the suitable technique based on the requirement.
CO4	**:**	Analyze the performance of different compression technique for given data
CO5	**:**	Develop the required compression techniques for multimedia applications

Board of Studies (BoS) :	**Academic Council:**
23^{rd} BoS of ECE held on 13.07.2022	19th AC 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	H	L	M	L	L	L	M	M	L	M	M	H
CO2	H	H	M	H	L	M	L	L	L	M	M	L	M	M	H
CO3	H	H	M	H	L	M	L	L	L	M	M	L	M	M	H
CO4	H	H	M	H	L	M	L	L	L	M	M	L	M	M	H
CO5	H	H	M	H	L	M	L	L	L	H	H	M	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.

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 compression in communication.

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

Statement: Able to apply the theoretical concepts for the various applications of multimedia.

ECDX 009	BIOMEDICAL SIGNAL PROCESSING	L	T	P	C
SDG: 4 & 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To define the nature of various bio-potentials.

COB2 : To analyze the various processing techniques involved in biomedical signals for parameter detection.

COB3 : To classify the different techniques ECG signal processing

COB4 : To explain the signal processing techniques for EEG signal

COB5 : To discuss signal processing for different biomedical applications.

PREREQUISITE:

Basic knowledge about signals and systems

Fundamentals of signal processing

MODULE I INTRODUCTION TO BIOMEDICAL SIGNALS 8

Characteristics of Bio-medical signals - ECG, EEG, ENG, EMG, PCG, EOG, EGG, ERP, CP – Need for bio-medical signal analysis – Computer aided diagnosis.

MODULE II PROCESSING OF BIOMEDICAL SIGNAL 9

Processing of Random & Stochastic signals - spectral estimation - Properties and effects of noise - Filtering for removal of artifacts - Detection of events.

MODULE III ELECTROCARDIOGRAM SIGNAL PROCESSING 10

ECG data acquisition – ECG lead system ECG parameters estimation - Removal of Artifacts in the ECG - Maternal - Fetal ECG - Direct data compression techniques - Direct ECG data compression techniques - Transformation compression techniques.

MODULE IV ELECTROENCEPHALOGRAM SIGNAL PROCESSING 9

Data acquisition and classification of sleep stages - Modeling of EEG – linear and Non linear stochastic models - artifacts in EEG & their characteristics - correlation analysis of EEG channels - coherence analysis of EEG channels - EEG segmentation.

MODULE V BIOMEDICAL APPLICATIONS 9

Bio-telemetry - HL7 Protocol- Patient Monitoring System - Wearable Devices - Nano medicine and application.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Rangaraj M. Rangayyan, “Bio medical signal analysis - A case study approach”, Wiley-IEEE Press June 2015.
2. D.C.Reddy, "Biomedical Signal Processing: Principles and techniques", Tata McGraw Hill, New Delhi, 6th Reprint 2009.

REFERENCES:

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", Tata McGrawHill, New Delhi, 2014.
2. Joseph J.Carr and John M.Brown, "Introduction to Biomedical equipment Technology", John Wiley and Sons, New York, 2001.
3. Leislie Cromwell, "Biomedical instrumentation and measurement", Prentice Hall of India, New Delhi, 2013.
4. Willis J.Tompkins,”Biomedical digital signal processing”, Prentice Hall of India, New Delhi, 2000

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Explain the characteristics of various Biomedical signals

CO2 : Discuss the properties and effects of noise in biomedical signals

CO3 : Design filters for biomedical signals

CO4 : Analyze ECG and EEG signal processing techniques.

CO5 : Summarize the biotelemetry and modern technologies in health care applications.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	M	H	L	L	H	L	L	L	M	H	H	M
CO2	M	M	M	M	H	L	L	H	L	L	L	M	M	H	M
CO3	H	H	H	M	H	L	M	H	M	M	L	H	M	H	H
CO4	H	H	M	H	H	M	M	H	M	M	M	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H	H	H	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: This course enables the student to understand basic biomedical signal processing and its applications which make lifelong learning opportunities.

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.
Statement: Medical data is an asset that needs to be effectively handled for sustainable and resilient infrastructure.

ECDX 010	**ADVANCED DIGITAL LOGIC SYSTEM DESIGN**	**L**	**T**	**P**	**C**
SDG: 4,8,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 **:** To analyze and design sequential circuits.

COB2 **:** To analyze and design asynchronous sequential circuits.

COB3 **:** To discuss the concepts involved in designing digital systems such as ALU, UART.

COB4 **:** To design Synchronous circuits using PLDs.

COB5 **:** To illustrate new generation PLDs.

PREREQUISITES: Digital Electronics, VLSI Design, Programming in Verilog

MODULE I SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Clocked Synchronous Sequential Networks (CSSN)- Modelling of CSSN – State Stable Assignment and Reduction – Design of CSSN – Design of Iterative Circuits – ASM Chart – ASM Realization, Design of Arithmetic circuits for Fast adder-Array Multiplier.

MODULE II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Races in ASC – State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Designing vending Machine Controller – Mixed Operating Mode Asynchronous Circuits.

MODULE III SYSTEM DESIGN 9

Design and Synthesis of Datapath Controllers – Partitioned sequential machines – – Design and synthesis of a RISC stored-program machine – Processor, ALU, Controller Design and Program Execution – UART – Operation, Transmitter, Receiver.

MODULE IV SYNCHRONOUS CIRCUIT DESIGN USING PROGRAMMABLE DEVICES 9

Programming Techniques -Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Realize combinational, Arithmetic, Sequential Circuit with Programmable Array, Logic; Architecture and application of Field Programmable Logic Sequence.

MODULE V NEW GENERATION PROGRAMMABLE LOGIC DEVICES 9

Foldback Architecture with GAL, EPLD, EPLA , PEEL, PML; PROM – Realization State machine using PLD – FPGA – Xilinx FPGA – Xilinx 2000 - Xilinx 3000

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill, 2017.
2. Parag K Lala, "Digital System design using PLD", BS Publications, 2003.

REFERENCES:

1. Brian Holdsworth, Clive Woods, "Digital Logic Design", IV edition, Elesevier, 2008.
2. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Design state machines and ASM charts for the given requirements

CO2 : Analyze asynchronous sequential circuits and design digital systems based on the given specifications.

CO3 : Elaborate the concepts involved in designing digital systems such as ALU, UART.

CO4 : Make use of appropriate PLDs to realize digital systems based on the requirements.

CO5 : Apply the digital system design principles and do projects based on the requirements.

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	H	H	M	-	-	-	-	-	-	-	H	H	H
CO2	H	H	H	H	M	-	-	-	-	-	-	-	H	H	H
CO3	H	H	H	H	M	-	-	-	-	-	-	-	H	H	H
CO4	H	H	H	H	M	-	-	-	-	-	-	-	H	H	H
CO5	H	H	H	H	M	-	-	-	-	-	-	-	H	H	H

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

SDG 4: Analysis and design of digital circuits promote Engineering skills and quality education.

SDG 8: Development of new technologies with digital circuits provides sustainable economic growth and productive employment.

SDG 9: Design of combinational and sequential circuits fosters innovation and sustainable industrialization.

Statement: Analysis, design and implementation of digital circuits promote sustained economic growth.

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:

Basics of electronic circuits, Digital Electronics, Microprocessors & 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/Trasmitter (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 bootloader – 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) :
23rd BOS of ECE held on 13.07.2022

Academic Council:
19th AC held on 29.09.2022

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

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: Statement: Able to apply the programming concepts of ARM for various applications practically.

ECDX 012 SDG: 4,9	NEURAL NETWORKS AND FUZZY LOGIC	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To define the concepts of Neural network terminologies

COB2: To explain the basics of back propagation networks

COB3: To choose the associative memory for networks

COB4: To apply the fuzzy set theory in system design

COB5: To design fuzzy based systems.

PREREQUISITE: Fundamentals of Set theory and Digital electronics

MODULE I FUNDAMENTALS OF NEURAL NETWORKS 9

Basic concepts of neural networks, Model of an Artificial Neuron, Neural Network Architectures – Single Layer Feedforward Network, Multilayer Feedforward network, Recurrent Networks, Characteristics of Neural networks, Learning methods, early Neural Network Architectures-Rosenblatt's Perceptron, ADALINE Network, MADALINE network.

MODULE II BACKPROPAGATION NETWORKS 9

Architecture of a Backpropagation Network, Backpropagation Learning, Applications – Design of Journal Bearing, Classification of soil, Hot extrusion of steel, Selection of various parameters in BPN, Variations of standard backpropagation algorithms.

MODULE III ASSOCIATIVE MEMORY 10

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem

MODULE IV FUZZY SET THEORY 8

Fuzzy Set Theory: Fuzzy versus Crisp, Crisp sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations.

MODULE V FUZZY SYSTEMS 9

Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based System, Defuzzification Methods, Applications

L –45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. S. Rajasekaran, G. A. VijayalakshmiPai, “Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications”- PHI Publication, 2011.
2. Ross, T. J. “Fuzzy logic with engineering applications,” John Wiley & Sons, 2005.
3. Timothy J Ross, “Fuzzy Logic with Engineering Applications”, John Willey and Sons, West Sussex, England, 2005.

REFERENCES:

1. 1. Jack M. Zurada, “Introduction to Artificial Neural Systems”, PWS Publishing Co., Boston, 2002.
2. Klir G.J. & Folger T.A., “Fuzzy sets, Uncertainty and Information”, Prentice –Hall of India Pvt. Ltd., New Delhi, 2008.
3. Zimmerman H.J., “Fuzzy set theory and its Applications”, Kluwer Academic Publishers Dordrecht, 2001.
4. Driankov, Hellendroonb, “Introduction to fuzzy control”, Narosa Publishers,2001.
5. LauranceFausett, Englewood cliffs, N.J., “Fundamentals of Neural Networks”, PearsonEducation, New Delhi, 2008.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Outline the principles of neural networks and fuzzy Logic systems.

CO2: Compare the various neural network models.

CO3: Explain the associative memory concepts.

CO4: Apply the concepts of fuzzy set theory in relevant applications

CO5: Design fuzzy based system for real time applications.

Board of Studies (BoS) :	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

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

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

SDG No: 4 -Quality Education

This course will deliver the basic concepts of neural networks which is mostly used in Artificial Intelligence.

SDG No: 9 - Industry, Innovation and Infrastructure

Artificial intelligence plays major roles in industry and modern infrastructures. Innovative ideas can be implemented by programming.

		L	T	P	C
ECDX 013	**PRINCIPLES OF ROBOTICS**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To define the functional aspects of Robotics

COB2: To discuss direct and inverse kinematics.

COB3: To explain the manipulator differential motion and statics.

COB4: To compare various trajectory planning techniques.

COB5: To build the Dynamic Modeling and Control of Manipulators.

PREREQUISITE: Basic knowledge in Engineering Mathematics, Design of Electronic Circuits and Control Systems.

MODULE I FUNDAMENTALS 8

Evolution of Robots – Types of Robots – Anatomy of Robot – Human arm characteristics - Design and Control Issues – Principles and applications of Sensors in Robotics – Programming Robots.

MODULE II DIRECT AND INVERSE KINEMATICS 9

Mathematical representation of Robots - Homogeneous transformation – Mechanical structure – Links and Joints; Denavit Hattenberg notation – Direct kinematics – Inverse kinematics – Solvability, Solution Techniques and Closed Form Solution.

MODULE III MANIPULATOR DIFFERENTIAL MOTION AND STATICS 9

Linear and Angular Velocity – Mapping Velocity Vector – Manipulator Jacobian – Jacobian Computation, Prismatic Joint Jacobian, Rotary Joint Jacobian – Jacobian Inverse – Computation of singularities – Static analysis.

MODULE IV TRAJECTORY PLANNING 9

Terminologies and steps in Trajectory planning – Joint space Techniques – Cartesian space techniques – Comparison of Joint space and Cartesian Trajectory planning.

MODULE V DYNAMICS MODELING AND CONTROL OF MANIPULATORS 10

Lagrangian mechanics – Two DOF Manipulator - Lagrange Euler formulation- Dynamic model – Manipulator control problem - Linear control schemes - PID control scheme - Force control of robotic manipulator.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw Hill, 4th Edition, New Delhi, 2013.

2. Kevin M. Lynch, Frank C. Park, Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press, 1st Edition, 2017, ISBN-13 - 978-1107156302.
3. Saeed B.Niku, Introduction to Robotics – Analysis, Control and Applications, John Wiley, USA, 2020.

REFERENCES:

1. Spong M.W., Hutchinson .H., & Vidyasagar M., Robot Modeling and Control, John Wiley (Wiley India Ed.), 2006, ISBN-13: 978-0471649908.
2. John J. Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford, 2006, ISBN – 0195673913.
4. Robert J. Schilling, Fundamental of Robotics Analysis and control, Prentice Hall, 1996, ISBN - 13: 978-0133444339.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Discuss the fundamental concepts of robotics.

CO2: Explain the mechanical structure and kinematic model in robotics.

CO3: To relate the velocities of the end-effectors and the joint velocities of the manipulator.

CO4: To apply the reference inputs for motion control of the system

CO5: Formulate the equations to describe the relationship between force and motion in a system.

Board of Studies (BoS) :	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	-	-	-	M	-	M	-	-	M	H	H	-	-
CO2	H	M	-	-	-	M	-	M	-	-	M	H	H	-	-
CO3	H	M	-	-	-	M	-	M	-	-	M	H	-	H	M
CO4	H	M	-	-	-	M	-	M	-	-	M	H	-	H	M
CO5	H	M	-	-	-	M	-	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.
Statement : Improving lives through the advancement of learning.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
Statement: To increase the industrial productivity and work safety by using automotive robots for performing repetitive actions or jobs considered too dangerous for humans.

ECDX 014	FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB1: To define the basics of the automotive system.

COB2: To choose the automotive sensors for real time applications.

COB3: To build a digital engine control system.

COB4: To develop knowledge on automated vehicle control.

COB5: To design automotive electronics systems.

PREREQUISITE:

Fundamentals of basic electronics

MODULE I AUTOMOTIVE FUNDAMENTALS OVERVIEW 9

Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control. Exhaust Emissions, Fuel Economy, Electronic Engine control system concepts, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance.

MODULE II CONTROL SYSTEMS AND AUTOMOTIVE SENSORS 9

Automotive Control System applications of Sensors and Actuators – Typical Electronic Engine Control System. Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor

MODULE III DIGITAL ENGINE CONTROL SYSTEMS 9

Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics.

MODULE IV VEHICLE-MOTION CONTROLS 9

Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS). Bus Systems–

Classification, Applications in the vehicle, Coupling of networks, Examples of networked vehicles.

MODULE V AUTOMOTIVE ELECTRONIC SYSTEMS 9

Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Heads Up display, Speech Synthesis, Navigation – Navigation Sensors - Radio Navigation, Signpost navigation, dead reckoning navigation, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Stability Augmentation, Automatic driving Control. Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. William B.Ribbens, “Understanding Automotive Electronics”, 7th Edition, Elsevier Publishing, 2012.
2. Hillier’s, “Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics”, Fifth Edition, Nelson Thrones, 2007.

REFERENCES:

1. Bosch, “Automotive Electrics and Automotive Electronics. System and components, Networking and Hybrid drive”, Fifth edition, Springer view 2014
2. Najamuz Zaman , “ Automotive Electronics Design Fundamental’’ first edition, Springer 2015.
3. William B. Ribbens, “Understanding Automotive Electronics” Sixth Edition, Elsevier Newnes, 2002

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Explain the electronics systems used for control of automobiles.

CO2: Analyze the operation of sensors, actuators and control systems used in automobiles.

CO3: Diagnose the faults in the subsystems and systems of automobiles.

CO4: Apply the fundamental knowledge in the development of automotive systems.

CO5: Integrate the functions of each system with its design.

Board of Studies (BoS) :	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	L	L	L	L	L	H	M	L	L	H	M	L
CO2	H	H	M	M	L	L	L	L	H	M	L	L	H	M	L
CO3	M	M	H	H	L	H	M	M	M	M	L	M	H	M	L
CO4	L	M	M	H	M	M	H	M	H	M	L	L	H	M	L
CO5	L	M	H	H	H	M	H	H	H	M	L	M	H	M	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.
Statement: This course enables the student to understand the basic concepts of automotive electronics and control systems

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.
Statement:
Use various sensors, actuators and control systems in automobiles.

ECDX 015	**INTRODUCTION TO SATELLITE COMMUNICATION**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB 1 : To define satellite orbits and to understand about satellite communication

COB 2 : To explain geostationary orbit and to formulate uplink and down link equations.

COB 3 : To explain the basic concepts of earth and space segments.

COB 4 : To analyze the principles and mechanism involved in satellite systems.

COB 5 : To describe the facts and ideas of different satellite services and its applications

PREREQUISITE: Fundamentals of analog and digital Communication

MODULE I ORBITAL MECHANICS AND LAUNCHER 9

Orbital Mechanics – Look angle determination –Orbital perturbations – Orbit determination- launches and launch vehicles – Orbital effects in communication systems

MODULE II THE SPACE AND EARTH SEGMENT 9

Space segment: Satellite subsystems – Attitude and orbit control systems – Telemetry, Tracking, Command and Monitoring – Power systems – Communication Subsystems. Earth segment: Receive only Home TV Systems-Master antenna TV systems – community antenna TV systems - Transmit-Receive Earth stations

MODULE III SATELLITE ANTENNAS CHARACTERISTICS 9

Satellite antennas– Antenna foot prints- horn antenna- Parabolic Antenna – Multibeam Antenna – Phased array antenna –Frequency reuse in multibeam and Phased array antenna

MODULE IV THE SPACE LINK AND INTERFERENCE 9

EIRP- transmission loss- the link power budget equation –system noise –CNR-the uplink- the downlink – Effects of rain – Combined uplink and down link – Intermodulation noise- Intersatellite links- Interference between satellites – Energy dispersal – Coordination

MODULE V FIXED TELEPHONY SATELLITE NETWORKS AND MOBILE SATELLITE SERVICE 9

Role of satellite in telephone services – Demand assignment SCPC Network Architecture – Preassigned point to point link – Application of FTS- Foundation of Mobile Satellite services – GEO MSS system – Handheld terminals – Non- GEO MSS systems – Intelligent MSS services- Multiple access in MSS – Digital speech compression – Ground Segment Architecture in MSS- Subscriber access and connectivity – Network security - DTH- Satellite Applications- Satellite Navigation.

L – 45: TOTAL HOURS – 45

TEXT BOOKS:

1. Timothy Pratt, Charles Bostian, Jeremy Allmuti, "Satellite Communications", John Wiley &Sons (Asia) Pvt. Ltd. 2004.
2. Dennis Roddy, "Satellite Communications", 4th Edition, McGraw-Hill Publication, 2006.

REFERENCES:

1. Satellite Communications Network Design and Analysis, Kenneth Y. Jo,Artech House, 2011- Artificial satellites in telecommunication
2. The Satellite Communication Applications Handbook, 2nd edition Bruce R. Elbert , Artech House, 2004 - Technology & Engineering
3. Introduction to Satellite Communication, Bruce R. Elbert , 3rd edition Artech House, 2008 - Technology & Engineering
4. Wilbur L. Pritchard, Henri G.Suyder, Hond Robert A.Nelson, "Satellite Communication Systems Engineering", 2nd Edition, Pearson Education Ltd., 2003.
5. M.Richharia,"Satellite Communication Systems (Design Principles)", 2nd Edition, Macmillan Press Ltd, 2003.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : analyze satellite orbits and launching mechanisms

CO2 : describe the space segment and earth segment

CO3 : compare antennas used in satellite communication.

CO4 : design uplink and downlink of a satellite systems

CO5 : explain FSS, DBS, MSS and VSS.

Board of Studies (BoS) :	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC 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	H	M	-	-	M	M	-	M	-	M	H	H	L
CO2	H	H	H	M	-	-	M	M	-	M	-	M	H	H	L
CO3	H	H	H	M	-	-	M	M	-	M	-	M	H	H	L
CO4	H	H	H	M	-	-	M	M	-	H	-	M	H	H	L
CO5	H	H	H	M	-	-	M	M	-	M	-	M	H	H	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.

Statement: This course enables the student to understand the concepts of orbits, satellites and its application in various domains of communication.

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

Statement: Able to understand the concepts of various satellite services.

ECDX 016 SDG: 4,9	ELECTROMAGNETIC INTERFERENCE & COMPATIBILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1 : To apply, identify and understand the basic knowledge of science in EMI & EMC in different environments

COB2 : To select and apply appropriate coupling principles for EMI

COB3 : To formulate and analyze different EMI measurements

COB4 : To describe the concepts of EMI control mechanisms

COB5 : To select, apply and differentiate appropriate standards for EMI/EMC.

PREREQUISITE: Knowledge on Electromagnetic Fields and Microwaves

MODULE I EMI ENVIRONMENT 8

Concepts of EMI and EMC and definitions - Sources of EMI - Celestial Electromagnetic noise - Lightning discharge-Electrostatic Discharge-Electromagnetic Pulse - Electromagnetic emissions - Noise from relays and Switches - Nonlinearities in Circuits

MODULE II EMI COUPLING PRINCIPLES 8

Capacitive coupling - Inductive coupling- Common impedance ground coupling-Ground loop coupling-Transients in power supply lines- Radiation coupling, Conduction coupling- Common - mode and Differential mode interferences-Conducted EM noise on power supply lines.

MODULE III EMI MEASUREMENTS AND STANDARDS 10

Open area test site measurements-Measurement precautions - Open -area test site- Anechoic Chamber-TEM Reverberating TEM-GTEM cell- Standards for EMI/EMC- MIL-STD-461/462-IEEE/ANSI standard-CISPR/IEC standard- FCC regulations-British standards-VDE standards-Euro norms.

MODULE IV EMI CONTROL TECHNIQUES 10

EMC Technology- Grounding-Shielding-Electrical Bonding-Power line filter-CM filter - DM filter- EMI suppression Cables- EMC Connectors -Isolation transformer.

MODULE V EMC DESIGN OF PCBs 9

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Kodali, V. Prasad, and V. Prasad. "Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models". IEEE Press, 2001.
2. C.R.Paul, "Introduction to Electromagnetic Compatibility", John Wiley and Sons, Inc, 2006.
3. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, New York,1988
4. Bernhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Edition, Artech house, 1986.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 : Summarize the concepts in EMI & EMC in different environments.

CO2 : Distinguish coupling principles for EMI

CO3 : Measure different EMI parameters

CO4 : Apply EMI control mechanisms for specific needs with appropriate techniques

CO5 : Compare and discuss different standards for EMI/EMC

Board of Studies (BoS) :	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC 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	H	H	H	-	-	-	-	-	-	-	H	H	-
CO2	H	H	H	H	H	-	-	L	-	-	-	-	H	H	-
CO3	H	H	H	H	H	-	-	M	-	-	-	-	H	H	-
CO4	H	H	H	H	H	-	-	L	-	-	-	-	H	M	-
CO5	H	H	H	H	H	-	-	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.

Statement: Provide Quality education by understanding the fundamental concepts and promote research in the area of RF & Communication.

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

Statement: Build resilient Infrastructure, promote inclusive and sustainable industrialization through EM wave propagation within the industry.

ECDX 017	INTRODUCTION TO PCB DESIGN	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1 : To identify and understand the basics of PCB components.

COB2 : To explain and demonstrate about EDA Tools and analyze the circuit

COB3 : To make use of schematic and layout design flow using Electronic Design Automation (EDA) Tools.

COB4 : To analyze design rule check and prepare footprint.

COB5 : To design and develop the PCB and propose the steps involved in PCB design and fabrication process.

PREREQUISITE: Basic knowledge on Electronic components and Circuits.

MODULE I INTRODUCTION TO PRINTED CIRCUIT BOARD 9

fundamental of electronic components, Categorizing electronic components according to their size, power-ratings, package style and placements Understanding the difference between through-hole components and SMD components Reading component's data-sheets and transferring their mechanical layout and dimensions to a new footprint library design basic electronic circuits.

MODULE II SCHEMATIC CAPTURE AND DESIGN RULES FOR PCB 9

Familiarize with EDA user interface and design environment Defining the types of libraries and the function of each one Getting started with a new project Opening, storing and managing various schematic designs and projects. Compiling and checking the schematic design against warnings, errors and faults Creating output reports such as BOM (Bill of Material) Exporting and importing schematic data.

MODULE III PCB LAYOUT DESIGN 9

PCB design process by defining the board shape. Defining the PCB board profile and details. Specifying the number of signal-layers and power-planes Placement of components using either: manual, interactive and automatic technique Routing using either manual or interactive routing. Tricks and tips of best component placement and interactive routing strategies.

MODULE IV PCB ANATOMY AND FABRICATION OUTPUTS 9

Description of different types of PCB by discussing the difference between single & double sided PCB. Understanding the difference between single-layer, double-layer and multiple-layer

PCB Understanding the main physical layers of a given PCB: Top-Overlay, Mechanical-Layer, Solder-Paste, Solder-Mask, Solder-Pad. Generation of GERBER File (Gerber Setup in order to specify the accuracy, Layers and Drill-Drawings). Setup and generate an NC-Drill Files.

MODULE V PCB DESIGN FOR EMI/EMC 9

Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards. Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.

L – 45: TOTAL HOURS – 45

TEXT BOOKS:

1. Walter C Bosshart, ‘’ Printed Circuit Boards, Design and Technology” McGraw Hill.Inc., 2009.
2. Printed Circuits Handbook, Sixth Edition, by Clyde F. Coombs, Jr, Happy T. Holden, Publisher: McGraw-Hill Education Year: 2016.
3. EMC and Printed circuit board **,**Design theory and layout**,** Mark I Montrose IEEE compatibility society.

REFERENCES:

1. Kraig Mitzner “Complete PCB Design Using Or CAD Capture and PCB Editor” Newnes, 2009.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Describe the evolution of PCB, types and classes of PCB.

CO2 : Experiment with circuit design process and different machines used for designing.

CO3 : Make use of the steps involved in schematic, layout, fabrication and assembly process of PCB design.

CO4 : Analyze PCB model for analog circuits, digital circuits and mixed circuits.

CO5 : Design and fabricate PCB for simple circuits.

Board of Studies (BoS):	Academic Council:
23rd BoS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M	-	M	-	-	-	L	L	-	M	H	M	H
CO2	H	M	H	-	M	-	-	-	M	-	-	M	H	M	H
CO3	H	M	M	-	M	-	-	-	L	M	-	M	H	M	H
CO4	H	M	M	-	M	-	-	-	M	-	-	M	H	M	H
CO5	H	M	M	-	M	-	-	-	L	L	-	M	H	L	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 parameters to design PCB, constraints in designing a PCB and techniques for fabricating PCB.

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

Statement: Able to apply the theoretical concepts of PCB for various applications practically.

ECDX 018	RADAR AND NAVIGATIONAL AIDS	L	T	P	C
SDG: 4,11		3	0	0	3

COURSE OBJECTIVES:

COB1: : To describe the fundamentals of Radar.

COB2 : To explain the different types of Radars and its applications.

COB3 : To apply doppler principles for Target tracking.

COB4 : To identify the detection and processing methodologies for radar receivers.

COB5 : To analyze the principles of navigations and satellite based positioning systems.

PREREQUISITE:

Basic knowledge of Communication systems, Antenna and RF propagation.

MODULE I INTRODUCTION TO RADAR 9

Basic Radar - Radar Block Diagram - Radar Equation - Radar Frequencies Applications of Radar. Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm.

MODULE II TYPES OF RADAR 9

Continuous Wave and Frequency Modulated CW Radar, Doppler Effect, MTI and Pulse Doppler Radar, Tracking Radar – Tracking techniques.

MODULE III RADAR TRANSMITTERS AND ANTENNAS 9

Magnetron Oscillator, Klystron Amplifier, TWTA, Modulators, Solid State Transmitters, Radar Antenna – Parabolic Reflector Antennas – Feeds, Lens Antenna, Pattern Synthesis, Stabilization of Antennas.

MODULE IV DETECTION OF RADAR SIGNALS 9

The Radar Receiver - Noise Figure, Mixers, Matched-Filter Receiver Correlation Detection, Detector Characteristics, Constant-False-Alarm-Rate (CFAR) Receiver. Synthetic Aperture Radar.

MODULE V FUNDAMENTALS OF NAVIGATION 9

Introduction to Navigation - Radio Direction Finding - Direction Finding at Very High Frequencies - Automatic Direction Finders, Radio Ranges - The LF/ MF Four course Radio Range - VHF Omni Directional Range(VOR) - Hyperbolic Systems of Navigation (Loran and Decca), Satellite Navigation systems – GPS.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Merrill I. Skolnik," Introduction to Radar Systems", 3rd Edition, McGraw-Hill Education, 2017.
2. N Nagaraja, "Elements of Electronics Navigation", 2nd Edition, McGraw Hill Education, 2017.
3. Byron Edde, "Radar Principles, Technology, Applications", Pearson Education India, 2009.

REFERENCES:

1. Peyton Z. Peebles, "Radar Principles", Wiley India Pvt Ltd, 2007
2. J.C Toomay, "Principles of Radar", 2nd Edition –PHI, 2004

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : discuss and interpret the basic principle and operation of Radar

CO2 : explain the principle and mechanism involved in the navigational aids

CO3 : apply the principle of Doppler effect to radar systems

CO4 : compare and analyze different types of Radar and its merits.

CO5 : evaluate the detection capacity and accuracy of radars at various circumstances.

Board of Studies (BoS): 23rd BoS of ECE held on 13.07.2022

Academic Council: 19th AC held on 29.09.2022

	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	PSO 3
CO1	H	M	-	-	L	-	M	-	-	-	-	L	H	M	L
CO2	H	H	-	-	H	-	L	-	-	-	-	L	H	M	L
CO3	M	H	-	-	L	-	H	-	-	-	-	L	H	M	L
CO4	M	H	-	-	L	-	L	-	-	-	-	H	H	M	L
CO5	L	M	-	-	L	-	L	-	-	-	-	M	H	M	L

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

SDG No: 4 - Quality Education

This course will deliver the concepts of Radar, a rapidly evolving technology, promoting life long learning.

SDG No: 11 - Make cities and human settlements inclusive, safe, resilient and sustainable.

Advanced radars are often used in Weather, and Militiary to safegaurd settlements, and fight climate change.

		L	T	P	C
ECDX 019	**ADVANCED DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
SDG: 3, 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To list the concept of discrete random signal processing

COB2 : To estimate the spectrum of Discrete Random Signals

COB3 : To design Linear predictors

COB4 : To model and design adaptive filters

COB5 : To evaluate noise and echo cancellers

PREREQUISITE: Fourier series, Signal and System

MODULE I DISCRETE RANDOM SIGNAL PROCESSING 9

Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem, special types of random process – Signal modeling-Least Squares method, Pade approximation, Prony’s method.

MODULE II SPECTRUM ESTIMATION 9

Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation - Model based approach - AR, MA, ARMA Signal modeling – Parameter estimation using Yule-Walker method.

MODULE III LINEAR ESTIMATION 9

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener Hoff equations - Recursive Bayesian Estimation

MODULE IV LINEAR PREDICTION 9

Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations

MODULE V ADAPTIVE FILTERS 9

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive - Adaptive channel equalization – Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley and Sons Inc., New York, 2006.
2. Sophoncles J. Orfanidis, “Optimum Signal Processing “, McGraw-Hill, 2000.

REFERENCES:

1. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing”, Prentice Hall of India, New Delhi, 2005.
2. Simon Haykin, “Adaptive Filter Theory”, Prentice Hall, Englehood Cliffs, NJ1986.
3. S. Kay,” Modern spectrum Estimation theory and application”, Prentice Hall, Englehood Cliffs, NJ1988.
4. P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Prentice Hall, 1992.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Apply the concept of random signal processing

CO2 : Estimate the spectrum of Discrete Random Signals

CO3 : Design and analyze linear predictors

CO4 : Design adaptive filters for a given application

CO5 : Analyze noise and echo cancellation systems

Board of Studies (BoS):	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	P O1	P O2	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	H	H	M	L	-	-	-	-	H	M	-	-	L	H	L
CO2	M	H	H	M	L	-	-	-	H	M	-	-		H	L
CO3	M	H	H	M	L	-	-	-	M	M	-	-	L	H	L
CO4		M	H	H	M	-	-	-	H	M	-	-		H	L
CO5				M	H	-	-	-	H	M	-	-	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. A sound knowledge in these could lead to a 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 advanced digital signal processing, digital filers, adaptive filters.

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

Statement: advanced digital signal processing forms the basis of control systems and automation.

ECDX 020	**INTRODUCTION TO SYSTEM VERILOG FOR VERIFICATION**	**L**	**T**	**P**	**C**
SDG: 4,9		2	0	2	3

COURSE OBJECTIVES:

COB1: To know the Fundamentals of System Verilog, Design, verification and testing methodologies

COB2: To get an insight into datatypes in System Verilog

COB3: To Build a complete verification environment function coverage

COB4: To learn coding for a productive RTL design

COB5: Link to concepts of OOPs in System Verilog

PREREQUISITE: Verilog, Digital VLSI Testing

MODULE I VERIFICATION GUIDELINES 9

Verification Process, Verification Plan, Verification Methodology Manual, Basic Test bench functionality, Directed Testing, Methodology Basics, Constrained Random Stimulus, Functional Coverage, Test bench Components, Layered Test bench, Building a Layered Test bench, Simulation Environment Phases, Maximum Code Reuse, Test bench Performance.

MODULE II DATA TYPES 9

Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, Choosing a Storage Type, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression Width, Net Types.

MODULE III PROCEDURAL STATEMENTS AND ROUTINES 9

Procedural Statements, Tasks, Function Overview, Task functions and Void functions, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values.

MODULE IV CONNECTING THE TESTBENCH AND DESIGN 9

Separating the Testbench and Design, The Interface Construct, Stimulus Timing, Interface Driving and Sampling, Top-Level Scope, Program – Module Interactions, System Verilog Assertions, The Four-Port ATM Router.

MODULE V RANDOMIZATION AND THREADS 9

Randomization in System Verilog, Constraint Details, Solution Probabilities, Controlling Multiple Constraint Blocks, Valid Constraints, In-line Constraints, The pre-randomize and post-randomize Functions, Constraints Tips and Techniques, Common Randomization Problems, Iterative and Array Constraints, Atomic Stimulus Generation vs Scenario Generation, Random Control, Random Generators, Random Device Configuration- Threads-building a testbench with threads.

List of Experiments:

1. Running the Simulator in Vivado IDE
2. Debugging the Design
3. Running Simulation in Batch Mode
4. System Verilog Feature
5. Functional Coverage

L –30; P – 30; TOTAL HOURS – 60

TEXT BOOKS:

1. . Chris Spear, "System Verilog for Verification: A Guide to Learning the Test bench Language Features", Springer, 2nd edition, 2008, ISBN-978-1-4419-4561-7
2. Stuart Sutherland, Simon David Mann, Peter Flake, "System Verilog For Design", Springer, 2nd edition, ISBN-10: 0-387-33399-1, 2006.

REFERENCES:

1. Mark Zwolinski, "Digital System Design with System Verilog", Prentice Hall,2009

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Understand Fundamental syntax of System Verilog.

CO2: Create a verification environment.

CO3: design and develop coding for high level synthesis.

CO4: Employ various verification techniques.

CO5: Apply randomization to control constraint blocks

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M				M		L	L		M	H			H
CO2	M	M				M		L	L		M	H			H
CO3	M	M				M		L	L		M	H			H
CO4	M	M				M		L	L		M	H			H
CO5	M	M				M		L	L		M	H			H

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

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

Statement : To incorporate verification methodology with OOP concept in verilog

ECDX 021	DIGITAL VLSI TESTING	L	T	P	C
SDG: 4, 9, 12		3	0	0	3

COURSE OBJECTIVES:

COB1: To define the different techniques for detection of faults in digital circuits.

COB2: To analyze the combinational circuits using test vectors.

COB3: To discuss the test vectors used for sequential circuits.

COB4: To design the different approaches for testability.

COB5: To explain the Self-testing methods.

PREREQUISITE:

Basics of digital circuits, Knowledge on VLSI design·

MODULE I BASICS OF TESTING AND FAULT MODELING 10

Introduction to Testing - Role of testing - Types of Testing; Fault Modeling - Defects, Errors, and Faults, Functional Versus Structural Testing-Faults in digital circuits, Levels of Fault Models, Levels of Fault Models, A Glossary of Fault Models, Single Stuck-at Fault - Logic Simulation.

MODULE II TESTING OF COMBINATIONAL CIRCUIT 9

Algorithms and Representations - Single Stuck-at Fault, Definition of Automatic Test-Pattern Generator, Search Space Abstractions, ATPG Algebras, Algorithm Types- Redundancy Identification - Testing as a Global Problem - Significant Combinational ATPG Algorithms - Test Generation Systems - Test Compaction.

MODULE III TESTING OF SEQUENTIAL CIRCUITS 9

ATPG for Single-Clock Synchronous Circuits - Use of Nine-Valued Logic, Development of Time-Frame Expansion Methods, Approximate Methods, Implementation of Time-Frame Expansion Methods, Complexity of Sequential ATPG, Clock Faults and Multiple-Clock Circuits, Asynchronous Circuits - Simulation-Based Sequential Circuit ATPG.

MODULE IV DESIGN FOR TESTABILITY 8

Digital DFT and Scan design- Ad-hoc design, Generic scan based design – Scan Design Rules, Scan Design Rules, Multiple Scan Registers, Overheads of Scan Design, Design Automation, Physical Design and Timing Verification of Scan; Partial-Scan Design - Variations of Scan.

MODULE V SELF TESTING 9

Built-In Self Test (BIST) - Definitions , BIST Process Test pattern generation for BIST, BIST Response Compaction, Built-in Logic Block Observers, Test-Per-Clock BIST Systems, Test-Per-Clock BIST Systems, Circular BIST , Device level BIST; Memory BIST.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Springer-Verlag New York Inc, 2013.
2. A.L. Crouch, "Design Test for Digital ICs and Embedded Core Systems", Pearson Education Limited, 2008.

REFERENCES:

1. Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, Third Edition, 2011.
2. W. W. Wen, "VLSI Test Principles and Architectures Design for Testability", Morgan Kaufmann Publishers. 2006.

COURSE OUTCOMES:

On completion of the course, the students will be able to(Reframe Co5,

CO1: Apply the standard testing principles to test digital circuits logically using stuck at faults models.

CO2: Construct the test vectors using ATPG algorithms for combinational and sequential.

CO3: Make use of test principles for designing digital systems

CO4: Design circuits to function in teams involving the testing of digital VLSI systems.

CO5: Apply the concepts in testing which can help them design a better yield in IC design.

Board of Studies (BoS) :	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	M	-	-	M	M	M	H	M	-	-	-	H	M	H	M
CO2	M	-	-	M	M	M	H	M	-	-	-	H	M	H	-
CO3	M	-	-	M	M	M	H	M	-	-	-	H	H	H	H
CO4	M	-	-	M	M	M	H	M	-	-	-	H	H	H	-
CO5	M	-	-	M	M	M	H	M	-	-	-	H	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: Implementation of new engineering measures to drive eco efficiency across industry network p promotes lifelong learning opportunities for all.

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

Statement: Fundamentals of this course paves a way to the development of sustainable manufacturing

SDG12. Sustainable Consumption and Production

Statement: Promoting engineering skills to develop the infrastructure to improve life Sustainable economic growth and productive employment.

ECDX 022	**INTRODUCTION TO REAL TIME OPERATING SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To describe the aspects of the Operating systems and Real-time Operating Systems

COB2 : To learn the concepts of scheduling and task management

COB3 : To describe Resource management, time-constrained communication and synchronization for real-time kernels.

COB4 : To familiarize MicroC/OS-II features and services.

COB5 : To impart necessary skills to develop real time embedded system applications using RTOS.

Prerequisites: Basics of Embedded system

MODULE I REAL TIME OPERATING SYSTEMS 9

Overview of Operating Systems concepts **-** Defining RTOS- Characteristics of RTOS- Comparison with general purpose operating system- scheduler- schedulable entities, multitasking, context switching, dispatcher, scheduling algorithms- schedulability Analysis.

MODULE II KERNEL OBJECTS AND RTOS SERVICES 9

Kernel Objects **-** Task, Tasks states and scheduling, Task Operations, Task structure, Synchronization, Communication and Concurrency - semaphores- state diagram, Types - Defining Message Queue, States, Pipes, Event Registers, Signals- RTOS Services.

MODULE III EXCEPTIONS , INTERRUPTS AND MEMORY MANAGEMENT 9

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Dynamic memory allocation.

MODULE IV MICROC/OS-II 9

MicroC/OS-II -Introduction – Features and Goals of µC/OS – II – Requirements of µC/OS – II - Support Devices for µC/OS – II – File Structure in µC/OS – II - Task Management Functions – Creating a Task - Time Management Functions – OS Delay Functions - Implementation of Scheduling and rescheduling.

MODULE V APPLICATION OF RTOS 9

Comparison RT Linux, Vx Works, QNX and Basic Concepts of Android OS-RTOS for Image Processing – RTOS for fault Tolerant Applications – RTOS for Control Systems.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating system concepts”, 9th edition, John Wiley and Sons Inc., 2012
2. Qing Li, Elsevier , “Real Time Concepts for Embedded Systems”, 2011
3. Jean J. Labrosse, “MicroC/OS – II The Real Time Kernel”, CMP Books, 2002.
4. Karim Yaghmour, “Embedded Android: Porting, Extending, and Customizing”, O’Reilly March 2013.
5. Wang, K.C.Embedded and Real-Time Operating Systems-Springer 2018.

REFERENCES:

1. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH
2. Jim Cooling, Real-time Operating Systems: Book 1 - The Theory (The engineering of real-time embedded systems) ISBN-13: 978-1549608940, Lindentree Associates 2017.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Describe various task assignment and scheduling methods of operating system and real time operating system.

CO2 : Recognize exceptions, timer and memory management in OS.

CO3 : Analyze the use of synchronization techniques in real-time systems.

CO4 : Describe the application of real time operating system

CO5 : Determine the type of real time operating system needed for a particular application.

Board of Studies (BoS) : 23rd BOS of ECE held on 13.07.2022

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	PSO3
CO1	M	M	M	-	-	-	-	-	M	-	-	M	L	L	H
CO2	M	H	M	-	-	-	-	-	M	-	-	M	L	L	H
CO3	M	H	M	-	H	-	-	-	M	-	-	M	H	L	H
CO4	L	L	L	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	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 realize the real time embedded system development with the help of RTOS.

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

RTOS plays a major role in industry to develop real time embedded system product. Innovative ideas can be implemented using RTOS programming

ECDX 023	Introduction to Embedded Linux	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the history of embedded Linux and its architecture

COB2: To learn the memory mapping in LINUX environment

COB3: To understand driver concepts

COB4: To impart knowledge in real time operating system concepts

COB5: To know debugging techniques in Linux system

PREREQUISITE: Embedded System Design

MODULE I ARCHITECTURE OF EMBEDDED LINUX 9

History of Embedded Linux- Embedded Linux Versus Desktop Linux- Embedded Linux Distributions- Porting Roadmap- Architecture of Embedded Linux- Linux Kernel Architecture- User Space- GNU Cross-Platform Tool chain

MODULE II EMBEDDED STORAGE 9

Board Support Package- Memory Map- Interrupt Management- The PCI Subsystem- Power Management- Flash Map- Memory Technology Device- Embedded File Systems- Optimizing Storage Space- Tuning Kernel Memory

MODULE III EMBEDDED DRIVERS 9

Linux Serial Driver- Ethernet Driver- I2C Subsystem on Linux- USB- Watchdog Timer- Kernel Modules- Porting Applications

MODULE IV REAL-TIME LINUX 9

Real-Time Linux- Interrupt Latency , Scheduler Latency ,Real-Time Programming in Linux- Process Scheduling, Memory Locking, POSIX Shared Memory, POSIX Message Queues, POSIX Semaphores, Real-Time Signals Asynchronous I/O, Hard Real-Time Linux

MODULE V BUILDING AND DEBUGGING LINUX 9

Building the Kernel- Cross-Compiling- Troubleshooting Configure Script- Building the Root File System- Integrated Development Environment- Debugging Virtual Memory Problems- Kernel Debuggers- Profiling- Embedded Graphics

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. P.Raghavan,Amol Lad,Sriram Neelakandan,"EmbeddedLinux System Design & Development,Auerbach Publications, 2012
2. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, 'Building Embedded Linux Systems 2nd Edition', SPD -O'Reilly Publications, 2008.

REFERENCES:

1. William von Hagen, 'Ubuntu Linux Bible 3rd Edition', Wiley Publishing Inc., 2010
2. Robert Love, "Linux System Programming, SPD -O'Reilly Publications, 2010
3. Doug Abbott, "Linux for embedded and real time applications", Elsevier Science, 2003
4. Chris Simmonds, "Mastering Embedded Linux Programming" - Second Edition, PACKT Publications Limited.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Understand the architecture of Linux based system

CO2: Describe about the build process of embedded Linux system.

CO3:Develop device driver

CO4: Build the RTOS based LINUX system

CO5: Design and debug the application

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

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	PSO3
CO1	M	H	L	L	L	L	L	M	M	L	L	L	M	M	H
CO2	M	H	L	L	M	L	L	M	M	L	L	L	M	M	H
CO3	M	H	L	L	M	L	L	M	M	L	L	L	M	M	H
CO4	M	H	L	L	M	L	L	M	M	L	L	L	M	M	H
CO5	M	H	M	L	M	M	M	M	M	M	L	L	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.

Statement: This course enables the student to realize the concepts of Linux operating system

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

Embedded system design plays a major role in industry to provide Intelligent solutions that can then be used to make manufacturing processes more efficient and reduce their energy consumption.

ECDX 024	MECHATRONICS	L	T	P	C
SDG: 4 and 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the working of modern mechanical system, deals with sensors, actuators and controllers

COB2: To learn the principles of actuation systems

COB3: To gain knowledge of system models and controllers

COB4:to impart necessary skill to develop logic functions in controllers

COB5:understand the design principles of mechatronics systems.

PREREQUISITE: Fundamental of Electronic devices and MATLAB

MODULE I MECHATRONICS, SENSORS AND TRANSDUCERS 9

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Displacement, Potentiometer LVDT – Encoders – Hall Effect – Capacitive transducers Microprocessor based Controllers - Applications.

Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, (thermistor, thermocouple) Light Sensors – Selection of Sensors.

MODULE II ACTUATION SYSTEMS 9

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and Pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – D.C Motors – A.C Motors – Stepper Motors - Servomotors.

MODULE III SYSTEM MODELS AND CONTROLLERS 9

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems.

Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

MODULE IV PROGRAMMING LOGIC CONTROLLERS 9

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC Problem – Application of PLCs for control.

MODULE V DESIGN OF MECHATRONICS SYSTEM 9

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions. Case Studies of Mechatronics Systems, Pick and place robot – Automatic Car Park Systems – Automatic Camera – Automatic Washing Machine - Engine Management Systems.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

- Musa Jouaneh, "Fundamentals of Mechatronics" Cengage Learning, 2012
- W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4/e, Prentice Hall, 2009, ISBN 978-0132407632
- Dr. K. K. Appukuttan, "Introduction to Mechatronics" Oxford Higher Education, 2007.

REFERENCES:

- N.P.Mahalik , "Mechatronics Principles concepts & Applications"Mc Graw Hill, 2017
- G Rzevski; J Johnson, Philip Picton "Mechatronics: Designing Intelligent Machines" Open University, London, 1994.
- David G. Alciatore, Michael B. Histand, Introduction to Mechatronics and Measurement Systems, 4th Edition, McGraw Hill, 2012.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Classify various sensors, transducer and actuators according to the applications.

CO2: Explain various system models and controllers.

CO3: Select a controller for a mechanical and mechatronics system.

CO4:write various logic functions for the controllers

CO5:design various mechatronics systems

Board of Studies (BoS):
23rd BOS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	H	H							M	H	M	M
CO2	H	H	H	H	H							M	H	M	M
CO3	H	H	H	H	H							M	H	H	H
CO4	H	H	H	H	H							M	H	H	H
CO5	H	H	H	H	H							M	M	H	M

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

SDG 4: Provide Quality education by understanding the fundamental concepts of mechatronics and promote research in the area of automation.
SDG 9: Build resilient automated system through electronics and embedded systems in the field of Mechatronics.

ECDX 025	**R Programming**	**L**	**T**	**P**	**C**
SDG: 4 & 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To outline the basics of R programming concepts

COB2: To explain the data manipulation in R

COB3: To interpret the information from big data

COB4: To analyze the problem solving skills through programming

COB5: To make use of graphics for data visualization

PREREQUISITE: Basic Programming concepts

MODULE I INTRODUCTION 9

Introducing to R – R Data Structures – Help functions in R – data types-Vectors – Scalars – Declarations – recycling – Common Vector operations – Vectorized operations – Filtering – control statements – Vector Equality – Vector Element names.

MODULE II R DATA STRUCTURES 9

Matrices and Arrays - Creating matrices – General Matrix operations –Functions to matrix– Adding and deleting rows and columns – Vector/Matrix Distinction – Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – list components and values –functions to lists – recursive lists.

MODULE III DATA FRAMES, FACTORS AND TABLES 9

Creating and accessing Data Frames-Extracting Subdata Frames-Merging Data Frames- functions-Factors and Levels-Factors built in function-working with tables- Tables built in function.

MODULE IV R PROGRAMMING STRUCTURES 9

Control Statements-Arithmetic and Boolean Operators and Values-Function & return values-Environment and Scope Issues-Recursion-Replacement Functions-Anonymous Functions- MATH operation –Input /Output-Reading and Writing Files-String manipulation.

MODULE V GRAPHICS 9

Creating Graphs - Customizing Graphs - Graphs to Files - Creating Three - Dimensional Plots - Debugging - Performance Enhancement: Speed and Memory.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011
2. Christian Heumann, Michael Schomaker and Shalabh, " Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R", Springer, 2016

REFERENCES:

1. Mark Gardener, "Beginning R – The Statistical Programming Language", Wiley, 2013.
2. Robert Knell, "Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013.
3. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters,, " A Beginner's Guide to R", Springer 2009

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Summarize the basics of R programming language

CO2: Apply programming concepts for real time application

CO3: Analyze the big data through programming

CO4: Make use of R functions for data visualization

CO5: Design a model using R language

Board of Studies (BoS):
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Academic Council:
19th AC held on 29.09.2022

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

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

Statement :

Improving lives through the advancement of learning.

Data infrastructure is an asset that needs to be invested in.

ECDX 026	MACHINE LEARNING	L	T	P	C
SDG: 4,9		2	0	2	3

COURSE OBJECTIVES:

COB1: To explain basic principles of Machine learning

COB2: To model the supervised machine learning techniques

COB3: To analyze the unsupervised machine learning techniques

COB4: To evaluate the machine learning models

COB5: To identify suitable machine learning technique for real time applications

PREREQUISITE: Basic Programming knowledge and Algorithms

MODULE I INTRODUCTION 4

Introduction to Artificial Intelligence- Overview of machine learning-Mathematical basics for machine learning- basics of algebra, Calculus, Linear Algebra-vector ,Matrix operations, Probability- Conditional Probability, Random Processes and Random variables.

MODULE II SUPERVISED LEARNING 9

Linear Regression- Model and Cost Function-Parameter Learning, Multiple Linear Regression- Gradient Descent for Multiple Variables- Normal Equation, Logistic Regression, Regularization Neural Networks: Non-linear Hypotheses, Model Representation, Back propagation Algorithm, Support vector machines: Linear and Non-Linear, Kernel Functions, K Nearest Neighbors.

MODULE III ANALYSIS AND OPTIMIZATION OF MODELS 4

Evaluating a Hypothesis Model Selection and Train/Validation/Test Sets, Diagnosing Bias vs. Variance, Regularization and Bias/Variance, Learning Curves, Deciding What to Do Next Revisited, Prioritizing, Error Analysis, Error Metrics for Skewed Classes, Trading Off precision and Recall.

MODULE IV UNSUPERVISED LEARNING 8

Unsupervised Learning: Introduction, K-Means Algorithm, Optimization Objective, Random Initialization, Choosing the Number of Clusters, Expectation Maximization for Mixture of Gaussians- Dimensionality Reduction -Factor analysis-Principal components analysis-Independent components analysis- Anomaly Detection-Recommender system

MODULE V LARGE SCALE MACHINE LEARNING 5

Learning With Large Datasets, Stochastic Gradient Descent, Mini-Batch Gradient Descent, Stochastic Gradient Descent Convergence, Online Learning, Map Reduce and Data Parallelism, applications.

LAB EXPERIMENTS:

1. Basics of Programming languages and its Libraries
2. Data preprocessing of the dataset
3. Implementation of Linear regression and analysis the model parameters
4. Implementation of KNN algorithm
5. Implementation of Logistic Regression
6. Implement the classification using SVM
7. Implementation of back propagation algorithm
8. Application of machine learning

L: 30, P:30; Total Hours - 60

TEXT BOOKS:

1. Ethem lpaydin, "Introduction to Machine Learning", MITPress, Prentice Hall of India, ThirdEdition2014.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press,2012.

REFERENCES:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 3rdEdition, 1997.
2. Charu C.Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.
3. Charu C. Aggarwal, "DATA CLUSTERING Algorithms and Applications", CRC Press, 2014.
4. Kevin P. Murphy , "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.
5. Jiawei Hanand Micheline Kambers and JianPei ," DataMining Concepts and Techniques", 3rd edition, Morgan Kaufman Publications, 2012.
6. Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly,2016.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: define the fundamental concepts of machine learning

CO2: Identify suitable mathematical technique for machine learning problems

CO3: Compare various techniques for machine learning

CO4: make use of suitable dimensionality reduction techniques

CO5: apply suitable techniques for machine learning applications

Board of Studies (BoS):
23rd BOS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	H	H	H				L			H		H	
CO2	H	H	H	H	H	M			L	L	M	H		H	M
CO3	H	H	M									L		H	
CO4	H	H	M	H	H				L			H		H	
CO5	H	H	H	H	H	H			L	L	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.

Provide Quality education by understanding the fundamental concepts of machine Learning and apply in solving the real world problems

Statement :

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

Build resilient system using signal processing techniques and ML classification techniques.

ECDX 027	COMPUTER VISION	L	T	P	C
SDG: 4,9		2	0	2	3

COURSE OBJECTIVES:

COB1 : To define image processing techniques for computer vision

COB2 : To find shape and region of an image

COB3 : To explain image processing techniques for feature extraction

COB4 : To compare motion analysis approaches

COB5 : To discuss camera geometry fundamentals

PREREQUISITES:

Basic knowledge of image processing

Basic knowledge of image transforms

MODULE I COMPUTER VISION INTRODUCTION 8

Human and Computer vision system- Image sampling and frequency domain processing- Image transforms- Image enhancement operation - Classical filtering operations-Color image processing fundamentals

MODULE II FEATURE EXTRACTION 8

Low-level feature extraction- Edge detection- Canny, LOG, DOG; Line detectors, Corners - Harris and Hessian Affine - Localised feature extraction, High-level feature extraction-Deformable shape analysis, Active contours, Space Analysis-Image Pyramids and Gaussian derivative filters

MODULE III PATTERN AND MOTION ANALYSIS 8

Types of computer vision learning - Supervised, Unsupervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction, Background Subtraction and Modeling, Motion parameter estimation- Moving feature extraction and description -Moving object detection.

MODULE IV CAMERA GEOMETRY 6

Overview-Projective space, Perspective camera, affine camera, Camera and Epipolar Geometry, Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

LIST OF EXPERIMENTS:

1. Image enhancement using filters and histogram
2. Object detection using segmentation techniques
3. Face recognition
4. Video surveillance
5. Domain adaptation in Object detection
6. Segmenting places from a single RGB image
7. Boundary pattern analysis
8. Location of Laparoscopic tools
9. Human Iris location
10. Hole detection

L –30 ; P- 30, TOTAL HOURS – 60

TEXT BOOKS:

1. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Fourth Edition, Academic Press, 2020.
2. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
3. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
4. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

REFERENCES:

1. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
2. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.
3. Jayaraman, S.Essakirajan and T.Veerakumar "Digital Image Processing", Tata McGraw Hill Education,5th edition,2015

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Select image processing techniques required for computer vision

CO2 : Choose suitable image analysis techniques for feature extraction and pattern recognition

CO3 : Analyze supervised and unsupervised learning for computer vision applications

CO4 : Recall suitable camera geometry principles

CO5 : Adapt suitable computer vision algorithms for various applications

Board of Studies (BoS):
23rd BOS of ECE held on 13.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H			M							H		H	
CO2	M				M							H		H	
CO3		H	H	M	M							H		M	
CO4	M	M			M							H		M	
CO5				M	M							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: This course enables the student to learn image processing concepts applied for computer vision

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

Statement: Apply the practical knowledge of computer vision concepts for developing computer vision related applications.

ECDX 029	**DATA SCIENCE**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To explain basic principles of Data Science

COB2: To experiment with Data Manipulation techniques.

COB3: To identify the types of regression

COB4: To analyze Natural Language Processing and Parallel computing

COB5: To apply the data science analysis for various applications.

PREREQUISITE:

Basic knowledge of Matrix, Basic knowledge in data and its types Knowledge in programming algorithms

MODULE I DATA SCIENCE INTRODUCTION 9

Introduction to Data Science- Toolboxes for Data Scientists- Fundamentals- Get Started with Python for Data Scientists- Reading - Selecting Data- Filtering Data Filtering Missing Values- Manipulating Data- Sorting- Grouping Data- Rearranging Data- Ranking Data- Plotting.

MODULE II DESCRIPTIVE STATISTICS 9

Introduction - Descriptive Statistics- Data Preparation- Exploratory Data Analysis- Summarizing the Data- Data Distributions- Outlier Treatment- Measuring Asymmetry- Continuous Distribution- Kernel Density- Estimation.

MODULE III REGRESSION ANALYSIS 9

Linear regression- Simple Linear Regression- Multiple Linear Regression and Polynomial Regression- Sparse Model- Logistic Regression- overview Unsupervised Learning

MODULE IV STATISTICAL NATURAL LANGUAGE PROCESSING 9

Introduction- Statistical Natural Language Processing -Data Cleaning- Text Representation- Bi-Grams and n-Grams.

MODULE V High dimensional data analysis 9

Mathematical distances between data-Dimension reduction-Singular value decomposition-Principle component Analysis-Case study : Bio medical data analysis using data science methods.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Laura Igual, Santi Seguí," Introduction to Data Science" Springer International Publishing Switzerland 2017.
2. Yunus Emrah Bulut, Zacharias Voulgaris, AI for Data Science:

Artificial Intelligence Frameworks and Functionality for Deep Learning, Optimization, and Beyond, Publisher: Technics Publications, 2018.

3. Jake Vander Plas, “Python Data Science Handbook: Essential Tools for Working with Data”, O'Reilly Media, 1st Edition, ISBN: 9781491912058, 2016.

REFERENCES:

1. Joel Grus, “Data Science from Scratch: First Principles with Python”, O'Reilly Media, 1stEdition, ISBN: 9781491901427, 2015
2. Jake vanderplas,” Python data science hand book”, O’reilly media, 2016.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Apply modern tools to validate the data consistency

CO2: Inspect the statistical characteristics of data.

CO3: Estimate the relationship between variables using regression analysis

CO4: Interpret the characteristics of the dataset.

CO5: Evaluate the unique benefits of data representation and computation

Board of Studies (BoS):	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

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CO1	H	L	L	L	H	L	L	L	L	L	L	H	-	-	L
CO2	H	H	L	L	H	L	L	L	L	L	L	H	-	-	L
CO3	H	H	L	L	H	L	L	L	L	L	L	H	--	-	L
CO4	H	H	L	L	H	L	L	L	L	L	L	H	-	-	L
CO5	H	H	H	H	H	H	M	H	H	L	L	H	-	-	H

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

SDG No: 4 -Quality Education

This course will deliver the basic concepts of Data science which is used in Artificial Intelligence applications

SDG No: 9 - Industry, Innovation and Infrastructure

Data science and Artificial intelligence plays major roles in industry and modern infrastructures. Innovative ideas can be implemented by programming.

ECDX 031	PROGRAMMING FOR ROBOTICS	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB1 : To apply the fundamentals of robotics programming.

COB2 : To explain the variable assembly language programming for robotics.

COB3 : To discuss RAPID language in robotics programming.

COB4 : To build programming skills in virtual robotics.

COB5 : To develop A manufacturing language (AML) for robotics.

PREREQUISITE:

Fundamentals of robotics; Basic knowledge in algorithms and programming

MODULE I BASICS OF ROBOTICS PROGRAMMING 10

Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation-Interlock commands-Operating mode of robot, Jogging-Types, Robot specifications- Motion commands, end effectors and sensors commands.

MODULE II VARIABLE ASSEMBLY LANGUAGE 9

Robot Languages-Classifications, Structures- VAL language commands- motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications.

MODULE III RAPID LANGUAGE 9

RAPID language basic commands- Motion Instructions-Pick and place operation using Industrial robot- manual mode, automatic mode, subroutine command based programming. Movemaster command language-Introduction, syntax, simple problems.

MODULE IV PRACTICAL STUDY OF VIRTUAL ROBOT 9

Robot cycle time analysis-Multiple robot and machine Interference-Process chart- Simple problems-Virtual robotics, Robot studio online software-Introduction, Jogging, components, work planning, program modules, input and output signals-Singularities- Collision detection-Repeatability measurement of robot-Robot economics.

MODULE V A MANUFACTURING LANGUAGE 8

AML Language-General description, elements and functions, Statements, constants and variables-Program control statements- Operating systems, Motion, Sensor commands-Data processing.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Deb. S. R. "Robotics Technology and Flexible Automation", Tata McGraw Hill publishing company limited, 2010.
2. Huat, Low Kin. Industrial robotics: programming, simulation and applications. Pro Literature Verlag, Germany/ARS, Austria, 2006

REFERENCES:

1. Mahtani, Anil, Luis Sanchez, Enrique Fernandez, and Aaron Martinez. Effective robotics programming with ROS. Packt Publishing Ltd, 2016.
2. Fernandez, Enrique, Luis Sanchez Crespo, Anil Mahtani, and Aaron Martinez. Learning ROS for robotics programming. Packt Publishing Ltd, 2015..

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 : Analyze the basics of robotics programming.

CO2 : Apply variable assembly language in robotics

CO3 : Develop programming skills in RAPID language for robotics.

CO4 : Examine the programming modules in virtual robotics.

CO5 : Develop A Machine Language (AML) programs for industrial robotics.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG No. & Short Description:

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

Statement: Understanding of the course brings new levels of applications in automation and offers global impact on quality education.

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

Statement: Able to apply Programming in robotics for industrial automation towards sustainable industrialization and innovations.

ECDX 033	REMOTE SENSING	L	T	P	C
SDG: 2,4,7,9,11		3	0	0	3

COURSE OBJECTIVES:

COB1 : To explain the basics of remote sensing

COB2 : To analyze the various remote sensing platforms and sensors

COB3 : To describe the elements of surface sensing.

COB4 : To evaluate the concepts of atmospheric remote sensing.

COB5 : To create a basis for integration of remote sensing in any field of application

PREREQUISITE:

- Basic knowledge about signals & systems and antenna and wave propagation
- Fundamentals of optical communication and microwave engineering

MODULE I BASICS OF REMOTE SENSING 9

Principles of Remote Sensing, Electromagnetic Radiation, Radiometric terms and definitions, Radiation Laws, Interaction of EM Radiation with atmosphere, and target, Platforms: Types of platforms, ground, airborne, and space born platforms, satellites for Earth observations studies. Sensors: Types and classification of sensors, imaging modes, Characteristics of optical sensors, sensor resolution-spectral, radiometric and temporal, Characteristics of detectors,

MODULE II SOLID SURFACES SENSING IN THE VISIBLE AND NEAR INFRARED 9

Wave-Surface Interaction Mechanisms, Signature of Solid Surface Materials Passive Imaging Sensors, Description of Some Visible/Infrared Imaging Sensors, Image Data Analysis, Solid-Surface Sensing: Thermal Infrared

MODULE III SOLID-SURFACE SENSING: MICROWAVE EMISSION 9

Simple Microwave Radiometry Models, Applications and Use in Surface Sensing, Description of Microwave Radiometers, Basic Principles of Radar Sensors, Imaging Sensors, Non-imaging Radar Sensors:

MODULE IV ATMOSPHERIC REMOTE SENSING 9

Physical Properties of the Atmosphere, Wave Interaction Mechanisms in Planetary Atmospheres, Radiative Transfer Equation, Basic Concepts of Atmospheric Remote Sounding, Atmospheric Remote Sensing in the Microwave Region- Basic Concept of Downlooking Sensors, Microwave Scattering by Atmospheric Particles, Radar Equation for Precipitation Measurement

MODULE V APPLICATIONS OF REMOTE SENSING 9

Applications: Plant Sciences - Earth Sciences - Hydrospheric Sciences - Land Use and Land Cover -. Global Remote Sensing

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Elachi, Charles, and Jakob J. Van Zyl. Introduction to the physics and techniques of remote sensing. John Wiley & Sons, 2021.
2. Campbell, James B., and Randolph H. Wynne. Introduction to remote sensing. Guilford Press, 2011.

REFERENCES:

1. Jensen, John R. Remote sensing of the environment: An earth resource perspective 2/e. Pearson Education India, 2009.
2. George Joseph and Jeganathan. C, Fundamentals of Remote Sensing, Universities Press, 3rd edition, 2018
3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 2003.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 : describe the basic concepts of remote sensing.

CO2 : classify the platforms and sensors used for remote sensing.

CO3 : distinguish various methods of solid surface sensing.

CO4 : elaborate atmospheric remote sensing

CO5 : Identify the role of remote sensing in various domains.

Board of Studies (BoS) :	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC 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	H	L	-	-	-	-	-	-	-	H	H	L
CO2	H	H	H	H	L	-	-	-	-	-	-	-	H	H	L
CO3	H	H	H	H	L	-	-	-	-	-	-	-	H	H	L
CO4	H	H	H	H	L	-	-	-	-	-	-	-	H	H	L
CO5	H	H	H	H	L	-	-	-	-	-	-	-	H	H	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.

Statement: This course enables the student to understand the basic concepts of remote sensing and atmospheric remote sensing and promote lifelong learning opportunities for all.

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

Statement : The holistic understanding of the course will bring global impact on quality education.

		L	T	P	C
ECDX 034	**MIMO COMMUNICATION**	**L**	**T**	**P**	**C**
SDG: 4,7,9,11		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To summarize the basics of MIMO Communication

COB2 : To experiment with wireless channel models

COB3 : To analyze the MIMO channel models

COB4 : To evaluate capacity and diversity performances in MIMO

COB5 : To discuss Massive MIMO

PREREQUISITE: Digital Communication

MODULE I INTRODUCTION 9

Evolution of Wireless Communication Systems 1G - 5G Elements of Wireless Communication System Overview of MIMO Communication Systems Layered View of Transmitter and Receiver : Introduction to the Channel

MODULE II WIRELESS CHANNEL MODELS 9

Wireless Channel Models Large Scale Propagation Models Path Loss ,shadowing Small Scale Propagation Multipath Model - Frequency Flat Fading - Received Signal Correlation- Coherence Time Doppler Spectrum- Frequency Selective Fading - Spatial Channel Characteristics

MODULE III MIMO CHANNEL MODELS 9

Expression of MIMO Channel MIMO Channel Characteristics Spatial Diversity Selection Combining Maximal Ratio Combining : Problem of Error in Maximum Ratio Combining(MRC)- Diversity Gain and Transmit MRC

MODULE IV CAPACITY AND DIVERSITY PERFORMANCE OF MIMO 9

MIMO Transmit Diversity MIMO Diversity Capacity of Deterministic MIMO Channels Capacity of Channel Unknown at Transmitter Capacity of Channel Known of Transmitter - Capacity of Random Channel- MIMO in Practice

MODULE V MASSIVE MIMO 9

Massive MIMO: Resource allocation and transceiver algorithms for massive MIMO - Fundamentals of baseband and RF implementations in massive MIMO - Beamforming 5G - spectrum regulations, deployment scenarios, Propagation Characteristics of 5G Channel physical layer techniques, interference and mobility management

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Heath Jr., R., & Lozano, A. Foundations of MIMO Communication. Cambridge: Cambridge University Press, 2018
2. Hampton, J. Introduction to MIMO Communications. Cambridge: Cambridge University Press., 2013
3. Marzetta, Thomas L., and Hien Quoc Ngo. Fundamentals of massive MIMO. Cambridge University Press, 2016.

REFERENCES:

1. Cho, Yong Soo, Jaekwon Kim, Won Y. Yang, and Chung G. Kang. MIMO-OFDM wireless communications with MATLAB. John Wiley & Sons, 2010.
2. Oestges, Claude, and Bruno Clerckx. MIMO wireless communications: from real-world propagation to space-time code design. Academic Press, 2010.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 : describe the basics of MIMO Communication

CO2 : classify various wireless channel models

CO3 : examine MIMO channel models

CO4 : Analyze the capacity and diversity performances in MIMO

CO5 : Discuss Massive MIMO in 5G.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	H	-	-	-	-	-	-	-	-	H	H	H
CO2	H	H	H	H	-	-	-	-	-	-	-	-	H	H	H
CO3	H	H	H	H	-	-	-	-	-	-	-	-	H	H	H
CO4	H	H	H	H	-	-	-	-	-	-	-	-	H	H	H
CO5	H	H	H	H	-	-	-	-	-	-	-	-	M	M	M

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

SDG4 : Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Statement: Provide Quality education by understanding the fundamental concepts and promote research in the area of RF & Communication.

SDG7 : Basic Understanding and research in the area of RF & Communication, can promote affordable energy.

Statement: Basic Understanding and research in the area of RF & Communication, can promote affordable energy.

ECDX 035	**GPU ARCHITECTURE AND PROGRAMMING**	**L**	**T**	**P**	**C**
SDG: 3,4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To elaborate the basics of GPU architectures

COB2 : To develop code in GPU programming environment

COB3 : To analyze the programming issues and error handling in CUDA

COB4 : To explain the algorithms on GPU

COB5 : To discuss the different GPU programming models

PREREQUISITE:

- Basic knowledge about Microcontroller architecture and programming
- Fundamentals of embedded systems design

MODULE I GPU ARCHITECTURE 9

Introduction to Graphics Processing Units (GPU) - GPU architecture - Parallelism with GPU- Types of Parallelism -GPU Hardware – Threads-Threading on GPUs, Blocks arrangement, Grids-Stride and offset, Warps-Branching, GPU utilization, Block Scheduling - Memory Handling with CUDA-Shared Memory, Constant Memory, Global Memory and Texture Memory.

MODULE II GPU PROGRAMMING 9

GPU Programming using CUDA –Serial and Parallel code, Processing Datasets, Multi GPU systems - Multi GPU systems – Algorithm on Multiple GPUs, Single –Node Systems, Multiple-Node Systems and Optimizing CUDA Applications.

MODULE III ERROR HANDLING 9

CUDA Error Handling, Kernel launching and bounds checking, Parallel Programming Issues- Race hazards, Synchronization, Algorithmic Issues-Back-to-back testing, Memory leaks, Finding and Avoiding Errors.

MODULE IV ALGORITHMS ON GPU 9

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication - Programming Heterogeneous Cluster - CUDA Dynamic Parallelism.

MODULE V GPU PROGRAMMING MODELS 9

Introducing OpenGL- Background, Data Parallelism Model, Device Architecture, Kernel Functions, Device Management and Kernel Launch, Electrostatic Potential Map in OpenGL, Open ACC, Thrust.

L –45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Shane Cook, CUDA Programming: "A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", Morgan Kaufmann of Elsevier, First Edition, USA, 2013. (ISBN: 978-0-12-415933-4)
2. David Kirk Wen-mei W. Hwu, "Programming Massively Parallel Processors", Morgan Kaufmann of Elsevier ,3rd Edition, USA, 2016.
3. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, Heterogeneous computing with OpenCL, Morgan Kaufmann of Elsevier, 3rd Edition, USA, 2015.

REFERENCES:

1. Nicholas Wilt, "The CUDA Handbook: A Comprehensive Guide to GPU Programming", Addison-Wesley Professional, Second edition, 2013.
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Create Space Independent Publishing Platform, USA, 2017.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 **:** Describe the GPU Architecture

CO2 **:** Design and develop programs using CUDA

CO3 **:** Classify the Parallel Programming issues in CUDA

CO4 **:** Make use of efficient algorithms in GPUs for common application kernels

CO5 **:** Summarize the different GPU programming models

Board of Studies (BoS) : 23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	H	L	-	-	-	-	-	-	-	H	H	L
CO2	H	H	H	H	L	-	-	-	-	-	-	-	H	H	L
CO3	H	H	H	H	L	-	-	-	-	-	-	-	H	H	L
CO4	H	H	H	H	L	-	-	-	-	-	-	-	H	H	L
CO5	H	H	H	H	L	-	-	-	-	-	-	-	H	H	L

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

SDG3: Ensure healthy lives and promote well-being for all.

The real understanding of this course on GPU will make the students to innovate better technologies. This leads to a healthcare organizations are digitally process and transforming massive amounts of data in real time.

SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

The complete understanding of the course will bring global impact on quality education. Graphics Processing Units (GPU) is originally developed for graphics and video applications, but nowadays it is widely used in many applications beyond graphics. So, various GPU applications can improve the quality of life style.

ECDX 036	NANOELECTRONICS	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1 : To select the materials for nano electronics.

COB2 : To demonstrate the architectures of nanoelectronic devices.

COB3 : To discuss the electron moments in various structures.

COB4 : To explain spin-based transport in the device.

COB5 : To discuss the concepts of nanostructural devices.

PREREQUISITE:

Basic of Electronics, Electron Devices

MODULE I MATERIALS FOR NANO ELECTRONICS 9

Semiconductors - Crystal lattices: bonding in crystals - Electron energy bands - Semiconductor hetero structures - Lattice-matched and pseudomorphic hetero structures - Organic semiconductors - Carbon nano materials: nano tubes and fullerenes.

MODULE II NANO ELECTRONIC ARCHITECTURES 9

Nanofabrication –Nano patterning of Metallic/Semiconducting nanostructures (e-beam/X-ray, Optical lithography, STM/AFM- SEM & Soft-lithography) – Nano phase materials – Self assembled Inorganic/Organic layers

MODULE III ELECTRON TRANSPORT IN SEMICONDUCTORS AND NANOSTRUCTURES 9

Time and length scales of the electrons in solids - Statistics of the electrons in solids and low-dimensional structures - Electron transport in nanostructures.

MODULE IV SPINTRONICS 9

Introduction, Overview, History & Background, Generation of Spin Polarization Theories of spin Injection, spin relaxation and spin dephasing, Spintronic devices and applications, spin filters, spin diodes, spin transistors.

MODULE V NANOSTRUCTURE DEVICES 9

Introduction – Resonant tunneling diodes – Field effect transistors – Single electron transfer devices –Potential effect transistors – Light emitting diodes and lasers – Nano electro mechanical system devices

L –45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Vladimir V. Mitin ,Viatcheslav A. Kochelap , Michael A. Stroscio, "Introduction to Nanoelectronics Science, Nanotechnology, Engineering, and Applications", Cambridge University Press,1st edition,6 December 2012.
2. Karl Goser, Jan Dienstuhl, "Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices", Springer-Verlag Berlin Heidelberg,2004.
3. Rainer Waser , "Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices", Wiley publishers,3rd edition, May 2012

REFERENCES:

1. S. Datta, "Lessons from Nanoelectronics: A New Perspective on Transport (Lessons from Nanoscience: a Lecture Notes Series) World Scientific, second edition, 2017

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: **:** Choose the materials for nanodevices.

CO2 **:** Apply and Analyze the different characterization techniques for nanodevices.

CO3 **:** Elaborate the electron transport in nanostructures.

CO4 **:** Demonstrate the spin-based transport in the nano device.

CO5: **:** Construct different types of nanoelectronic devices.

Board of Studies (BoS) :	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC 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	H	H	H	L	L	L	L	M	M	M	H	H	M
CO2	H	H	H	H	H	L	L	L	L	M	M	M	H	H	M
CO3	H	H	H	H	H	L	L	L	L	M	M	M	H	H	M
CO4	H	H	H	H	H	L	L	L	L	M	M	M	H	H	M
CO5	H	H	M	M	M	L	L	L	L	M	M	M	H	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 concepts of various characteristics of nanoelectronic devices.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
Statement: This course is able to understand the concepts of various nano devices and to fabricate the nano devices.

ECDX 037	RF MEMS CIRCUIT DESIGN	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB1 : To discuss the basics of RF MEMS

COB2 : To explain the various MEMS circuit elements and their characteristics

COB3 : To analyze the various filters for the MEMS circuits

COB4 : To analyze the concepts and working of microstrip and reconfigurable antennas

COB5 : To elaborate the process of packaging MEMS devices

PREREQUISITE: Basic concepts of Electromagnetics and Antennas

MODULE I INTRODUCTION TO MEMS 9

MEMS and Microsystems, Miniaturization, Micro sensors, Micro actuation, MEMS with micro actuators, Microaccelorometers. MEMS materials, Micro fabrication, MEMS relays and switches. Switch parameters, Dynamics of switching operation.

MODULE II RF MEMS ENABLED CIRCUIT ELEMENTS AND MODELS 9

MEMS inductors and capacitors. Micro machined inductor. Effect of inductor layout. Modeling and design issues of planar inductor. Gap-tuning and area-tuning capacitors. Dielectric tunable capacitors, Varactors

MODULE III MICROMACHINED RF FILTERS AND PHASE SHIFTERS 10

Introduction to filters – Modelling of mechanical filters – Micromechanical filters – Surface acoustic wave filters – Bulk acoustic wave filters – Micromachined filters for millimeter wave frequencies.

Introduction phase shifters– Types of Phase shifters and their limitations – MEMS phase shifters – Ferroelectric phase shifters – Applications

MODULE IV MICROMACHINED TRANSMISSION LINES AND ANTENNAS 10

Micro-machined transmission lines – Losses in transmissions – coplanar transmission lines – Microshield and membrane-supported transmission lines – microshield circuit components – micro-machined waveguide components – micro machined directional coupler – micro-machined mixer. Introduction to microstrip antennas – characteristics of microstrip antennas – Design parameters of microstrip antenna – Micromachining techniques to improve antenna performance – micromachining as a fabrication process for small antenna – micro-machined reconfigurable antenna

MODULE V INTEGRATION AND PACKAGING FOR RF MEMS DEVICES 7

Role of MEMS packages – Types of MEMS packages – Flip-Chip assembly – Multichip module packaging – RF MEMS packaging reliability issues – Thermal issues

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Vijay K. Varadanetal, RF MEMS and their Applications, Wiley-India, 2011
2. H.J.D. Santos, RF MEMS Circuit Design for Wireless Communications, Artech House, 2002.
3. G.M.Rebeiz, RF MEMS Theory, Design, and Technology, Wiley, 2003

REFERENCES:

1. NadimMaluf, ”An Introduction to Micro Electro Mechanical System Engineering, Artech House, 2004
2. Tai Ran Hsu, “MEMS and Micro Systems Design, Manufacture and Nanoscale Engineering”, John Wiley, New Jersy, 2008.
3. Chang Liu, “Foundations of MEMS”, Pearson Education, 2012.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Elaborate different MEMS technologies

CO2: Analyze the characteristics of MEMS circuit elements

CO3: Design filters and circuits for MEMS

CO4: Formulate reconfigurable antennas using micromachined design.

CO5: Explain the packaging of MEMS devices

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	H	H	H				L			H			
CO2	H	H	H	H	H	M			L	L	M	H	M	H	
CO3	H	H	M									L	M	H	
CO4	H	H	M	H	H				L			H	M		
CO5	H	H	H	H	H	H			L	L	M	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: This course enables the student to understand the basic characteristics of RF MEMS devices and circuits and the applications of MEMS in communications systems.

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

Statement: Able to apply the theoretical concepts of MEMS circuits for the various application of electronic sub domains.

ECDX 038	**COGNITIVE RADIO NETWORK**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES: The aim of the course is to

COB1 : outline the basic concepts of cognitive radio.

COB2 : experiment with SDR and Cognitive Radio

COB3 : analyze spectrum sensing and dynamic spectrum access using cognitive radio

COB4 : evaluate the broadband wireless access with cognitive radio

COB5 : discuss the secured cognitive radio transmission

PREREQUISITE:

- Basic knowledge of analog and digital communication
- Fundamentals of wireless communication

MODULE I INTRODUCTION TO SOFTWARE DEFINED RADIO 9

Software Define Radio: Characteristics and Benefits, Design Principles of a software radio, RF Receiver front – End Topologies: Topologies, Flexibility of the RF chain with Software Radios, Noise and Distortion in the RF Chain. Multirate signal processing

MODULE II COGNITIVE RADIO NETWORK ARCHITECTURE 9

Cognitive Radio – functions, components and design rules, Cognition cycle, Inference Hierarchy, Building the Cognitive Radio Architecture on Software defined Radio Architecture, Software defined radio architectures for cognitive radios.

MODULE III SPECTRUM SENSING , ACCESS AND SHARING 9

Introduction – Primary user detection techniques – Spectrum opportunity detection, Fundamental Tradeoffs. Spectrum access and sharing, Dynamic spectrum access, NC-OFDM Based Cognitive Radio.

MODULE IV COGNITIVE RADIO FOR BROADBAND WIRELESS ACCESS 9

Protocol Architecture and Building Blocks, Mobility Modeling, Power Control and Multiuser Diversity, Multiple Access Schemes, IEEE 802.22 Physical Layer, IEEE 802.22 Medium-Access Control Layer. Cognitive radio for internet of things.

MODULE V COGNITIVE RADIO NETWORK SECURITY 9

Primary User emulation attacks, Robust Distributed Spectrum Sensing, Security Vulnerabilities in IEEE 802.22,Public safety and cognitive radio

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Alexander M. Wyglinski, MaziarNekovee, Thomas Hou, "Cognitive Radio Communications and Networks", Academic Press, Elsevier, 2010.
2. Bruce Fette, "Cognitive Radio Technology", Newnes, 2006.

REFERENCES:

1. Jeffrey H.Reed, "Software Radio – A modern approach to radio engineering" Prentice Hall PTR, 2002.
2. HuseyinArslan (Ed.), "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.
3. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive Radio Networks", John Wiley and Sons, 2009.
4. S.Shanmugavel, M.A.Bhagyaveni, R.Kalidoss, "Cognitive Radio-An Enabler for Internet of things", River Publishers, 2017.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 : Summarize basic SDR architectures.

CO2 : Make use of SDR and Cognitive radio architecture

CO3 : Analyze the spectrum to reduce error probability

CO4 : Apply cognitive radio for wireless broad band network

CO5 : Discuss the significance and role of Cognitive radio in the future IoT world.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	H	L								H	H	L
CO2	H	H	H	H	L								H	H	L
CO3	H	H	H	H	L								H	H	L
CO4	H	H	H	H	L								H	H	L
CO5	H	H	H	H	L								H	H	L

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

SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

The holistic understanding of the course will bring global impact on quality education. Advanced communication technology can improve the quality of life style.

SDG9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
Statement: Understanding Cognitive radio networks enables the student to cope-up with future generation of communication networks

		L	T	P	C
ECDX 039	**ADVANCED ANTENNA DESIGN**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To classify and compare the modern antenna concepts.

COB2 : To choose and apply antenna design for various applications.

COB3 : To explain various types of antennas including the planar printed antennas.

COB4 : To apply the concept of smart and broadband antennas.

COB5 : To determine different materials for wearable antennas.

PREREQUISITE: Basic knowledge of antenna

MODULE I ADVANCED ANTENNA CONCEPTS & APPLICATIONS 9

Reconfigurable Antennas – Millimeter Wave Antennas – Antennas for medical applications - Antennas for MIMO / Full-Duplex Systems - Antennas for mobile communications

MODULE II SMART ANTENNAS AND ANTENNA SIMULATION 9

Introduction to Smart Antennas, Beam Forming, Estimation of DOA, AOA. Introduction to ADS, HFSS. Design of Microstrip antennas using Simulators.

MODULE III SPECIAL ANTENNAS 9

Need of metamaterial structures, Advantages of metamaterial structures. Design of the metamaterial antennas, Fractal antennas, polarization sensitive antenna design, sinuous antennas, EBG structure, PBG structures.

MODULE IV BROADBAND ANTENNAS 9

Broadband concept, Log-periodic antennas, frequency independent antennas, Antennas For Satellite communication.

Practice: Design of Circular antenna Simulation for UWB

Practice: Design of Log Periodic Dipole Antenna

MODULE V FLEXIBLE MATERIALS FOR WEARABLE ANTENNAS 9

Conductive (Nano) Materials-Fabrication Techniques For Wearable Antennas-Miniaturization Techniques For Wearable Antennas-Effects Of The Human Body On Wearable Antennas

L- 45: TOTAL HOURS – 45

TEXT BOOKS:

1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley &Sons.,2005.
2. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley &Sons., 1998.
3. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.

REFERENCES:

1. G.S.N. Raju, “Antennas and Wave Propagation”, Person Education, 2006.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Design reconfigurable antennas for practical applications

CO2 : Build and experiment with smart antenna designs.

CO3 : Identify different methods to design metamaterial antennas.

CO4 : Categorize broadband antenna concepts with applications

CO5 : Choose materials used for antenna fabrication

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	M	L	L		M		H	H			M	M	H	H	L
CO2	H	M	M				L			H	L	M	H	H	L
CO3	L	L	M	H	M		M			H	M	M	H	H	L
CO4	L	L	H	H	M		M			H	L	H	H	H	L
CO5	M	H	H	M	M		M			M	M	H	H	H	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.

Statement: This course enables the student to understand the concepts of antennas and its application in various fields.

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

Statement: Able to understand the concepts of various Special antennas.

ECDX 040	**5G COMMUNICATION**	**L**	**T**	**P**	**C**
SDG:2,3,4, 8,11,15,17		**3**	**0**	**0**	**3**

COURSE OBJECTIVES: The aim of the course is to.

COB1 : Explain the key requirements, key capabilities and usage scenarios of 5G and the key innovations behind it.

COB2 : Distinguish the antenna systems and channel models used for 5G from the conventional systems.

COB3 : List the security issues involved in 5G design

COB4 : Analyze the behavior of 5G in cloud.

COB5 : Estimate the issues and challenges for 5G deployment.

PREREQUISITE: Analog Communication, Digital Communication

MODULE I INTRODUCTION 9

Introduction to 5G 5G use cases and system concepts 5G architecture Spectrum Millimetre wave communications 5G Radio Access Technologies Waveforms: OFDM, DFT-spread-OFDM frame structure, HARQ Modulation and coding in 5GMassive MIMO systems

MODULE II CHANNEL MODELS AND ADVANCED ANTENNA SYSTEMS 9

Propagation Characteristics of 5G Channel models Antenna Arrays Beam forming Multi antenna technologies High band Millimeter Wave Advanced Antenna Systems in Network Deployments

MODULE III 5G SECURITY 9

Mobile Network Security Design Principles of 5G Security Mobile Virtual Network Operators (MVNO) Security NFV based Security Services Cloud and MEC Security Regulatory Impact on 5G Security and Privacy

MODULE IV 5G IN CLOUD 9

Introduction to Cloud based Networking Cloud Platform for networking Virtualization vs cloud computing Software Defined Networks Virtualizing the Network services Cloud RAN

MODULE V 5G AND BEYOND NETWORKS 9

Heterogeneous Ultra Dense networks in 5G, (Small cells, D2D, MIMO-NOMA) Ubiquitous Quality of Service Provisioning for real time traffic.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Osseiran, Afif, Jose F. Monserrat, and Patrick Marsch, eds. 5G mobile and wireless communications technology. Cambridge University Press, 2016.
2. Asplund, Henrik, David Astely, Peter von Butovitsch, Thomas Chapman, MattiasFrenne, FarshidGhasemzadeh, MånsHagström et al. Advanced Antenna Systems for 5G Network Deployments: Bridging the Gap Between Theory and Practice. Academic Press, 2020.
3. Liyanage, Madhusanka, Ijaz Ahmad, Ahmed BuxAbro, Andrei Gurtov, and Mika Ylianttila, eds. A comprehensive guide to 5G security. John Wiley & Sons, 2018.
4. Zhang, Yin, and Min Chen. Cloud based 5G wireless networks. Cham: Springer International Publishing, 2016.

REFERENCES:

1. Dahlman, Erik, Stefan Parkvall, and Johan Skold. 5G NR: The next generation wireless access technology. Academic Press, 2020.
2. Vaezi, Mojtaba, and Ying Zhang. Cloud mobile networks. Vol. 5, no. 3. Springer, 2017.

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1	**:**	demonstrate the requirements of 5G
CO2	**:**	apply the advanced antenna systems and MIMO channel models of 5G
CO3	**:**	analyze the security issues in 5G design
CO4	**:**	discuss key issues and challenges in 5G deployment
CO5	**:**	show the awareness of the 5G initiatives and commercial progress.

Board of Studies (BoS) :	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC 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	H	L	M	L	L	L	M	M	L	H	M	M
CO2	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO3	H	H	M	H	L	M	L	L	L	M	M	L	H	M	M
CO4	H	H	M	H	L	M	L	L	L	M	M	L	H	H	M
CO5	H	H	M	H	L	M	L	L	L	H	H	M	H	M	H

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

SDG2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

Statement: The holistic understanding of 5g communication leads to a connected world with better communication across the globe. This ensures essential meteorological and geo information to farmers at the right time helping those who are facing famine or adverse effects of nature like storm or flood and plan better. Advanced communication techniques help the farmers across the globe to share agriculture ideas to increase production.

SDG3: Ensure healthy lives and promote well-being for all.

The real understanding of this basic course on 5g communication will make the students to innovate better technologies. This leads to a doctor in New York perform operation for a patient in rural areas of India.

SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

The holistic understanding of the course will bring global impact on quality education. Advanced communication technology can improve the quality of life style.

SDG8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

The understanding of the 5g communication course helps in providing Safe and inclusive work environment for professionals during pandemic period.

SDG11: Make cities and human settlements inclusive, safe, resilient and sustainable

The understanding of the 5g communication course helps in develop technologies and processes globally to ensure safety and security across engineered systems by connecting all.

SDG15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss.

The course will lay strong foundation to develop advanced communication techniques like solar operated sensors that can communicate temperature of forest/trees to satellite to avoid forest fire and deforestation.

SDG17: Strengthen the means of implementation and revitalize the global partnership for sustainable development

The holistic understanding of the course will enable the engineers to design sustainable solutions on telecommunications.

ECDX 041	CYBER SECURITY	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To discuss the fundamentals of the cyber security system.

COB2: To explain the threats, vulnerabilities and attacks of network security.

COB3: To analyze network and distributed system attacks, defenses against them.

COB4: To elaborate the privacy concepts of cyber security.

COB5: To examine the approaches for incident analysis and response.

PREREQUISITE: Knowledge on Computer Network fundamentals.

MODULE I INTRODUCTION TO SECURITY 9

Computer Security - Threats -Harm - Vulnerabilities - Controls - Authentication - Access Control - Cryptography

MODULE II WEB-USER SIDE AND NETWORK SECURITY ATTACKS 9

Web—User Side: Browser Attacks - Web Attacks Targeting Users - Obtaining User or Website Data - Email Attacks

Network Security Attacks: Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service

MODULE III DEFENSES: SECURITY COUNTERMEASURES 9

Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data

MODULE IV PRIVACY IN CYBERSPACE 9

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining -Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies

MODULE V MANAGEMENT AND INCIDENTS 9

Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster. Emerging Technologies: The Internet of Things – Economics – Electronic Voting - Cyber Warfare

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition, Pearson Education , 2015
2. George K.Kostopoulous, Cyber Space and Cyber Security, 2nd Edition, Auerbach Publications, 2017.

REFERENCES:

1. MarttiLehto, Pekka Neittaanmaki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015
2. Nelson Phillips and Enfinger Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1: Explain the general security issues.

CO2: Discuss the security threats and attacks.

CO3: Apply privacy policies in cyberspace.

CO4: Analyze and resolve security issues in networks.

CO5: List the risk management processes.

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

Academic Council:
19th AC held on 29.09.2022

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CO1	H	H	M	L	L	L	L	L	H	M	-	L	H	M	L
CO2	H	H	M	M	L	L	L	L	H	M	-	L	H	M	L
CO3	M	M	H	H	L	H	M	M	M	M	-	M	H	M	L
CO4	L	M	M	H	M	M	H	M	H	M	-	L	H	M	L
CO5	L	M	H	H	H	M	H	H	H	M	-	M	H	M	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.

Statement: This course enables the student to understand the basic concepts of security threats and attacks.

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

Statement: Implement cyber security solutions addressing the industrial problems.

ECDX 042	**MICROWAVE AND RF ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To explain RF/microwave components and design techniques

COB2: To discuss the characteristics of microwave devices, Sources and systems

COB3: To evaluate various microwave parameters

COB4: To describe the microwave and measurements with its properties

COB5: To analyze the design principles of microwave amplifiers and transmission lines

PRE REQUISITES: Electromagnetic properties, Transmission lines

MODULE I MICROWAVE COMPONENTS h

Microwave frequencies – waveguides and transmission modes- Passive Microwave Components - Microwave Cavities, Directional Couplers, waveguide junctions-attenuators-Circulators Isolators and Microwave Hybrid Circuits.

MODULE II MICROWAVE DEVICES h

Klystrons, Reentrant Cavities, Velocity-Modulation Process, Bunching Process, Output Power and Beam Loading, Multicavity Klystron amplifiers, Helix Traveling - Wave Tubes (TWTs) .

Transferred Electron Devices: Introduction, Gunn-Effect Diodes- Ridley-Watkins-Hilsun (RWH) Theory, Modes of Operation, LSA Diodes, InP Diodes, CdTe Diodes, Microwave Generation and Amplification. Avalanche Transit-Time Devices: Read Diode, IMPATT Diodes, TRAPATT Diodes, BARITT Diodes.

MODULE III MICROWAVE MEASUREMENTS h

VSWR measurement, power measurement, impedance measurement, insertion loss and attenuation measurements - measurement of scattering parameters - Measurement of dielectric constant. Impedance Matching using smith chart, ABCD and S-Parameters.

MODULE IV RF AMPLIFIERS AND MATCHING NETWORKS h

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers, Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor, T and Pi Matching Networks, Microstrip Line Matching Networks.

MODULE V MICRO STRIPLINES h

Introduction to Microstrip Lines, Parallel Strip Lines, Distributed Lines-Design principles. Characteristic Impedance, Attenuation Losses, Coplanar Strip Lines, ShieldedStrip Lines.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. David M. Pozar, "Microwave Engineering: Theory and Techniques", Wiley – An Indian Adaption, 2020.
2. Edward C. Jordon, Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Pearson Education, 4th edition, 2017.
3. Samuel Y.Liao, "Microwave Devices and Circuits", Pearson, 3rd Edition, 2003
4. Robert E. Collin, "Foundations for Microwave Engineering", Wiley, 2nd Edition, 2000.
5. Constantine A. Balanis, "Antenna Theory: Analysis and Design, John Wiley & Sons publications, 4th edition, 2016.

REFERENCES:

1. Clive Poole, IzzatDarwazeh, "Microwave Active Circuit Analysis and Design", Elsevier, 2016.
2. Annapurna Das, Sisir K. Das, "Microwave Engineering", McGraw Hill, 3rd Edition, 2017
3. John D. Kraus, "Antennas", McGraw-Hill (International Edition),5th Ed, 2017.
4. Joseph J.Carr , "Practical Antenna Handbook", McGraw-Hill,5th edition,2012.

COURSE OUTCOMES:

After the completion of this course, the students will be able to

CO1: Select appropriate microwave device, source, device for the specific applications.

CO2: Determine the S-Matrix of various passive devices.

CO3: Analyze a linear small-signal amplifier using s-parameter concepts to determine gain and stability

CO4: Analyze and solve problems related to microwave transmission lines

CO5: Design simple microwave strip lines, couplers, Microwave filters

Board of Studies (BoS) :
23rd BoS of ECE held on 13.07.2022

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	PSO3
CO1	H	H	M	L	L	L	L	L	H	M	-	L	H	M	L
CO2	H	H	M	M	L	L	L	L	H	M	-	L	H	M	L
CO3	M	M	H	H	L	H	M	M	M	M	-	M	H	M	L
CO4	L	M	M	H	M	M	H	M	H	M	-	L	H	M	L
CO5	L	M	H	H	H	M	H	H	H	M	-	M	H	M	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.

Statement: This course enables the student to understand the basic characteristics of microwave components, devices, measurement techniques and applications for newer technologies.

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

Statement: Able to apply the theoretical concepts of microwave components and devices for various high frequency applications

ECDX 043	**AUTOMOTIVE NETWORKING**	**L**	**T**	**P**	**C**
SDG: 4, 9	**AND PROTOCOLS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 : To describe the functions of electronic systems in modern automobiles

COB2 : To understand Embedded networking protocols.

COB3 : To Describe the Automotive networking protocols for internal communication

COB4 : To illustrate the CAN,LIN, Flexray and MOST protocol frame format

COB5 : To introduce the need of AUTOSAR in Automotive industry

PREREQUISITES: Embedded system concepts

MODULE I INTRA-VEHICLE COMMUNICATIONS 9

Overview of vehicle electronic systems- Intra-Vehicle Communications and Functions-Systems and Sensors-Air Bag System, Air Conditioning and Climate Control System, Braking System, Crash Sensors, Engine Control Unit, Electronic Stability Control, Steering, Infotainment System, Integrated Starter Generator, Lighting System, Power Train, Seat Belt Sensors, Tire Pressure Monitoring System, Window and Door System.

MODULE II EMBEDDED NETWORKING 9

Introduction – Serial/Parallel Communication – Serial communication protocols - RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming - ISA/PCI Bus protocols - Firewire USB bus – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types – Enumeration –Descriptors.

MODULE III CONTROLLER AREA NETWORK (CAN) PROTOCOL 9

Overview- Evolution- CAN Versions-Types of Controllers- Layered Architecture- CAN Bus-Signaling States, The Physical Layer, Data Transmission, Interoperability Issues, Bus Speed, Cable Length, Bus Termination, Cable and Cable Connectors-Message Frames-Data Frame, Remote Frame, Error Frame, Overload Frame-Error Handling.

MODULE IV AUTOMOTIVE NETWORKING PROTOCOLS 9

Overview- LIN Specification- Specification Components- Introduction, Key features and properties of Flex Ray - Overview of Flex Ray consortium - Flex Ray Physical Layer - Topologies- Flex Ray communication controller- Flex Ray bus transceiver, Rest bus simulation- Overview of MOST technology, key features, application examples- MOST frame structure, speed grades, transport mechanisms, synchronization.

MODULE V AUTOSAR 9

AUTOSAR Architecture- Basic concepts- Software components - Layered Architecture - Microcontroller Abstraction Layer – ECU Abstraction Layer - Service Layer – RTE - Application Layer- Diagnostics - Methodology - Tools in SW development using AUTOSAR.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Gilbert Held. Inter- and Intra-Vehicle Communications, CRC Press, 2007.
2. Muhammad Ali Mazidi, Danny Causey and Janice Mazidi. HCS12 Microcontrollers and Embedded Systems, Prentice Hall, 2008.
3. Kevin Roebuck, “AUTOSAR – Automotive Open System Architecture: Emereo Pty Limited, 2011.

REFERENCES:

1. William B. Ribbens, “Understanding Automotive Electronics - An Engineering Perspective”, Seventh edition, Butterworth-Heinemann Publications.
2. Glaf P.Feiffer, Andrew Ayre and Christian Keyold, “Embedded networking with CAN and CAN open”, Embedded System Academy 2005.
3. Christophe Sommer and Falko Dressler, “Vehicular Networking”, Cambridge University Press, 2014.
4. Jorg Schauffele and Thomas Zurawka, Automotive Software Engineering Principles, Processes Methods and Tools, SAE International Publishers, 2005.
5. Konrad Reif, “Automotive Mechatronic: Automotive Networking, Driving Stability Systems, Electronics”, Springer, 2015.

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1 : Describe the components and significance of Embedded networking system

CO2 : Analyze data communication and the layers of the CAN.

CO3 : Compare the different automotive networking protocols and its characteristics

CO4 : Implement CAN and LIN protocol

CO5 : Analyze the features of AUTOSAR Architecture

CO6 : Use appropriate interfaces, protocols and buses in Automotive embedded systems

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

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	PSO3
CO1	M	M	M	-	-	-	-	-	M	-	-	M	L	L	H
CO2	M	H	M	-	-	-	-	-	M	-	-	M	L	L	H
CO3	M	H	M	-	H	-	-	-	M	-	-	M	H	L	H
CO4	L	L	L	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	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.

This course enables the student to realize the need of communication protocols in automotive Industry and helps for lifelong learning of newer technologies and concepts related to Automotive Embedded systems.

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

Network protocols play a major role in the automotive Industry for interfacing sensors and automotive subsystems with microcontrollers.

ECDX 044	EMBEDDED MACHINE LEARNING	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the concepts of machine learning in embedded system

COB2: To impart knowledge on regression and classification models

COB3: To learn clustering and dimensionality reduction techniques

COB4: To introduce neural networks concepts

COB5: Learn to implement machine learning application in embedded hardware

PREREQUISITE:

Basic of Embedded system and Algorithms

MODULE I INTRODUCTION TO MACHINE LEARNING 9

Introduction to AI, Concept of learning, designing a learning system, perspective and issues in machine learning, supervised-classification, regression and unsupervised learning clustering, applications of machine learning and ML in embedded systems

MODULE II SUPERVISED LEARNING 9

Regression, Linear models for regression, Gradient Descent and Normal Equations Method, Multiple Linear Regression, Classification- Logistic Regression, Support vector machines, K Nearest Neighbours, Decision Tree, Evaluation Measures of models, Bias and variance tradeoff.

MODULE III UNSUPERVISED LEARNING 9

Introduction, K-Means clustering Algorithm, - Dimensionality Reduction -Factor analysis-Principal components analysis-Independent components analysis-Anomaly Detection-Recommender system.

MODULE IV NEURAL NETWORKS 9

Introduction, Biological motivation, ANN representation and learning, Perceptron, multi-layer networks and back propagation, introduction to Convolution Neural Networks and Deep Learning.

MODULE V EMBEDDED SYSTEM DESIGN USING ML 9

Machine Learning Hardware, Tensor Flow TPU, machine learning algorithm implementation framework -open-source software libraries - Caffe, Torch, Theano, machine learning algorithms on hardware -GPU, CPU and FPGA.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Mitchell, T. M., Machine Learning, McGraw-Hill,1997
2. Bishop, C., Pattern Recognition and Machine Learning, Springer.

REFERENCES:

1. Alpaydin, E., Introduction to Machine Learning, MIT Press.
2. Duda, R.O. and Hart, P.E., Pattern Classification and Scene Analysis, John Wiley.
3. Kevin P. Murphy , “Machine Learning: A Probabilistic Perspective”, The MIT Press, 2012.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Compare machine learning approaches as supervised and unsupervised algorithms.

CO2: understand the regression and classification algorithms

CO3: Apply machine learning concepts of Neural Network and Deep Learning for the given application.

CO4: Demonstrate the implementation of machine learning algorithms on embedded platform of GPU, CPU and FPGA

CO5: Analyze the issues of computational complexity, memory and speed in embedded hardware.

Board of Studies (BoS):
23rd BOS of ECE held on 13.07.2022

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	PSO3
CO1	M	M	M	-	-	-	-	-	M	-	-	M	L	L	H
CO2	M	H	M	-	-	-	-	-	M	-	-	M	L	L	H
CO3	M	H	M	-	H	-	-	-	M	-	-	M	H	L	H
CO4	L	L	L	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	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 realize the need of AI and Machine learning concepts in Embedded Systems

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

AI plays a major role in industry to provide Intelligent software solutions that can then be used to make manufacturing processes more efficient and reduce their energy consumption.

ECDX 045	CMOS ANALOG IC DESIGN	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the DC biasing conditions and small signal model of various MOS amplifier configurations.

COB2: To understand gm/I_D design methodology of various MOS circuits.

COB3: To illustrate different MOS transistor circuits.

COB4: To learn the noise modeling and analysis procedure associated with various MOS circuits.

COB5: To gain knowledge of stability conditions and various compensation techniques in OPAMP and negative feedback amplifiers.

PREREQUISITE:

Analog Circuits, Linear Integrated Circuits

MODULE I BASIC BUILDING BLOCKS 9

NMOS and PMOS device operation in saturation and sub-threshold regions, device transconductance, output impedance and equivalent circuit. Introduction to Device models for simulation. CG, CS and source follower circuits. gm/I_D design methodology

MODULE II MULTIPLE TRANSISTOR STAGES 9

Cascode circuits, folded cascode circuits, Differential amplifier circuits, quantitative analysis of differential pair, CMRR, Differential pair with MOS loads, Gilbert Cell, Current Mirrors.

MODULE III FREQUENCY RESPONSE AND NOISE 9

Frequency response of CS and CG stages. Miller effect and association of poles with nodes. Characteristics of noise – thermal and flicker noise. Noise in CS, CG, Cascode and source follower stages.

MODULE IV OPERATIONAL AMPLIFIERS 9

Two stage op-amps, gain boosting, common mode feedback, input range limitation, slew rate, power supply rejection, noise in op-amps.

MODULE V FEEDBACK AND STABILITY 9

Properties of feedback circuits, topologies, effect of loading and noise in feedback circuits. Stability in multipole systems, phase margin, frequency compensation in two stage op-amps, other compensation techniques.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. B.Razavi, “Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2nd edition, India, November 2017
2. P.R.Gray, Hurst and Meyer "Analysis and Design of Analog Integrated Circuits", John Wiley, 5th Edition, India, January 2009.

REFERENCES:

1. Willy Sansen, “Analog Design Essentials:", Springer US, 2006
2. NPTEL Course: http://nptel.ac.in/courses/117106030/#

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: differentiate the various building blocks used in CMOS analog ICs.

CO2: design current sources and voltage references for given specifications

CO3: design operational amplifiers to meet the desired frequency and noise analysis.

CO4: describe the different opamp circuits used in analog devices.

CO5: analyze the performance of the stability and frequency compensation techniques of Op-Amp Circuits.

Board of Studies (BoS):
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CO2	H	H	H	M	M	L	L	L	M	M	M	M	H	H	M
CO3	H	H	H	M	M	L	L	L	M	M	M	M	H	H	M
CO4	H	H	H	M	M	L	L	L	M	M	M	M	H	H	M
CO5	H	H	H	M	M	L	L	L	M	M	M	M	H	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: It is a chip-level design course that explains the CMOS transistor design and intends to provide quality education.

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

Statement: This course will deliver the concepts to design and innovate electronic circuits for Chip level design which will enhance the quality of life and meet industry requirements.

		L	T	P	C
ECDX 046	**MULTICORE ARCHITECTURE AND PARALLEL PROGRAMMING**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To illustrate multicore architecture and their design issues.

COB2: To interpret the concepts of parallel hardware and software.

COB3: To develop fundamental concepts of parallel programming language.

COB4: To design distributed memories and shared memory systems.

COB5: To discuss the concepts of MPI and openMP

PREREQUISITE: Microprocessors and microcontrollers, computer architecture

MODULE I INTRODUCTION TO MULTI-CORE ARCHITECTURE 9

Motivation for concurrency in software-Parallel computing Platforms-Parallel computing in Microprocessors-Differentiating Multi-core architectures from Hyperthreading technology-Multithreading on Single-Core versus Multi-core platforms understanding performance-Amdahl's law-Gustafson's law-Homogeneous multi-core Heterogeneous multi-core.

MODULE II PARALLEL HARDWARE AND PARALLEL SOFTWARE 9

The basics of caching- Cache mappings- Virtual memory- Instruction-level parallelism- Hardware multithreading- SIMD systems- MIMD systems - Interconnection networks- Cache coherence- Shared-memory versus distributed memory.

MODULE III FUNDAMENTAL CONCEPTS OF PARALLEL PROGRAMMING 9

Designing for threads – Task decomposition, data flow decomposition, implications of different decomposition, Challenges, Parallel Programming patterns, Error diffusion, Analysis of the error diffusion algorithm, parallel error diffusion, co-ordaining processes/threads, shared memory, distributed memory, programming hybrid systems, parallel programming design.

MODULE IV DISTRIBUTED-MEMORY PROGRAMMING WITH MPI 9

Getting Started- Compilation and execution- MPI programs- Communicators- SPMD programs- Communication- Message matching- The Trapezoidal Rule in MPI- Dealing with I/O- Collective Communication- MPI Derived Data types- Performance Evaluation of MPI Programs

MODULE V SHARED-MEMORY PROGRAMMING WITH OPENMP 9

Compiling and running OpenMP programs- The Trapezoidal Rule- The Reduction Clause- The parallel for Directive- Loops in OpenMP- Scheduling Loops- Producer Consumer Synchronization - Caches, Cache Coherence, and False Sharing- Thread Safety.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Elsevier, 1st edition, 2011.
2. Shameem Akhtar and Jason Roberts, “Multi-core Programming”, 2nd Edition, Intel Press, 2006.
3. Richard Y. Kain, “Advanced Computer Architecture a Systems Design Approach”, Prentice Hall, 1st edition, 2011.

REFERENCES:

1. Kai Hwang and Zhi Wei Xu, “Scalable Parallel Computing”, Tata McGraw Hill, New Delhi, second edition, 2003.
2. Kai Hwang and Faye Briggs, “Computer Architecture and Parallel Processing”, Mc Graw-Hill International Edition, second edition, 2000.
3. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture: A hardware/software approach”, Morgan Kaufmann Elsevier Publishers, 1st edition, 1999.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Analyze the functions of multicore architecture

CO2: Compare various multicore processor architectures

CO3: Design efficient parallel programs to run on multicore architecture.

CO4: Develop parallel programming using MPI for DSM

CO5: Create program for shared memory architecture using OpenMP

Board of Studies (BoS):	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	M	M				M		L	L		M	H			H
CO2	M	M				M		L	L		M	H			H
CO3	M	M				M		L	L		M	H			H
CO4	M	M				M		L	L		M	H			H
CO5	M	M				M		L	L		M	H			H

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

SDG 4: Ensure inclusive and equitable quality education and promote life-long learning opportunities for all.

Statement: This course provides Quality of education by understanding the fundamental concepts of Multicore processor architecture and improves the performance efficiency of computing.

SDG9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement : Apply the knowledge of parallel computing concepts in multicore processor design.

ECDX 047	**INTRODUCTION TO CLOUD COMPUTING AND EDGE COMPUTING**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To study the fundamentals of cloud computing.

COB2: To acquire knowledge on the evolution of cloud from existing technologies.

COB3: To know about the various issues in cloud computing.

COB4: To learn the lead players in the cloud.

COB5: To get introduced to edge computing.

PREREQUISITE: Basics of Computer Architecture and Organization, Networking

MODULE I INTRODUCTION TO CLOUD COMPUTING 9

Definition of Cloud – Roots of Cloud Computing –Layers and Types of Clouds - Desired Features of a Cloud - Cloud Infrastructure Management.

MODULE II UNDERSTANDING ABSTRACTION AND VIRTUALIZATION 9

Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

MODULE III CLOUD COMPUTING ARCHITECTURE, SERVICES AND STORAGE 9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

MODULE IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management - Cloud Security Challenges – Software-as-a-Service Security – Security architecture design – Data privacy – Application security – Virtual machine security – Identity Access management.

MODULE V INTRODUCTION TO EDGE COMPUTING 9

Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2013.
2. Cloud Computing: Principles and Paradigms, Editors: RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Wiley,2011.
3. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017.
4. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806.

REFERENCES:

1. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing‖, Tata Mcgraw Hill, 2013.
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.
6. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice) ‖, O'Reilly, 2009.
7. Fog and Edge Computing: Principles and Paradigms by RajkumarBuyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
8. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO2: Implement virtualization that helps in the development of cloud.

CO3: Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

CO4: Discuss the core issues of cloud computing such as resource management and security.

CO5: Explain the architecture and use case of edge computing.

Board of Studies (BoS) : 23rd BOS of ECE held on 13.07.2022

Academic Council: 19th AC held on 29.09.2022

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

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

Statement:

Improving lives through the advancement of learning.

To increase the performance by providing scalable computing and storage resources.

ECDX 048	Nanoscale Devices and Circuit Design	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB 1: To define nanoscale devices and its applications

COB 2: To illustrate various nano devices and their constructions

COB 3: To explain the basic concepts of gate and channel engineering

COB 4: To acquire knowledge on NASIC circuit and logic styles

COB 5: To introduce CNT VLSI circuits

PREREQUISITE:

Fundamental of electron devices and digital circuits

MODULE I Fundamentals of Nanoscale Electronic Devices 9

Free Electron theory and Quantum theory - Origin of band gap in solids- Tight binding approximation - Low dimensional materials -Quantum confinement in low dimensional materials - Density of states in bulk materials- Density of states in 2D, 1D and 0D materials with examples -Non-Equilibrium green's Function (NEGF) - Density Function Theory (DFT)

MODULE II Carbon Nanotubes and their Device Applications 9

Physical properties of Carbon nanotubes (CNTs)- Ballistic transport and Quantum conductance in CNTs- CNT two probe devices- CNT Field Effect Transistors (CNT-FETs) - CNT logic gates - CNT sensors -CNT photo-detectors and Photoresistors - CNT Interconnects - CNT memories

MODULE III Gate and Channel Engineered Nanoscale Electronic Devices 9

Non-Conventional Solutions to Miniaturization Problems - Gate and Channel Engineering Techniques - Multi-gate Multi-material MOSFET -Phase Change Memory (PCM) - Memristor - Resistive Random Access Memory (RRAM)

MODULE IV Nanoscale Application-Specific Integrated Circuits (NASIC) 9

Fabric Introduction -Nanowires and xnwFETs - NASIC Circuit Styles - NASIC Logic Styles - NASIC Architectures - Built-in Fault Tolerance – Manufacturing pathway

MODULE V Imperfection-Immune Carbon Nanotube VLSI Circuits 9

Introduction-Mis-Positioned-CNT-Immune Logic Design - Metallic-CNT-Immune CNFET Circuits - Probabilistic Analysis of CNFET Circuits

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Khurshed Ahmad Shah, Farooq Ahmad Khanday ,Nanoscale Electronic Devices and Their Applications , CRC Press, 2020
2. Niraj K. Jha l Deming Chen ,Nanoelectronic Circuit Design, Springer New York, 2010

REFERENCES:

1. L. Banyai and S.W.Koch, ―Semiconductor Quantum Dots‖, World Scientific, 1993.
2. Edward L. Wolf, ―Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience‖,Wiley-VCH 2006
3. V. Mitin, V. Kochelap, M. Stroscio, ―Introduction to Nanoelectronics‖, Cambridge University Press ,2008
4. Karl Goser, Peter Glosekotter, Jan Dienstuhl, ―Nanoelectronics and Nanosystems‖, Springer 2004.
5. Marc J. Madou, Fundamentals of Microfabrication: The Science of Miniaturization, CRC Press,2002.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Identify nanoscale devices and its architectures

CO2: Discuss CNT and their applications

CO3: Identify the process for nano circuit design

CO4: Interpret the logic design involved in gate and channel engineering

CO5: Relate CNT and NASIC styles

Board of Studies (BoS):	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	M				M		M	M			M	M	H	H	
CO2	H	M	M							M		M			
CO3			M	M	H					M	M	M	H		
CO4	M		M		H					H		M			
CO5	M	M	H	H	H					M	M		H	H	

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

SDG 4: Provide Quality education by understanding the fundamental concepts of nano scale devise and promote research in the area of nano technology.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization through nano electronics in the field of nano electronic devices.

ECDX 050	**PATTERN RECOGNITION**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To summarize, analyze, and relate research in the pattern recognition area

COB2: To apply design principles of pattern recognition system

COB3: Implement simple pattern classifiers

COB4: To apply parametric and nonparametric techniques in pattern recognition

COB5: To analyze the pattern recognition techniques to real-world problems

PREREQUISITE:

Fundamentals of Probability, Statistics, Linear algebra and Machine Learning

MODULE I INTRODUCTION 8

Introduction: Basics of pattern recognition – Design principles of pattern recognition system – Learning and adaptation – Pattern recognition approaches. Mathematical foundations: Linear algebra – Probability theory – Expectation – Mean and Covariance – Normal distribution – Multivariate normal densities – Chi square test of hypothesis.

MODULE II STATISTICAL PATTERN RECOGNITION 7

Statistical Patten Recognition: Bayesian Decision Theory – Classifiers – Normal density and discriminant functions.

MODULE III MODELS 10

Parameter estimation methods: Maximum-Likelihood estimation – Bayesian Parameter estimation – Dimension reduction methods – Principal Component Analysis (PCA) – Fisher Linear discriminant analysis – Expectation – maximization (EM) – Hidden Markov Models (HMM) – Gaussian mixture models.

MODULE IV NON PARAMETRIC TECHNIQUES 10

Nonparametric Techniques: Density Estimation – Parzen Windows – K-Nearest Neighbor Estimation – Nearest Neighbor Rule – Fuzzy classification.

MODULE V CLUSTERING TECHNIQUES 10

Unsupervised Learning and Clustering: Criterion functions for clustering – Clustering Techniques: Iterative square – Error partitional clustering – K-Means – agglomerative hierarchical clustering – Cluster validation.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, Second Edition, John Wiley, 2007.
2. 2. Bishop, Christopher M., “Pattern Recognition and Machine Learning”, First Edition, Springer, 2009.

REFERENCES:

1. S. Theodoridis, K. Koutroumbas, “Pattern Recognition”, Fourth Edition, Academic Press, 2009.
2. Keinosuke Fukunaga, “Introduction to Statistical Pattern Recognition”, Second Edition, Academic Press, 2003.
3. Dougherty, Geoff, “Pattern Recognition and Classification”, Springer, 2013

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Apply the mathematical foundations for recognition of patterns.

CO2: Analyze the design principles to solve the real world problems

CO3: Identify the pattern Recognition models

CO4: Discuss the non parametric techniques and clustering techniques in pattern Recognition

CO5: Implement pattern recognition for various real time applications.

Board of Studies (BoS):	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

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

Provide Quality education by understanding the fundamental concepts of Pattern Recognition and apply in solving the real world problems

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

Build resilient system using signal processing techniques and classification techniques.

ECDX 051	AI FOR IOT	L	T	P	C
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To become familiar with AI and IoT concepts.

COB2: To explain the mathematical background for carrying out the optimization.

COB3: To familiarize with genetic algorithms and other random search procedures.

COB4: To apply Ml and DL concepts in IoT

COB5:To learn data access and distributed processing for IoT

PREREQUISITE:

Fundamentals of Artificial Intelligence and principles of IoT

MODULE I PRINCIPLES AND FOUNDATIONS OF IOT AND AI 9

IoT, Big data and IoT, Infusion of AI – data science in IoT.

MODULE II DATA ACCESS AND DISTRIBUTED PROCESSING FOR IOT 9

TXT format, CSV format, XLSX format, Working with the JSON format, HDF5 format, SQL data, NoSQL data, HDFS.

MODULE III MACHINE LEARNING FOR IOT 9

ML and IoT-Learning paradigms, prediction using linear regression, logistic regression for classification, classification using support vector machines, naïve bayes, decision trees, ensemble learning.

MODULE IV DEEP LEARNING FOR IOT 9

Deep learning, multilayered perceptrons for regression and classification, convolutional neural networks, Recurrent neural networks, auto encoders.

MODULE V GENETIC ALGORITHMS FOR IOT 9

Optimization, introduction to genetic algorithms, coding genetic algorithms using distributed evolutionary algorithms in python.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Amita kapoor, “Hands – On Artificial Intelligence for IoT”, Packt Publishing, Birmingham-Mumbai, ISBN – 9781788832762, January – 2019.
2. Stuart J. Russel, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 3 rd Edition, Pearson Education India, 2015.
3. Wolfgang Ertel, “Introduction to Artificial Intelligence”, 2nd Edition, Springer, ISBN 978-3-319-58487-4, 2018.

REFERENCES:

1. Elaine Rich, Kevin Knight, “Artificial Intelligence”, 3rd Edition, McGraw Hill, Education, 2017.
2. Waymond Rodgers, “Artificial Intelligence in a Throughput Model: Some Major Algorithms”, CRC Press, ISBN-13978-0367217815, March 2020.
3. George F. Luger, William A. Stubblefield, “AI Algorithms, Data Structures, and Idioms in Prolog, Lisp and Java”, Pearson Education, 2009.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Demonstrate fundamentals of artificial intelligence and its functions.

CO2: Apply the principles of AI in IoT.

CO3: Choose appropriate AI techniques in intelligent agents, and other machine learning models.

CO4: Provide solutions for various applications using AI tools.

CO5: Analyze knowledge representation, reasoning, and machine learning techniques to societal problems.

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

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	PSO3
CO1	M	M				M		L	L		M	H	M		H
CO2	M	M				M		L	L		M	H			H
CO3	M	M				M		L	L		M	H	M		H
CO4	M	M				M		L	L		M	H		M	H
CO5	M	M				M		L	L		M	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.

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

Statement:

Improving lives through the advancement of learning.

Data infrastructure is an asset that needs to be invested in.

ECDX 052	**DEEP LEARNING**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To define the basics of deep networks

COB2: To classify the deep learning algorithms

COB3: To compare different deep learning models

COB4: To discuss the various optimization and regularization methods for deep learning algorithms.

COB5: To apply the deep learning algorithms for various applications.

PREREQUISITE: Basic knowledge of Matrix, calculus and linear algebra.

MODULE I DEEP FEEDFORWARD NETWORKS 9

Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms.

MODULE II REGULARIZATION FOR DEEP LEARNING MODELS 9

Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods.

MODULE III OPTIMIZATION FOR TRAINING DEEP LEARNING MODELS 9

Differentiation of learning from pure optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms.

MODULE IV CONVOLUTIONAL NETWORKS AND RECURRENT AND RECURSIVE NETS 9

Basis for Convolution neural Networks, Convolution layer, Pooling layer, flattening, fully connected layer. Recurrent Neural Networks - Bidirectional RNNs - Encoder-Decoder Sequence-to-Sequence Architectures - Deep Recurrent Networks - Recursive Neural Networks.

MODULE V DEEP LEARNING APPLICATIONS 9

Computer Vision- image classification, object detection. Speech Recognition.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Good fellow I., Bengio Y., and Courville A., Deep Learning, MIT Press, 2016.
2. Deep Learning for Computer Vision: Image Classification, Object Detection, and Face Recognition in Python. N.p., Machine Learning Mastery, 2019.
3. Charniak, Eugene. Introduction to Deep Learning. United States, MIT Press, 2019.

REFERENCES:

1. Advanced Applications for Artificial Neural Networks. Croatia, IntechOpen, 2018.
2. Zhang, Xian-Da. A Matrix Algebra Approach to Artificial Intelligence. Singapore, Springer Singapore, 2020.
3. Antoniou, Andreas, and Lu, Wu-Sheng. Practical Optimization: Algorithms and Engineering Applications. United States, Springer US, 2021.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Recall the fundamentals of deep learning networks

CO2: Analyze the techniques of deep learning networks

CO3: Explain the functions and algorithms used for Convolutional networks

CO4: Elaborate the recurrent network and recursive network

CO5: Apply the type of deep learning network for different applications

Board of Studies (BoS):	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	L	L	L	H	L	L	L	L	L	L	H	M	M	M
CO2	H	H	L	L	H	L	L	L	L	L	L	H	L	M	M
CO3	H	H	L	L	H	L	L	L	L	L	L	H	L	M	M
CO4	H	H	L	L	H	L	L	L	L	L	L	H	L	M	M
CO5	H	H	H	H	H	H	M	H	H	L	L	H	H	H	H

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

SDG No: 4 -Quality Education

This course will deliver the basic concepts of Artificial Intelligence using Deep learning techniques.

SDG No: 9 - Industry, Innovation and Infrastructure

Artificial intelligence plays major roles in industry and modern infrastructures. Innovative ideas can be implemented by programming.

ECDX 053	**NATURAL LANGUAGE PROCESSING**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- **COB1** : To define the fundamentals of natural language processing
- **COB2** : To analyse a language in word level and syntax level.
- **COB3** : To illustrate semantic analysis and discourse processing.
- **COB4** : To interpret the machine translation principles.
- **COB5** : To explain about information retrieval and lexical resources in natural language processing.

PREREQUISITE: Probability, linear algebra and calculus

MODULE I INTRODUCTION TO NATURAL LANGUAGE PROCESSING 8

Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages - NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.

MODULE II WORD LEVEL AND SYNTACTIC ANALYSIS 10

Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

MODULE III SEMANTIC ANALYSIS AND DISCOURSE PROCESSING 10

Semantic Analysis: Meaning Representation-Lexical Semantics-Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.

MODULE IV NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION 10

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation- Characteristics of Indian Languages-Machine Translation Approaches-Translation involving Indian Languages.

MODULE V INFORMATION RETRIEVAL AND LEXICAL RESOURCES 7

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger-Research Corpora.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Daniel Jurafsky and James H Martin, ”Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice Hall, 2nd Edition, 2008.
2. C. Manning and H. Schutze, “Foundations of Statistical Natural Language Processing”, Massachusetts Institute of Technology, 2003.
3. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninian perspective, PHI, 2000

REFERENCES:

1. James Allen. “Natural Language Understanding”, Addison Wesley, 1994.
2. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.

COURSE OUTCOMES:

At the end of the courses, the students will be able to

CO1 : Interpret various models of natural language processing.

CO2 : Analyse natural language in word level and syntactic level.

CO3 : Compare semantics and discourse processing.

CO4 : Explain natural language generation and machine translation.

CO5 : Describe Lexical Resources and information retrieval techniques.

Board of Studies (BoS): 23rd BOS of ECE held on 13.07.2022

Academic Council: 19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	L	L	L	L	L	L	L	L	L	L	M	M
CO2	H	H	H	L	L	L	M	L	L	L	M	M	L	M	M
CO3	H	H	H	H	L	L	L	M	L	L	L	L	L	M	M

CO4	H	H	H	H	H	L	L	L	L	L	L	L	H	H	M
CO5	H	H	H	H	H	L	L	L	L	H	M	M	H	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:

Understanding of the course Natural Language Processing will bring a global impact on quality education.

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

Statement: Able to apply Natural Language Processing concepts in automation.

ECDX 054	AUTONOMOUS VEHICLE	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To apply the vehicle concepts and designs.

COB2: To adapt sensors and sensor technology in vehicles.

COB3: To evaluate the different technologies and methods required for the efficient vehicle implementation & validation.

COB4: To design the transportation systems with a focus on road vehicles and traffic flow theory.

COB5: To plan and control the road traffic flow

PREREQUISITE: Fundamentals of automotive, embedded networking

MODULE I FUNDAMENTALS OF VEHICLE 9

Basic vehicle characteristics: Vehicle concepts, static and dynamic loads and weight distributions, front, rear and all-wheel drive.Internal combustion engines: Types and characteristics: torque, power and fuel consumption. Emissions. Drive Cycles.Electric motors and drives: Types and characteristics: torque, power and efficiency.Vehicle performance: Maximum speed, hill start and climbing. Fixed and variable gear ratios: number and distribution of gear ratios.

MODULE II SENSORS, PERCEPTION AND VISUALISATION 9

Introduction to sensors, perception and visualisation for autonomous vehicles. Autonomous vehicle sensors and imaging. Sensor integration architectures and multiple sensor fusion.

MODULE III EMBEDDED VEHICLE CONTROL SYSTEMS 9

A review of modern automotive control hardware requirements and architectures. The evaluation of current and future vehicle networking technologies including, CAN, LIN, MOST and Flex-ray
The evaluation of control rapid prototyping techniques to design and calibrate the control algorithm. The use of modern validation and verification methods, such as software-in-the-loop, and hardware-in-the-loop techniques.

MODULE IV TRANSPORT SYSTEM OPTIMIZATION 9

Modelling the motion of a single vehicle. Effects of characteristics of vehicles, driver and environment on vehicle movement. Modelling of vehicle interactions and movement of groups of vehicles. Traffic operational performance characteristics and measures.

Different road types including freeways, signalised and unsignalised intersections, networks and their principles.

MODULE V PERCEPTION, PREDICTION, ROUTING, DECISION, PLANNING AND CONTROL 9

Dataset – Detection – Segmentation Stereo, optic and Sense flow , Tracking - Planning and control – traffic prediction – Lane level routing – Behavioral Decision – Motion Planning – Feed back control

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. William B. Ribbens, "Understanding Automotive Electronics- An Engineering Perspective", Seventh edition, Butterworth-Heinemann Publications, Seventh edtion 2011.
2. Ronald K. Jurgen, "Automotive Electronics Handbook", Mc Graw Hill, 1999.
3. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot "Creating Autonomous Vehicle Systems", Morgan & Claypool Publishers, 2020

REFERENCES:

1. Kiencke, Uwe, Nielsen&Lars, "Automotive Control Systems for Engine, Driveline and Vehicle", Second edition, Springer Publication,2004.
2. Tao Zhang, Luca Delgrossi, "Vehicle Safety Communications: Protocols, Security and Privacy", Wiley Publication,2012
3. Robert Bosch," Automotive Hand Book", Fifth edition, SAE Publications, 2007.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Discuss the advantages, disadvantages, and limitations of autonomous vehicle

CO2: Analyze qualitatively the functions and capabilities of the sensor technologies used in autonomous vehicles.

CO3: Compare the components of an automotive control systems and its implementation.

CO4: Evaluate models of vehicle interactions

CO5: Interpret transport optimization techniques.

Board of Studies (BoS) :	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC 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	H	L	M	H		H	L	M
CO2	H	H	H	-	-	-	M	L	L	L	M	M	H	L	M
CO3	H	H	H	-	-	-	L	M	L	L	L	L	H	H	H
CO4	H	H	H	-	-	-	L	L	L	L	L	L	H	M	H
CO5	H	H	H	-	-	-	L	L	L	H	M	M	M	L	M

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

SDG 4: Provide Quality education by understanding the fundamental concepts of autonomies vehicle and promote research in the area of automation.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization through electronics and embedded systems in the field of Autonomous vehicles

ECDX 055	**AUTOMOTIVE EMBEDDED SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To define the architecture of the embedded system.

COB2: To explain the characteristics of Automotive Communication systems.

COB3: To choose appropriate automotive protocols for the internal communication.

COB4: To apply the concepts of embedded software used in automotive electronics.

COB5: To discuss on testing and monitoring process of automotive control system

PREREQUISITE:

Fundamental of embedded systems

MODULE I AUTOMOTIVE ARCHITECTURES 9

Vehicle Functional Domains and Their Requirements – Functional domains, Standardized Components, Models, and Processes, Certification Issue of Safety-Critical In-Vehicle Embedded Systems, Application of the AUTOSAR Standard, Intelligent Vehicle Technologies.

MODULE II EMBEDDED COMMUNICATIONS 9

Automotive Communication Systems: Characteristics and Constraints, InCar Embedded Networks, Middleware Layer, Open Issues for Automotive Communication Systems

MODULE III COMMUNICATION PROTOCOLS 9

FlexRay Protocol- Introduction , FlexRay Communication , FlexRay Protocol , FlexRay Application , Dependable Automotive CAN Networks – Introduction, CANcentrate and ReCANcentrate, CANELy, FTT-CAN: Flexible Time-Triggered Communication on CAN, FlexCAN: A Deterministic, Flexible, and Dependable Architecture for Automotive Networks

MODULE IV EMBEDDED SOFTWARE AND DEVELOPMENT PROCESSES 9

Product Lines in Automotive Electronics, Reuse of Software in Automotive Electronics, Automotive Architecture Description Languages, Model-Based Development of Automotive Embedded Systems

MODULE V VERIFICATION, TESTING, AND TIMING ANALYSIS 9

Testing Automotive Control Software, Testing and Monitoring of FlexRay-Based Applications, Timing Analysis of CAN-Based Automotive Communication Systems, Scheduling Messages with Offsets on Controller Area Network: A Major Performance Boost , Formal Methods in the Automotive Domain: The Case of TTA

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Nicolas Navet, Francoise Simonot- Lion, “Automotive Embedded Systems Handbook”, CRC Press Taylor & Francis Group, 2009.
2. William Ribbens, “Understanding Automotive Electronics”, Elsevier Inc., 8th edition, 2017.

REFERENCES:

1. Kiencke, Uwe, Nielsen&Lars, “Automotive Control Systems for Engine, Driveline and Vehicle”, Second edition, Springer Publication, 2004.
2. Tao Zhang, Luca Delgrossi, “Vehicle Safety Communications: Protocols, Security and Privacy”, Wiley Publication, 2012
3. 3. Robert Bosch GmbH, “Bosch Automotive Electrics and Automotive Electronics Robert Bosch,” fifth edition, Springer Vieweg, 2007.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Illustrate the fundamentals of Automotive Electronic Systems

CO2: Outline the characteristics and issues of automotive Communication systems.

CO3: Choose communication protocols suitable for automotive embedded systems.

CO4: Develop model based automotive embedded Systems

CO5: Test and monitor the automotive electronic systems.

Board of Studies (BoS):	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC held on 29.09.2022

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

Statement: This course enables the student to understand the basic concepts of automotive architectures and protocols.

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

Statement: This course enables the students to build Model-Based Development of Automotive Embedded Systems

		L	T	P	C
ECDX 056	**INTRODUCTION TO ROBOTIC OPERATING SYSTEM**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1 **:** To apply the basics of robotics operating systems and its architecture.

COB2 **:** To analyze the linux environment with linux commands

COB3 **:** To discuss ROS File system and packages

COB4 **:** To test the debugging and visualization for ROS

COB5 **:** To design the low cost mobile robot using ROS for an application.

PREREQUISITES: Basics of Mechatronics, Embedded Systems, Operating Systems

MODULE I INTRODUCTION TO ROS 9

Overview of operating system concepts- introduction to robotic operating system (ROS) - ROS Equation– History of ROS – ROS distributions- Robots and Sensors Supporting ROS- ROS Computing Platforms- ROS Architecture and Concepts- ROS File System- ROS Computation Concepts.

MODULE II INTRODUCTION TO LINUX COMMANDS 9

UNIX commands - file system – redirection of input and output - File system security - Changing access rights – process commands – compiling, building and running commands – handling variables.

MODULE III ROS ARCHITECTURE 9

ROS File system level - packages – stacks – messages – services – ROS computation graph level - ROS community level-Navigation through ROS file system.

MODULE IV DEBUGGING AND VISUALIZATION 9

Debugging of Nodes – topics – services – messages – bags – master – parameter – visualization using Gazebo – Rviz – URDF modeling – Xacro – launch files- Hardware Interface- Sensor Interfacing – Sensor Drivers for ROS – Actuator Interfacing – Motor Drivers for ROS.

MODULE V CASE STUDIES: USING ROS IN REAL WORLD APPLICATIONS 9

Navigation stack-creating transforms -odometer – IMU – laser scan – base controller – robot configuration – cost map – base local planner – global planner – localization – sending goals – TurtleBot – the low cost mobile robot.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Lentin Joseph, “Robot Operating Systems (ROS) for Absolute Beginners, Apress, 2018.
2. Aaron Martinez, Enrique Fernández, “Learning ROS for Robotics Programming”, Packt Publishing Ltd, 2013.

REFERENCES:

1. Jonathan Cacace , lecture notes for the Robotics Lab by University of Naples Federico II, 2020.
2. Anis Koubaa, “Robot Operating System (ROS) – The Complete Reference (Vol.3), Springer, 2018.
3. Morgan Quigley , Brian Gerkey and Bill Smart , “ Programming Robots with ROS” , O'Reilly Media, 2016.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 : Infer the need for ROS and its significance

CO2 : Apply the Linux commands used in robotics

CO3 : Analyze the concepts of navigation through the file system.

CO4 : Explain the concepts of Node debugging

CO5 : Discuss the issues in hardware interfacing

Board of Studies (BoS):	**Academic Council:**
23rd BOS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	-	-	-	-	-	M	-	-	M	L	L	H
CO2	M	H	M	-	-	-	-	-	M	-	-	M	L	L	H
CO3	M	H	M	-	H	-	-	-	M	-	-	M	H	L	H
CO4	L	L	L	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	M	L	M
CO5	M	M	M	-	-	-	-	-	M	-	-	M	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 apply the architecture and usage of robotic operating system offers opportunities of quality education and promotes lifelong learning.

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

Statement: Able to apply the concepts of robotic operating system in real world applications in turn promotes sustainable industrialization and foster innovation.

ECDX 057	**AUGMENTED REALITY AND VIRTUAL REALITY**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To illustrate human machine interface.

COB2: To explain the methods and tools in Augmented reality

COB3: To interpret physiological considerations in virtual reality.

COB4: To discuss about virtual reality hardware.

COB5: To apply the concept of synthetic environment system.

PREREQUISITE: Basic knowledge in image processing

MODULE I HUMAN SYSTEM INTERFACE 9

Introduction - Design, Control, and Evaluation of a Hyper-redundant Haptic Device-Man-Machine Interface Systems for operation and Interaction - Acquisition, Processing and Display for robotic Applications

MODULE II AUGMENTED REALITY 10

Introduction- Definition-components of augmented reality-Differences between Augmented reality and virtual reality- Augmented reality methods- Abstraction and implementation- real time 3D design and modeling

MODULE III VIRTUAL REALITY 9

Virtual reality: Overview – Physiological considerations-visual channel-Auditory channel-Haptic interfaces-Position tracking and mapping

MODULE IV VIRTUAL REALITY HARDWARE 9

Motion Interfaces - Speech, Physiology and other interfaces - computer hardware and software for generation of virtual environment.

MODULE V APPLICATIONS OF AUGMENTED REALITY AND VIRTUAL REALITY 8

Augmented reality in education, sports, gaming, entertainment and medicine.- Synthetic Environment system –Virtual reality techniques in flight simulation-using virtual reality techniques in animation process.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Manuel Ferre, Martin Buss, Rafael Aracil, Claudio Melchiorri and Carlos Balaguer, Advances in Tele robotics, Springer, 2007.
2. Greg Kipper, Joseph Rampolla, Augmented Reality An Emerging Technologies Guide to AR, Elseiver, 2012
3. Haller, Michael, Billinghurst, Mark, Thomas, Bruce, Emerging technologies of Augmented reality: Interfaces and design, Idea group

publishing, 2007

4. R.A. Earnshaw, M.A.Gigante, H.Jones, Virtual reality systems, Academic Press, 2014

REFERENCES:

1. Nathaniel I. Durlach and Anne.S, Virtual Reality: Scientific and Technological Challenges, Academic Press,1995
2. Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human factors for Augmented reality and Virtual reality, Pearson Education, 2017.
3. Jason Jerald ,The VR Book: Human-Centered Design for Virtual Reality, ACM Books, 2015.
4. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, Springer 2016.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Illustrate the human-machine interface systems.

CO2: Explain the components and technologies for Augmented reality.

CO3: Compare the physiological considerations of visual and auditory channels in virtual reality systems.

CO4: Identify the hardware and software interfaces in virtual reality.

CO5: Discuss the applications of augmented reality and virtual reality.

Board of Studies (BoS):	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	M	M	L	L	L	M	M	M	M	H	H	M
CO2	H	H	H	M	M	L	L	L	M	M	M	M	H	H	M
CO3	H	H	H	M	M	L	L	L	M	M	M	M	H	H	M
CO4	H	H	H	M	M	L	L	L	M	M	M	M	H	H	M
CO5	H	H	H	M	M	L	L	L	M	M	M	M	H	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 will deliver the basic concepts of Augmented & Virtual Reality which is mostly used in Real Time Applications.

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

Augmented & Virtual Reality plays major roles in industry and modern infrastructures. Innovative ideas can be implemented by various algorithms.

ECDX 058	INDUSTRIAL ROBOTICS	L	T	P	C
SDG: 4&9		3	0	0	3

COURSE OBJECTIVES:

COB1: To summarize the basic concepts, parts of robots and types of robots.

COB2: To discuss about drive systems for robot, sensors and its applications

COB3: To design simple grippers for pick and place application

COB4: To select robots based on specific applications.

COB5: To apply a specific end system in industrial automation .

PREREQUISITE:

Fundamentals of robotics and its significance

MODULE I INTRODUCTION TO INDUSTRIAL ROBOTICS 9

Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, material transfer, machine loading and unloading, CNC machine tool loading, Robot centered cell.

MODULE II ROBOTS FOR INSPECTION 9

Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations.

MODULE III END EFFECTORS 9

Gripper force analysis and gripper design for typical applications, design of multiple degrees of freedom, active and passive grippers.

MODULE IV SELECTION OF ROBOT 9

Factors influencing the choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society

MODULE V APPLICATIONS 9

Robot Application in Manufacturing: Material Transfer – Material handling, loading and unloading- Processing – spot and continuous arc welding & spray painting – Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Richard D Klafter, Thomas A chmielewski and Michael Negin, “Robotic Engineering – An integrated Approach” Prentice Hall India, New Delhi,3rd eition 2010
2. Mikell P Groover, "Automation, Production Systems, and Computer-

Integrated Manufacturing", Pearson Education, 2016

REFERENCES:

1. James A Rehg, “Introduction to Robotics in CIM Systems”, Prentice Hall of India, 2002.
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 2nd edition, 2010

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Compare the various types of Industrial Robots and their architecture.

CO2: Apply the concepts of image processing for robotic inspection systems

CO3: Analyze the robotic functions in various industrial applications

CO4: Design simple grippers for pick and place application

CO5: Choose the appropriate robot system for a specific industrial application

Board of Studies (BoS): 23rd BoS of ECE held on 13.07.2022

Academic Council: 19th AC held on 29.09.2022

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

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

SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Statement: The holistic understanding of the course will bring global impact on quality education. Advanced robot technology can improve the quality of life style.

SDG9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Understanding and implementing industry Robots enables the student to cope-up with industry 4 revolution.

ECDX 059	**AI FOR ROBOTICS**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To define AI problems and solution

COB2: To apply different searching methods

COB3: To design the planning and reasoning of AI robots

COB4: To explain different machine learning methods

COB5: To select an appropriate robotics for an real world applications.

PREREQUISITE: Basic programming and mathematics, Data structure.

MODULE I INTRODUCTION TO AI AND ROBOTICS 9

Introduction to AI, Expert systems and AI agents, AI techniques-, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

MODULE II HEURISTIC SEARCH TECHNIQUES 9

Heuristic Search Techniques :AI and search process, brute force search, depth-first search, breadth-first search, time and space complexities, heuristics search, hill climbing, best first search, A* algorithm and beam search, AO search, constraint satisfaction.

MODULE III MACHINE LEARNING 9

Learning algorithms, capacity, overfitting and underfitting, hyperparameters and validation sets, Estimator, Bias and variance, Maximum likelihood estimation, Bayesian statistics, supervised learning algorithm, unsupervised learning algorithm, statistical learning,

MODULE IV PLANNING & REASONING 9

Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.

MODULE V AI IN ROBOTICS AND APPLICATIONS 9

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics. Applications in unmanned systems, defense, medical, industries, etc.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, Cambridge University Press, 2021
2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2016.
3. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: Addison Wesley, 2002.

REFERENCES:

1. Ibrahim (Abe) M. Elfadel, Duane S. Boning and Xin Li (2019), Machine Learning in VLSI Computer Aided Design
2. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.
3. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, "Introduction to AI Robotics", MIT Press, 2000.
4. Francis.X.Govers, "Artificial Intelligence for Robotics", Packt Publishing, 2018.
5. Huimin Lu, Xing Lu, "Artificial Intelligence and Robotics", Springer, 2017

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Identify AI problems

CO2: Analyze the appropriate search methods to solve a given problem.

CO3: Explain the basic definitions and concepts of Machine Learning

CO4: Discuss the methods of robotic planning and reasoning

CO5: Apply the AI concept in Robotic for real world applications.

Board of Studies (BoS):	**Academic Council:**
23rd BoS of ECE held on 13.07.2022	19th AC held on 29.09.2022

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

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

SDG No: 4 -Quality Education

This course will deliver the basic concepts of AI for robotics

SDG No: 9 - Industry, Innovation and Infrastructure

Robotics and Artificial intelligence plays major roles in industry and modern infrastructures. Innovative ideas can be implemented by programming.

ECDX 60	PROGRAMMING IN EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

SDG: 4,9

COURSE OBJECTIVES:

COB1: To design of embedded computing systems with its hardware and software architectures

COB2: To examine the various issues involved in developing software for embedded systems

COB3: To analyze the I/O programming and Embedded C coding techniques.

COB4: To illustrate the memory management techniques in embedded system

COB5: To design embedded system using python language

PREREQUISITE: Basic C language, Embedded System concepts

MODULE I C PROGRAMMING CONCEPTS 9

Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - -Debugging and Optimization.

MODULE II EMBEDDED C 9

Data representation in Embedded Systems- Embedded C –Compare C and Embedded C – 32 bit microcontroller features - I/O port programming - manipulating bits in memory- Adding Structure to C Code- Meeting Real Time Constraints - Creating an Embedded Operating System.

MODULE III INPUT/OUTPUT PROGRAMMING 9

Mixing C and assembly-I/O Instructions, Synchronization, Transfer Rate & Latency, Polled Waiting Loops, Interrupt – Driven I/O, Direct memory access.

MODULE IV MEMORY MANAGEMENT 9

Scheduling-Objects In C-Automatic Allocation-Static Allocation-Object Creation, Initialization and Destruction-Dynamic Allocation-Automatic Allocation With Variable Size-Recursive Function –Shared Memory.

MODULE V PYTHON PROGRAMMING 9

Basics of Python – data types- operators- sequential and non sequential –control statement - functions- module- introduction to SoC – I/O port programming – sensor interfacing with SoC.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Michael J Pont, “Embedded C”, Pearson Education, 2008.
2. Armstrong Subero, “Programming Microcontrollers with Python” APress; 1st ed. Edition, 2021.

REFERENCES:

1. Jason Cannon, “Python Programming for Beginners” O’Reilly, 2012.
2. Steve Oualline, ‘Practical C Programming 3rd Edition’, O’Reilly Media, Inc, 2006.
3. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Prentice Hall 2002.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: develop program using embedded C

CO2: analyze the Real-time constraints in embedded systems

CO3: describe memory management in embedded systems

CO4: solve the bugs in embedded system design

CO5: design the embedded system application using embedded C and python languages

Board of Studies (BoS) :
24th BOS of ECE held on 08.02.2023

Academic Council:
20th Academic Council held on 13.04.23

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO2	H	H	M	M	L	L	L	-	-	-	-	L	L	-	H
CO3	M	M	L	M	L	L	L	-	-	-	-	L	L	-	H
CO4	H	H	M	M	L	L	L	L	-	-	-	L	L	-	H
CO5	H	H	M	M	L	L	L	-	-	-	-	L	L	-	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 concepts of embedded systems, classification, Design process and applications helps for lifelong learning of newer technologies and concepts related to the embedded systems.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable

industrialization and foster innovation

Statement: Able to apply the theoretical and design concepts for the various applications in embedded domain.

ECDX 061	**GRAPHICAL PROGRAMMING BASED SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**

SDG: 3,9

COURSE OBJECTIVES:

COB1: To explore the LabVIEW environment, dataflow programming, and common LabVIEW development techniques in a hands-on format.
COB2: To Learn how to develop basic applications in the LabVIEW graphical programming environment.
COB3: To know about the graphs, charts and file I/Os.
COB4: To provide knowledge in process analysis by using debugging tools.
COB5: Create applications using a state machine design pattern.

PREREQUISITE: Experience in writing algorithms in the form of flowcharts or block diagrams

MODULE I **Introduction To LabVIEW** **6**
Introduction to Virtual Instrumentation , The LabVIEW Environment - Front Panels, Block Diagrams, LabVIEW Projects, SubVIs, the Icon, and the Connector, Alignment Grid, Pull-Down Menus, Floating Palettes, The Toolbar ,Pop-Up Menus, Help, Express Vis, Data types.

MODULE II **Programming Execution With Structures** **7**
Controlling Program Execution with Structures: Two Loops, Shift Registers, The Case Structure, Dialogs, The Sequence Structure, Flat or Stacked, Timing, The Timed Structures, The Formula Node, The Expression Node.
Arrays and Clusters: Creating Array Controls and Indicators, Functions for Manipulating Arrays, Polymorphism, Compound Arithmetic, Clusters, Error Clusters and Error-Handling Functions.

MODULE III **LabVIEW's Visual Displays and File Management** **7**
LabVIEW's Exciting Visual Displays: Waveform Charts, Graphs, XY Graphs, Chart and Graph Components, Intensity Charts and Graphs Colour as a Third Dimension, Time Stamps, Waveforms, and Dynamic Data, Mixed Signal Graphs, Exporting Images of Charts and Graphs.
Exploring Strings and File I/O: Overview, More About Strings, Using String Functions, Parsing Functions, File Input/output.

MODULE IV **Advanced LabVIEW Structures and Functions** **5**

Local, Global, and Shared Variables, Property Nodes, Invoke Nodes, Event-Driven Programming: The Event Structure, Type Definitions, The State Machine and Queued Message Handler, Messaging and Synchronization..

MODULE V **Data Acquisition – Interfacing with real world signals** **5**

Interfacing with real time systems with DAQ unit , Case study based on Embedded systems

L – 30 ,P –30 ; TOTAL HOURS –60

TEXT BOOKS:

1. Jeffrey Travis, Jim Kring, LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition) (National Instruments Virtual Instrumentation Series) (Hardcover), August 2006.
2. Gary W. Johnson , Richard Jennings, LabVIEW Graphical Programming, 4th Edition, McGraw-Hill Professional ©2007 ,ISBN:0071370013

REFERENCES:

1. Ronald W. Larsen, LabVIEW for Engineers 1st Edition, Published by Prentice Hall (2011)

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Create Virtual Instruments (VI) and sub VI

CO2: Edit and Debug Virtual Instruments.

CO3: Build Arrays, Loops, Formulas and Sequence Structures using LabVIEW

CO4: Create applications using state machine pattern

CO5: Interface the real time signals with relevant hardware.

Board of Studies (BoS) : **Academic Council:**

25th BOS of ECE held on 20.09.2023 21st AC held on 20.12.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	L									L	M	H
CO2	M	H	H	M	L									M	H
CO3	M	H	H	M	L								L	M	H
CO4		M	H	H	M									M	H
CO5				M	H								L	M	H

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

SDG 3 : Good Health and Well-Being Statement : Graphical Programming system design plays a major role in real time applications. A sound knowledge in these could lead to a substantial research and development in health and well-being.

SDG 9 : Industry, Innovation & Infrastructure Statement : Programming knowledge helps to innovate new applications and solve complex real world problems.

ECDX 065	QUANTUM COMPUTING	L	T	P	C
SDG: 4, 9		3	0	0	3

COURSE OBJECTIVES:

COB 1: To introduce the basic concepts of quantum mechanics.

COB 2: To develop the knowledge on quantum computation and quantum information.

COB 3: To explore the basic hardware and mathematical models of quantum computation.

COB 4: To familiarize the quantum logical operations and algorithms.

COB 5: To analyze the behavior of basic quantum circuits and algorithms.

PREREQUISITE: Basic knowledge on Digital logic circuits & Linear Algebra

MODULE I INTRODUCTION TO QUANTUM MECHANICS 9

Introduction to quantum computing- Power of quantum computing- Quantum information-Quantum Computers. The Superposition probability rule- A Photon coincidence experiment- Quantum mechanics-Hilbert space- linear operators tensor and outer products- Quantum states- Quantum operators- spectral decomposition of a quantum operators.

MODULE II QUANTUM GATES 10

Qubits, blocks sphere representation- Rotation operation-the measurement of a single qubits- A pair of qubits-Qubits-physical implementation-Measurement of the spin- Qubit as polarized photon- Entanglement, Exchange of information-single qubit gates- two, three and multiple qubit gates- The Toffoli gates- Matrix representation of quantum gates and circuits.

MODULE III QUANTUM CIRCUITS 9

The No-Cloning theorem- Full adder circuits- Single and multiple qubit controlled operations-Universal quantum gate-State transformation-Quantum circuit for the Walsh-Hadamard transform- Mathematical models of quantum computer.

MODULE IV QUANTUM PROTOCOLS AND QUANTUM ALGORITHMS 9

Deutsch-Jozsa, Bernstein - Vazirani, Simon’s, Quantum Fourier transform, Shor’s and Grover’s algorithms.

MODULE V PROGRAMMING A QUANTUM COMPUTER 8

Coding a quantum computer using a simulator to carry out basic quantum measurement and state analysis.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Chris Bernhardt, Quantum Computing for Everyone, The MIT Press, Cambridge, 2020.
2. Quantum Computation and Quantum Information, Textbook by M. A. Nielsen and I. Chuang, Cambridge University Press ,2013.
3. Eleanor G. Rieffel and Wolfgang H. Polak “Quantum Computing: A Gentle Introduction”, The MIT Press Cambridge, Massachusetts London, England, 2014.
4. Riley Tipton Perry, “Quantum Computing from the Ground Up”, World Scientific Publishing Ltd (2012).

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO 1 : Define the basics of Quantum mechanics and explain the mathematical framework of quantum computing to solve computational problems.

CO 2 : Design and analyze the circuits using quantum computation.

CO 3 : Design and write simple algorithms for quantum machines.

CO 4 : Analyze quantum algorithms described in quantum circuit or measurement-based quantum computing models.

CO 5 : Simulate simple quantum algorithms and information channels in the quantum circuit model.

Board of Studies (BoS) :
26th BoS of ECE held on 13.05.2024

Academic Council:
22nd AC held on 04.09.2024

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO 3
CO 1	H	M		M									H	H	L
CO 2	H	M		L	L								H	H	L
CO 3	H	M	L	M	L								H	H	L
CO 4	H	M	L	M	H								H	H	L
CO 5	H	M	L	H	H								H	H	L

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

SDG 4: Quality Education - Designing a quantum computing course to integrate emerging technologies into curricula, ensures inclusive access to resources, hands-on learning experiences, and lifelong learning opportunities for diverse learners, thus fostering a well-rounded education in quantum computing.

SDG 9: Building a quantum computing course that fosters innovation, promotes inclusive access to resilient infrastructure, and supports sustainable industrialization, thereby driving advancements in technology and contributing to global economic development.

Humanities Elective – II
(To be offered in VI Semester)

SSDX 11	ECONOMICS OF SUSTAINABLE DEVELOPMENT	L	T	P	C
		2	0	0	2

SDG: 1-17

COURSE OBJECTIVES:

COB1: To inculcate the knowledge base on sustainable development with a view to balance our economic, environmental and social needs, allowing prosperity for now and future generations.
COB2: To develop a capacity to undertake a theoretically grounded analysis of environment issues and identify and describe what the United Nations and other governing bodies are doing to assist in a more sustainable world.
COB3: To have an insight of the emerging debate about reconciling ecological sustainability with poverty alleviation in the context of globalization and development.
COB4: To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 8

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components – Sustainable Development Goals – Quality education, Gender equality, innovation and infrastructure, peace and justice - Sustainable engineering practices.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 6

Need for sustainability – Global environmental challenges: population growth, resource depletion, pollution, energy use, climate change, pollution, growing water scarcity, other urban problems, loss of biodiversity, hazardous wastes disposal.
International responses to environmental challenges - Global policy such as Kyoto Protocol, Paris Agreement, Montreal Protocol, Basel Convention.
Community Participation in Sustainable Development, Common Property Resource Management, Innovation, Industry and Sustainable Development.

MODULE III GLOBALIZATION AND ENVIRONMENT SUSTAINABILITY 7

Impact of Globalization on sustainable development, Co - existence of globalization and Environment sustainability - Globalization and Global Governance.
Green economy - Renewable energy, sustainable transport, sustainable construction, land and water management, waste management.

MODULE IV POLICIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT 9

Principles of environmental policy for achieving sustainable development: precautionary principle and polluter pays principle – Business Charter for Sustainable Development.
Policy instruments for sustainable development: direct regulation – market based pollution control instruments such as pollution tax, subsidy, pollution permits.

L –30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An Introduction to Sustainable Development", Glen Educational Foundation, 1st Edition, England, UK, 2008.

2. Sayer, J. and Campbell, B, "The Science of Sustainable Development: Local Livelihoods and the Global Environment" (Biological Conservation, Restoration &Sustainability), Cambridge University Press, London, 2003.

REFERENCES:

1. Anderson, David A, "Environmental Economics and Natural Resource Management", Routledge, 3rd edition, England, UK, 2010.
2. Berck, P., "The Economics of the Environment", New Delhi: Pearson India, 2015.
3. Karpagam M, "Environmental Economics: A Textbook.pdf", Sterling Publishers Pvt. Ltd, New Delhi, 2021.
4. Kumar, Pushpam, "Economics of the Environment and Development",Ane Book Publication, New Delhi, India, 2009.
5. Karpagam M and Jaikumar Geetha, "Green Management Theory and Applications", Ane Books Pvt. Ltd, New Delhi, India, 2010.
6. Sengupta Ramprasad, "Ecology and Economics: An Approach to Sustainable Development", Oxford University Press, New Delhi, 2004.
7. Muthukrishna, S, "Economics of Environment", PHI Learning Pvt. Ltd., New Delhi, India, 2010.

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

CO1: Develop awareness of the ethical, economic, social and political dimensions that influence sustainable development.

CO2: Clearly articulate their views and beliefs with regards to environmental issues.

CO3: Identify and describe the major economic forces that shape our approach to the environment issues and demonstrate responsible globalization through global governance.

CO4: Account for strategies, international agreements and major policy instruments for a sustainable use of resources and ecosystem services.

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		H	H		H	H	H		H		H	H
CO2			H			H	H		H		H	H
CO3	M	M	H			H	H		H		H	H
CO4			H			H	H	H	H		H	H

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

SDG 1: End poverty in all forms and everywhere.

SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

SDG 3: Ensure healthy lives and promote well-being for all at all ages

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

SDG 5: Achieve gender equality and empower all women and girls

SDG 6: Ensure availability and sustainable management of water and sanitation for all.

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy 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 inclusive and sustainable

industrialization, and foster innovation
SDG 10: Reduce income inequality within and among countries
SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.
SDG 12: Ensure sustainable consumption and production patterns
SDG 13: Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
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.
SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The holistic understanding of all the 17 SDGs aims to end poverty, ensure prosperity, and protect the planet.

SSDX 12	SOCIOLOGY OF INDUSTRIAL RELATION	L	T	P	C
		2	0	0	2

SDG: 8, 9

COURSE OBJECTIVES:

COB1: To familiarize sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.

COB2: To highlight the structure and functions of industrial organizations

COB3: To explicate the dynamics of organizational behavior, leadership and communication.

COB4: To provide an overview in labour legislation and labour welfare

MODULE I INTRODUCTION 7

Sociology of Industrial relation - definition, scope and importance - Theoretical approaches- scientific management, human relations approach, theory of bureaucracy- Fordism and post-fordism - Production system- concept and characteristics of factory system - automation and rationalization -The Industrial Employment (Standing Orders) Act, 1946 Industrial conflict-strike, lockout and trade unions- Emerging role of trade unions in India.

MODULE II INDUSTRIAL ORGANIZATION 7

Formal organization- definition, features, utility - Informal organization- definition, characteristics, types and relevance - Structure of industrial organization- features and functions of line organization, characteristics and roles of staff organization, distinction- Industrial hierarchy-white collar, blue collar, supervisors and managers.

MODULE III DYNAMICS OF INDUSTRIAL RELATIONS 7

Group dynamics- Definition, Group behaviour model - Group decision making process, group cohesiveness - Leadership- definitions, style and effective supervision- Communication- concepts, types, model barriers - Job satisfaction- nature, employee compensation and job satisfaction. Grievance Handling and Disciplinary Action, Code of Conduct, Industrial Relations in changing scenario, Employers’ organisations.

MODULE IV LABOUR LEGISLATION AND LABOUR WELFARE 9

Labour Legislation-Objectives, Principles, Classification and Evolution. International Labour Organisation. Social Justice and Labour Legislation, Indian Constitution and Labour Laws- The Factories Act, 1948, The Inter-state Migrant Workmen Act, 1979, The Contract Labour (Regulation and Abolition) Act, 1970, The Child Labour (Prohibition and Regulation) Act, 1986. Labour welfare-Concept, Scope, Types, and Principles, Industrial Health and Hygiene, Industrial Accidents and safety, Occupational Diseases. Social Security-Concept and Scope, Social Assistance and Social assurance.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Mamoria ,Gankar., “Dynamics of Industrial relations”, Himalaya Publishing House,Mumbai, 2007.
2. Narender Singh ., “Industrial Sociology”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
   Kumar., “Industrial Sociology”, Lakshmi Narain Agrawal Publishers, Agra, 2019.
3. SharmisthaBhattacharjee, “Industrial Sociology”, Aavishkar Publishers, Jaipur, 2016.

REFERENCES:

1. Bhatnagar M., “Industrial Sociology”,S. Chand Publications, New Delhi, 2012.
2. MisraRajan., “Industrial Sociology”, University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.), New Delhi, 2013.
3. Newstorm W John, “Organizational Behavior”, Mc. Graw Hill Publishing Co., New Delhi, 2006.
4. Nina, Bandlej (ed)., “Economic Sociology of Work”, Bingley: Emerald Group Publishing Ltd, 2009.
5. Richard Brown, John Child, S.R. Parker, “The Sociology of Industry”, Routledge Publisher, 2015.
6. Sushil Kumar Saxena, Satish Mittal, “Industrial Sociology”,Common Wealth Publishers, 2012.
7. Watson, Tony, “Sociology, Work and Industry (5th edition), Oxon: Routledge, 2008.

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

CO1: Understand the sociological perspectives for dealing with social relationships in production and service organizations.

CO2: Have deeper knowledge in structure of authority, roles and responsibility in organizational settings.
CO3: Assess the role of leadership, communication and behavioral acumen to govern the organization.
CO4: Describe the importance of labour legislation and labour welfare

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			H						M	H		M
CO2						M	L	M	M		H	M
CO3			M			M		M	H	H	H	M
CO4						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
SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

The holistic understanding of industrial relations leads to equal access to opportunity, and equal pay for work of equal value for male and female contributions is necessary for gender equality as well as for inclusive economic growth. Explore work opportunities, understand career processes and appreciate the meaning and purpose of work in people's lives which leads to decent work and safe working practices.

SSDX 13	**PROFESSIONAL ETHICS AND HUMAN VALUES**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

SDG: 8

COURSE OBJECTIVES:

COB1: To render basic insights and inputs to the students to inculcate human values to grow as responsible human beings with a proper personality.

COB2: To create awareness on senses of engineering ethics.

COB3: To inculcate knowledge and exposure on safety and risk, risks benefit analysis and professional rights.

COB4: To instill social values and loyalty and to appreciate the rights of others.

MODULE I HUMAN VALUES 7

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

MODULE II ENGINEERING ETHICS 7

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - Theories about right action - Self-interest - Customs and Religion - Uses of ethical theories - Valuing Time – Co-operation – Commitment.

MODULE III SAFETY, RESPONSIBILITIES AND RIGHTS 8

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

MODULE IV CONTEMPORARY ISSUES 8

Globalisation-Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Ethics-Ethics and codes of business conduct in MNC.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S., “Engineering Ethics”,

Prentice Hall of India, New Delhi, 2019.

2. Kiran. D R, “Professional Ethics and Human Values”, Mc Graw Hill Publishers,New Delhi, 2013.
3. Naagarazan R.S., “Professional Ethics and Human Values”, New Age International Publishers, New Delhi, 2006.
4. R Sangal, RR Gaur and G P Bagaria, “Foundational Course in Human Values & Professional Ethics”, Excel Books, India, 2010.

REFERENCES:

1. Charles D. Fleddermann , “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004.
2. Charles E Harris, Michael S.Protchard and Michael J Rabins., “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
6. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York, 2010.
7. Subramanian. R,“Professional Ethics - Includes Human Values”, Oxford HED Publishers, 2017.\

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Apply moral and ethical values scrupulously that ought to guide the engineering profession.

CO2: Understand the ethical issues related to engineering aspects.

CO3: Assess safety and risk and execute risk benefit analysis.

CO4: Become responsible engineers, experimenters, researchers or businessmen

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			H				H	H				M
CO2			M			M		H		H	M	
CO3			M		M	H		H				H
CO4			L				H	H	H		M	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

Holistic understanding of professional ethics explores work opportunities, understand career processes and appreciate the meaning and purpose of work in people’s lives leading to a decent work and safe working practices and environments.

SSDX 14	GENDER, TECHNOLOGY AND DEVELOPMENT	L	T	P	C
		2	0	0	2

SDG: 8

COURSE OBJECTIVES:

COB1: To conceptualize what is gender and sex and draw a line of distinction between the two.

COB2: To develop students' sensibility to the difference in gender roles, responsibilities, rights and injustice.

COB3: To reflect critically on the ways in which new technologies have sharpened and/or blurred gender difference.

COB4: To develop an insight to the gender and development with the paradigm shift from time to time.

MODULE I UNDERSTANDING GENDER 7

Basic Concepts: Sex/Gender, Gender roles, Gender socialization, - Construction of Gender- Making Women, Making Men Gender stereotyping, Femininity and Masculinity, Patriarchy, Heteronormativity, LGBTIQ - Theoretical Background to gender and feminist thinking: Liberal, Radical, Marxist, Socialist, Post-modern Feminism.

MODULE II GENDER ROLES AND GENDER INJUSTICE 7

Gender Roles and Relations-Types of Gender Roles Gender Roles and Relationships Matrix. Health conditions, Sex Ratio, Education: Literacy & Gender Bias - Work Related Issues: Existing Prejudices, gender Related Violence, Gender Discrimination - Political participation: Lack of women's representation - Economic Conditions- Social Conditions: divorce, rape, domestic violence.

MODULE III GENDER, TECHNOLOGY AND CHANGE 8

A historical perspective – Technology as masculine culture – Household technology – medical technology: New Reproductive technologies – Impact of Technological Change on Women. The Digital Divide: Unequal Access, Unequal Effects – Outcome and impact of ICT's Policies and projects for women. How gender influences technologies and the social organization of scientific and technical workspaces.

MODULE IV GENDER AND DEVELOPMENT 8

Gender, Governance and Sustainable Development - Women's role in Development - Women in Development (WID), Women and Development (WAD) - Gender and Development (GAD); Gender Mainstreaming and Gender Budgeting - Gender and Human Rights

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Bhasin, Kamala., "Understanding Gender", New Delhi: Kali for Women, 2000.
2. John, Mary E., "Gender and Development in India, 1970-90's: Some reflections on the constitutive role of context' Chaudhuri, Maitrayee. (ed.) Feminism in India", New Delhi: Kali for women. pp. 246-258, 2004.
3. Menon, Nivedita, "Embodying the Self: Feminism, Sexual Violence and the Law" in Partha Chatterjee and Pradeep Jeganathan (ed)- Subaltern Studies XI: Community, Gender and Violence", Permanent Black and Ravi Dayal, 2000.
4. Gender and Technology: A reader ., Edited by Nina E. Lerman, Ruth Oldenziel, and Arwen P. Mohun, John Hopkins University Press, Baltimore , 2003.

REFERENCES:

1. Lourdes Beneria , GünseliBerik , Maria Floro .,"Gender, Development and Globalization: Economics as if All People Mattered", 2nd edition , Routledge, 2015.
2. Moser, Caroline, "Gender Planning and Development: Theory, Practice and Training", Routledge, 1993.
3. Rege, Sharmila., "Sociology of Gender: The Challenge of Feminist Sociological Knowledge", Sage publications: New Delhi, 2003.
4. Jain S.C., Women and Technology, Rawat Publication, Jaipur Begh, 1985.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Distinguish important concepts related to gender in contemporary society.

CO2: Interpret the gender discrimination works in our society and how to counter it.

CO3: Illustrate how the intersection of gender and technology involves gender shaping technology and technology shaping gender.

CO4: Apply gender sensitive perspective on development and human rights.

Board of Studies (BoS) :	**Academic Council:**
4th BoS of SSSH held on 28.06.2021	17th AC held on 15.07.2021

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

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

SDG 5: Achieve gender equality and empower all women and girls

To imbibe gender concern and gender perspective in the invention, and application of technology, planning and designing production and innovating strategies for engendering gender equality.

PHYSICS ELECTIVE

PHDX 01	**NON DESTRUCTIVE TESTING OF MATERIALS**	**L**	**T**	**P**	**C**
SDG: 4		**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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2	PSO3
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		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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2	PSO3
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

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PHDX 03	BIOMATERIALS	L	T	P	C
SDG: 4		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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

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		L	T	P	C
PHDX 04	**OPTICAL FIBRE COMMUNICATION**	**L**	**T**	**P**	**C**
SDG: 4	(	**2**	**0**	**0**	**2**

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 optical receivers and 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 and configurations.

CO2:understand and assimilate the working principle of LED and Diode Laser.

CO3:select suitable photodetectors/sensors for different types of applications.

CO4:analyze the mechanism of optical amplifiers and analyze optical networks.

Board of Studies (BoS) :

BOS of Physics was held on 21.6.21

Academic Council:

17^{th} AC held on 15.07.2021

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2	PSO3
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

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PHDX 05	**SEMICONDUCTOR PHYSICS FOR INFORMATION TECHNOLOGY**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

SDG: 4

COURSE OBJECTIVES:

COB1: To study about electronic states of semiconductors.

COB2: To understand the physics of semiconductor devices

COB3: To gain knowledge on various methods involved in nanofabrication of semiconductor devices

COB4: To study the working principle of optoelectronic devices and various display devices

MODULE I ELECTRONIC STATES OF SEMICONDUCTORS 8

Energy bands in solids – Dynamics of electrons in periodic potential: Kronig – Penny model – Direct and Indirect Bandgaps – Brillouin Zone – Energy band structure in semiconductors (ZnO, GaAs) – concept of effective mass of electron and concept of holes.

MODULE II INTRODUCTION TO SEMICONDUCTOR DEVICES 6

Semiconductors: N and P type (Qualitative), 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.

MODULE III DEPOSITION TECHNIQUES OF SEMICONDUCTING MATERIALS 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 IV 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, Luminescence, Cathode Luminescence, Electro Luminescence, Transparent Conductors, Liquid crystal displays – Dynamic scattering and Twisted nematic display, Charge-coupled devices (CCD)

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: study about electronic states of semiconductors.

CO2: understand the physics of semiconductor devices and identify its significance towards information technology (IT).

CO3: gain insight into various fabrication techniques towards the realization of nano-dimensional semiconductor devices.

CO4: attain knowledge on working principles of optoelectronic devices and display technologies and can recognize their importance in commercial applications.

Board of Studies (BoS) :	**Academic Council:**
13th BoS of Physics held on 14.09.2023	21st AC held on 20.12.2023

	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	M	M	M
CO2	M	L	M	H	L	M	H	M	L	L	L	M	M	M	M
CO3	L	M	H	H	L	H	M	M	L	H	L	M	M	M	M
CO4	M	L	H	M	L	M	M	H	L	M	L	M	M	M	M

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

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PHDX 06 **SENSORS AND ACTUATORS**

SDG: 4

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

COB1:To understand the basic concept of measurements and sensors

COB2:To avail knowledge on variable resistance, capacitance and Inductance sensors.

COB3: To study about special sensors.

COB4: To get introduced towards MEMS technology and various actuators.

MODULE I INTRODUCTION TO MEASUREMENTS AND SENSORS 8

Sensors: functions – main technical requirement and trends, units and trends – calibration methods – classification of errors – error analysis – limiting error – probable error – propagation of error – odds and uncertainity – principle of transduction – classification: static and dynamic characteristics – mathematical model of transducers: zero, first and second order transducers.

MODULE II VARIABLE RESISTANCE, CAPACITANCE AND INDUCTANCE SENSORS 8

Characteristics and operation of resistive potentiometers – resistive pressure sensor – resistive position sensor - strain gauges: types, gauge factor calculation – resistive thermometer – thermistor Capacitive pressure sensor, Inductive sensor: Change in self-inductance with number of turns, change in self-inductance with change in permeability – inductive pressure transducer – inductive position transducer, LVDT – piezo resistive sensors.

MODULE III SPECIAL SENSORS 7

Photoconductors – optical detectors -photodiodes, phototransistors – charge coupled device (CCD) – Fabry Perot sensor - Hall effect – magneto resistive, magneto strictive sensors – microphones: resistive, capacitive, Fiber optic – thermocouple.

MODULE IV MICROSYSTEMS AND ACTUATORS 7

Microelectro-mechanical systems (MEMS), Micro fabrication and Applications, micro actuators– actuation principle, shape memory actuator: one way, two way and pseudo elasticity – types of micro actuators – electrostatic, inverse piezoelectric effect – Solid-state switches, relays Solenoids, D.C. Motors, A.C. Motors, Stepper motors.

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 the basics of measurements and sensors

CO2: familiarize towards variable inductance, capacitance and resistance sensors and recognize their importance in commercial applications.

CO3: gain knowledge about special sensors and their applications.

CO4:apply the ideas to conceptualize MEMS technology and different actuators in engineering field

Board of Studies (BoS) :
13th BoS of Physics held on 14.09.2023

Academic Council:
21st AC held on 20.12.2023

	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	M	M	M
CO2	M	L	M	L	L	M	M	M	L	L	L	M	M	M	M
CO3	M	L	H	H	L	H	M	M	L	H	L	M	M	M	M
CO4	M	L	H	M	L	M	M	M	L	M	L	M	M	M	M

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

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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 polymer 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2	PSO3
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.

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