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

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

B.Tech.
(Electronics and Instrumentation Engineering)

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

REGULATIONS 2021

CURRICULUM AND SYLLABI

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

B.TECH. ELECTRONICS & INSTRUMENTATION 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 INSTRUMENTATION ENGINEERING

VISION

The Department aspires to excel in, providing quality education, trainingand research in the area of Electronics and Instrumentation Engineering tomeet the industrial and societal needs

MISSION

- To provide quality education in the field of Electronics andInstrumentation Engineering by offering Under Graduate, Post Graduateand Doctoral Programs
- To impart technical knowledge and hands on experience, leadership andmanagerial skills to meet the current industrial and societal needs.
- To enhance problem solving capabilities through design projects,internship and industrial projects
- To maintain active linkages with industries and research institutions
- To develop analytical skills, leadership quality and team spirit throughbalanced curriculum and a judicial mix of co-curricular, extra-curricular andprofessional society activities
- To enrich the knowledge and skills of faculty through continuouslearning and active research

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.TECH. (ELECTRONICS & INSTRUMENTATION ENGINEERING)

PROGRAMME EDUCATIONAL OBJECTIVES

- To provide fundamental knowledge of Mathematics and Science to enable thestudent understand the basic concepts of Electronics and InstrumentationEngineering.

- To impart sound theoretical and practical knowledge in the broad areas ofElectrical and Electronic Measurements, Transducers, Industrial Instruments,Analytical Instruments Biomedical instruments, Microelectronics and ProcessControl.

- To provide knowledge and skill in the design, installation, maintenance, andcalibration of different types of instruments used in process industries.

- To develop skills for devising solutions in the design of conventional andadvanced Control Systems required for Industrial Automation.

- To inculcate sustained interest in the process of life- long learning to keepabreast of state-of-art technologies in the fields of Electronics andInstrumentation.

- To impart necessary managerial and soft skills required to face the challengesin the process industries and software companies.

PROGRAMME OUTCOMES

On successful completion of the programme, the graduates will

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

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

- 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.

- 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

- 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.

- 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.

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

- apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

- 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.

- 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.

- 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.

- test, Calibrate and Select measuring Instruments and analyzers for differentIndustrial applications.

- design & fabricate signal conditioning circuits for measurement systems.

- design, simulate and implement conventional, multi loop, intelligent andmodel based controllers for Industrial Automation.

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 20% of credits of courses in a semester excluding project semester with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean (Academic Affairs) during his / her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

4.1.4 Value Added Courses

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

The details of the value added course viz., syllabus, schedule of classes and the course faculty shall be sent to the Dean (Academic Affairs) for approval. The students may also undergo the valued added courses offered by other departments with the consent of the Head of the Department offering the course.

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

4.1.5 Industry Internship

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

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

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

4.1.6 Industrial Visit

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

4.2 Each course is normally assigned certain number of credits:

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

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

4.5 The medium of instruction, examinations and project report shall be in English, except for courses in languages other than English.

5.0 DURATION OF THE PROGRAMME

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

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

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

6.0 REGISTRATION AND ENROLLMENT

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

6.2 Change of a Course

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

6.3 Withdrawal from a Course

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

7.0 BREAK OF STUDY FROM PROGRAMME

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

7.1.1 Medical or other valid grounds

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

7.1.3 Debarred due to any act of indiscipline

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

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

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

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 Class Advisor

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

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

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

8.2 Faculty Advisor

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

9.0 COURSE COMMITTEE

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

10.0 CLASS COMMITTEE

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

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

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

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

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

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

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

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

11.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER

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

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

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

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

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

12.2 Theory Course

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

12.3 Laboratory Course

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

12.4 Laboratory Integrated Theory Courses

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

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

12.6 Industry Internship

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

12.7 Project Work

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

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

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

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

13.0 SUBSTITUTE EXAMINATIONS

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

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

14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

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

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

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

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

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

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

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

15.0 REDO COURSES

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

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

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

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

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

"W" - denotes withdrawal from the course

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

“U” - denotes unsuccessful performance in the course.

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

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

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

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

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

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

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

Where n = number of courses

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

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

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

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

Percentage equivalent of marks = CGPA X 10

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

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

16.6.1 Eligibility for First Class with Distinction

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

16.6.2 Eligibility for First Class

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

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

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

17.0 SUPPLEMENTARY EXAMINATION

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

18.0 DISCIPLINE

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

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

19.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

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

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

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

iv) No disciplinary action pending against him/her.

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

20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

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

• Civil Engineering	• Mechanical Engineering
• Electronics and Communication Engineering	• Electrical and Electronics Engineering
• Automobile Engineering	• Aeronautical Engineering
• Polymer Engineering	• Biotechnology Engineering
• Electronics and Instrumentation	• Computer Science and

Engineering	Engineering
• Information Technology	• Artificial Intelligence and Data Science
• Computer Science and Engineering (IoT)	• Computer Science and Engineering(Cyber Security)

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

Sl. No.	Minor Degree	Eligible Major Degree Programmes (from other Departments)
1.	Artificial Intelligence and Machine Learning	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering
2.	Block Chain	
3.	Cyber Security	
4.	Data Science	
5.	Internet of Things (IoT)	
6.	Virtual and Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering
8.	Robotics	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering

9.	3D Printing	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electronics and Communication Engineering
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electronics and Communication Engineering
12.	GIS and Remote Sensing	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Biotechnology Electrical and Electronics Engineering

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

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

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

21.0 POWER TO MODIFY

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

****

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY
B.TECH. ELECTRONICS & INSTRUMENTATION ENGINEERING
CURRICULUM & SYLLABUS, REGULATIONS 2021
(Choice Based Credit System)

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BSC	PHD 1182	Engineering Physics *	3	0	2	4
2.	BSC	CHD 1182	Chemistry for Computer and Electronics Applications	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 Practices Laboratory	0	0	2	1
7.	ESF	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	END1181	English for Engineers	3	0	0	3
2.	BSC	MAD 1283	Partial Differential Equations and Transforms	3	1	0	4
3.	ESC	GED 1203	Basic Electrical Engineering *	3	0	2	4
4.	ESC	GED 1211	Engineering Mechanics	3	1	0	4
5.	PCC	EID 1201	Network Analysis and Synthesis	2	1	0	3
6.	PCC	EID 1202	Electron Devices	2	0	0	2
7.	PCC	EID 1203	Electron Devices and Network Synthesis Laboratory	0	0	2	1
8.	MC	GED 1206	Environmental Sciences	2	0	0	2
			Credits				**23**

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	EID 2101	Digital Electronics	3	1	0	4
4.	PCC	EID 2102	Linear Integrated Circuits	3	0	2	4
5.	PCC	EID 2103	Transducers Engineering	3	0	0	3
6.	PCC	EID 2104	Electrical, Electronics and Physical Measurements	3	0	0	3
7.	PCC	EID 2105	Digital Electronics Laboratory	0	0	2	1
8.	PCC	EID 2106	Transducers and Measurements Laboratory	0	0	2	1
9.	HSC	GED 2101	Essential Skills and Aptitude for Engineers	0	0	2	1
			Credits				**24**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	EID 2201	Industrial Instrumentation I	3	0	0	3
2.	PCC	EID 2202	Control Systems	3	1	0	4
3.	PCC	EID 2203	Microprocessor and Microcontroller	3	0	0	3
4.	PCC	EID 2204	Python for Instrumentation Engineers	3	0	0	3
5.	PCC	MED 2281	Thermodynamics and Fluid Mechanics	3	0	0	3
6.	PCC	EID 2205	Industrial Instrumentation I Laboratory	0	0	2	1
7.	PCC	EID 2206	Microprocessor and Microcontroller Laboratory	0	0	2	1
8.	PEC		Professional Elective I	3	0	0	3
9.	HSC	GED 2201	Workplace Skills and Aptitude for Engineers	0	0	2	1
10.	MC	GED 2202	Indian Constitution and Human Rights	2	0	0	0
			Credits				**22**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	EID 3101	Process Control	3	0	0	3
2.	PCC	EID 3102	Industrial Instrumentation II	3	0	0	3
3.	PCC	ECD 3182	Communication Engineering	3	0	0	3
4.	PCC	EID 3103	Digital signal processing	3	1	0	4
5.	PCC	EID 3104	Process Control Laboratory	0	0	2	1
6.	PCC	EID 3105	Industrial instrumentation II Laboratory	0	0	2	1
7.	PEC		Professional Elective II	3	0	0	3
8.	PEC		Professional elective III	3	0	0	3
9.	HSC	GED 3101	Communication Skills for Career Success	0	0	2	1
10.	PROJ	EID 3106	Internship I ##	0	0	0	1
			Credits				**23**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	MSD 3281	Entrepreneurship$	3	0	0	3
2.	HSC		Humanities Elective II	2	0	0	2
3.	OEC		Open Elective I	3	0	0	3
4.	BSC		Chemistry Elective	2	0	0	2
5.	BSC		Physics Elective	2	0	0	2
6.	PCC	EID 3201	Embedded System and RTOS	2	0	1	3
7.	PEC		Professional Elective IV	3	0	0	3
1.	PEC		Professional Elective V	3	0	0	3
2.	HSC	GED 3201	Reasoning and Aptitude for Engineers	0	0	2	1
			Credits				**22**

#Not a Mandatory Course – upon completion – mentioned in grade sheet.

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	OEC		Open Elective II	3	0	0	3
2.	OEC		Open Elective III	3	0	0	3
3.	PCC	EID 4101	Industrial Automation	3	0	1	4
4.	PCC	EID 4102	Biomedical Instrumentation	3	0	0	3
5.	PEC		Professional Elective VI	3	0	0	3
6.	PEC		Professional Elective VII	3	0	0	3
7.	PEC		Professional Elective VIII	3	0	0	3
8.	PROJ	EID 4103	Internship II ###	0	0	0	1
9.	HSC		Employability Skills $	0	0	2	1
			Credits				**23**

SEMESTER VIII

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

Overall Total Credits – 166

- * 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.

LIST OF PROFESSIONAL ELECTIVE COURSES

Specialization I- Instrumentation Engineering

Sl. No	Course Group	Course Code	Course Title	L	T	P	C	Can be preferred in
1.	PEC	EIDX 01	Fiber Optic and Laser Instrumentation	3	0	0	3	IV sem
2.	PEC	EIDX 02	Advanced Sensors	3	0	0	3	V sem
3.	PEC	EIDX 03	Ultrasonic Instrumentation	3	0	0	3	V sem
4.	PEC	EIDX 04	Analytical Instrumentation	3	0	0	3	VI sem
5.	PEC	EIDX 05	Instrumentation System Design	2	0	1	3	VI sem
6.	PEC	EIDX 06	Advanced Instrumentation Systems	3	0	0	3	VII sem
7.	PEC	EIDX 07	Virtual Instrumentation	2	0	1	3	VII sem
8.	PEC	EIDX 08	Power Plant Instrumentation	3	0	0	3	VII sem
9.	PEC	EIDX 09	Space and Navigational instrumentation	3	0	0	3	VII sem
10.	PEC	EIDX 10	Safety Instrumentation	3	0	0	3	VII sem
11.	PEC	EIDX 11	Piping and Instrumentation Layout in Process Industries	3	0	0	3	VII sem

Specialization II –Control Engineering

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Can be preferred in
1.	PEC	EIDX 21	Control system components	3	0	0	3	IV sem
2.	PEC	EIDX 22	Modern Control System	3	0	0	3	V sem
3.	PEC	EIDX 23	Industry 4.0	3	0	0	3	V sem
4.	PEC	EIDX 24	Robotics and Automation	3	0	0	3	V sem
5.	PEC	EIDX 25	Modeling and Simulation	3	0	0	3	VI sem
6.	PEC	EIDX 26	Digital Process Control	3	0	0	3	VI sem
7.	PEC	EIDX 27	Nonlinear Control System	3	0	0	3	VII sem

8.	PEC	EIDX 28	System Identification	3	0	0	3	VII sem
9.	PEC	EIDX 29	Adaptive Control	3	0	0	3	VII sem
10.	PEC	EIDX 30	Plant Engineering	3	0	0	3	VII sem
11.	PEC	EIDX 31	Instrumentation and Control in Petrochemical Industries	3	0	0	3	VII sem
12.	PEC	EIDX 32	Instrumentation and Control in Iron and Steel Industries	3	0	0	3	VII sem
13.	PEC	EIDX 33	Instrumentation and control in Pharmaceutical Industries	3	0	0	3	VII sem
14.	PEC	EIDX 34	Instrumentation and Control in Chemical Industries	3	0	0	3	VII sem

Specialization III - Electrical and Electronics Engineering

Sl. No	Course Group	Course Code	Course Title	L	T	P	C	Can be preferred in
1.	PEC	EIDX 41	MEMS and Nanoscience	3	0	0	3	IV sem
2.	PEC	EIDX42	Applied Power Electronics	3	0	0	3	IV sem
3.	PEC	EIDX 43	Wireless Sensor Networks	3	0	0	3	V sem
4.	PEC	EIDX 44	Industrial Drives and Control	3	0	0	3	V sem
5.	PEC	EIDX 45	Mechatronics	3	0	0	3	V sem
6.	PEC	EIDX 46	Design Technology and Innovation	3	0	0	3	V sem
7.	PEC	EIDX 47	VLSI Design	3	0	0	3	VI sem
8.	PEC	EIDX 48	Advanced Digital Signal Processing	3	0	0	3	VI sem
9.	PEC	EIDX 49	Electronics Equipment Integration and Prototype Building	3	0	0	3	VI sem
10.	PEC	EIDX 50	Digital Image Processing	3	0	0	3	VII sem

Specialization IV-Computer Science Engineering

Sl. No	Course Group	Course Code	Course Title	L	T	P	C	Can be preferred in
1.	PEC	EIDX 61	Industrial Data Networks	3	0	0	3	IV sem

2.	PEC	EIDX 62	R-Programming	3	0	0	3	IV sem
3.	PEC	EIDX 63	3D Animation	3	0	0	3	V sem
4.	PEC	EIDX 64	Applied Soft Computing for Instrumentation Engineers	3	0	0	3	VI sem
5.	PEC	EIDX 65	Internet of Things for Automation	3	0	0	3	VI sem
6.	PEC	EIDX 66	Introduction to Industry 4.0 and Industrial Internet of Things	3	0	0	3	VI sem
7.	PEC	EIDX 67	Deep Learning	3	0	0	3	VII sem
8.	PEC	EIDX 68	Big Data Analytics	3	0	0	3	VII sem
9.	PEC	EIDX 69	Data Science for Engineers	3	0	0	3	VII sem
10.	PEC	EIDX 70	Practical Machine Learning with Tensor Flow	3	0	0	3	VII sem

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

CHEMISTRY ELECTIVES – VI SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C
1	CHDX 01	Chemistry of Construction Materials	2	0	0	2
2	CHDX 02	Chemistry of Materials and Electrochemical Devices	2	0	0	2
3	CHDX 03	Chemistry and Instrumentation for Electrical and Electronic Applications	2	0	0	2
4	CHDX 04	Functional Materials and Applications	2	0	0	2
5	CHDX 05	Chemistry of Fuels, Combustion and Lubricants	2	0	0	2
6	CHDX 06	Instrumental Methods of Polymer Analysis	2	0	0	2
7	CHDX 07	Medicinal Chemistry	2	0	0	2

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

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX 201	Application of Fluid Mechanics in Everyday Life	3	0	0	3	Aero
2	GEDX 202	Basics of Management and Organizational Behaviour	3	0	0	3	CSB
3	GEDX 203	Big data Analytics	3	0	0	3	CA
4	GEDX 204	Biology for Engineers	3	0	0	3	SLS
5	GEDX 205	Consumer Electronics	3	0	0	3	ECE
6	GEDX 206	Creative Writing	2	1	0	3	English
7	GEDX 207	Cyber Forensics	3	0	0	3	CSE
8	GEDX 208	Cyber Security	3	0	0	3	IT
9	GEDX 209	Disaster Management	3	0	0	3	Civil
10	GEDX 210	English for Competitive Examination	2	1	0	3	English
11	GEDX 211	Enterprise Risk Management	3	0	0	3	CSB
12	GEDX 212	Fundamentals of Project Management	3	0	0	3	CSB
13	GEDX 213	Industrial Robotics	2	0	2	3	Mech.
14	GEDX 214	Internet of Things and its Applications	3	0	0	3	ECE
15	GEDX 215	Introduction to Health Care Analytics	3	0	0	3	CA
16	GEDX 216	IPR and Patent Laws	3	0	0	3	CSB
17	GEDX 217	Logistics and Supply Chain Management	3	0	0	3	CSB
18	GEDX 218	Nano Materials and Technology *	2	0	2	3	Physics / Chemistry
19	GEDX 219	Numerical Computational Tools for Engineers *	2	0	2	3	EIE
20	GEDX 220	Optimization Techniques	3	0	0	3	EEE
21	GEDX 221	Polymers for Emerging Technologies	3	0	0	3	Polymer
22	GEDX 222	Programming Language Principles	3	0	0	3	CSE
23	GEDX 223	Public Speaking and Rhetoric	2	1	0	3	English
24	GEDX 224	Python Programming *	2	0	2	3	IT
25	GEDX 225	R Programming	3	0	0	3	CA
26	GEDX 226	Smart Sensors for Healthcare Applications	3	0	0	3	EIE
27	GEDX 227	Total Quality Management	3	0	0	3	Mech.
28	GEDX 228	Value Education	3	0	0	3	Commerce
29	GEDX 229	Waste Water Management	3	0	0	3	Civil
30	GEDX 230	Web Application Development	3	0	0	3	CA

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

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX 101	Advanced Entrepreneurship	3	0	0	3	CSB
2	GEDX 102	Artificial Intelligence and Machine Learning Applications	3	0	0	3	CSE
3	GEDX 103	Automotive Technology	3	0	0	3	Automobile
4	GEDX 104	Behavioural Psychology	3	0	0	3	SSSH
5	GEDX 105	Building Repair Solutions	3	0	0	3	Civil
6	GEDX 106	Cloud Services and Management	3	0	0	3	CA
7	GEDX 107	Cost Management for Engineers	3	0	0	3	Commerce
8	GEDX 108	Cyber Law and Ethics	3	0	0	3	CSL
9	GEDX 109	Data Analytics and Visualization	3	0	0	3	CA
10	GEDX 110	Deep learning Essentials	3	0	0	3	CSE
11	GEDX 111	Drone Technologies	2	0	2	3	Aero
12	GEDX 112	Electric Vehicle	3	0	0	3	EEE
13	GEDX 113	Emerging Technologies in Mobile Networks	3	0	0	3	ECE
14	GEDX 114	Fundamentals of Data Science and Machine Learning	3	0	0	3	IT
15	GEDX 115	Genetic Engineering	3	0	0	3	SLS
16	GEDX 116	Green Design and Sustainability	3	0	0	3	Civil
17	GEDX 117	Image Processing and its Applications	3	0	0	3	ECE
18	GEDX 118	Industrial Automation and Control	3	0	0	3	EIE
19	GEDX 119	Industrial Safety	3	0	0	3	Mech.
20	GEDX 120	Industry 4.0	3	0	0	3	Mech.
21	GEDX 121	Introduction to Artificial Intelligence	3	0	0	3	IT
22	GEDX 122	Introduction to Artificial Intelligence and Evolutionary Computing	3	0	0	3	EEE
23	GEDX 123	Motor Vehicle Act and Loss Assessment	3	0	0	3	Automobile
24	GEDX 124	National Service Scheme	3	0	0	3	SSSH
25	GEDX 125	National Cadet Corps	3	0	0	3	SSSH
26	GEDX 126	Personal Finance and Investment	3	0	0	3	Commerce
27	GEDX 127	Soft Computing Techniques	3	0	0	3	CSE
28	GEDX 128	Value Analysis and Engineering	3	0	0	3	Mech.
29	GEDX 129	Vehicle Maintenance	3	0	0	3	Automobile

SEMESTER I

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

COURSE OBJECTIVES:

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

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

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

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

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

MODULE I ELECTROMAGNETIC WAVES 9

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

MODULE II QUANTUM MECHANICS 9

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

MODULE III OSCILLATIONS, OPTICS AND LASERS 9

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

MODULE IV INTRODUCTION TO SOLIDS 9

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

MODULE V PHYSICS OF SEMICONDUCTORS 9

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

PRACTICALS

List of Experiments

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

L – 45; P – 30 ; Total Hours – 75

TEXT BOOKS:

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

REFERENCES:

1. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015.
2. Serway R.A. and Jewett, J.W., Physics for Scientists and Engineers with Modern Physics, Brooks/cole Publishing Co., 2010.
3. Tipler P.A. and Mosca, G.P., Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.
4. Markert J.T., Ohanian. H. and Ohanian, M., Physics for Engineers and Scientists, W.W. Norton & Co., 2007.
5. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.

6. Linear Integrated Circuits by D. Roy Choudhury and Shail Jain - New Age International (P) Ltd.(2003).
7. Integrated Electronics by J.Millman and C.Halkias, Tata McGraw Hill, New Delhi (2001).

COURSE OUTCOMES:

CO1: Express the knowledge of electromagnetic waves.

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

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

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

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

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

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	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**
		3	**0**	**2**	**4**

SDG: 9

COURSE OBJECTIVES:

To make the students conversant with

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

COB2: synthesis, properties and applications of nanomaterials

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

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

COB5: types of corrosion and its prevention.

MODULE I **POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS** **10**

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

MODULE II **NANOMATERIALS** **10**

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

MODULE III **BATTERIES** **8**

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

MODULE IV **PHOTOCHEMISTRY** **9**

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

– bioluminescence – photosensitization: principle and applications(photosynthesis and artificial photosynthesis) – photoelectrolysis.

MODULE V CORROSION AND ITS PREVENTION 8

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

PRACTICALS

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

L – 45 ; P – 30 ; Total Hours –75

TEXT BOOKS:

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2016.

REFERENCES:

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

COURSE OUTCOMES:

The students will be able to

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

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

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

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

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

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

Academic Council:
17th AC held on 15.07.2021

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

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

SDG 9 : Industry, Innovation & Infrastructure

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

		L	T	P	C
MAD 1181	**ALGEBRA AND DIFFERENTIAL CALCULUS**				
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	M		-	-	-	-	-	-	-	-	-	-	-	-	-
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 Engineering problems

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, 53rdEdtion, 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):
18thBoS of MECH held on 21.06.2021

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

		L	T	P	C
GED 1102	**ENGINEERING DESIGN**	**L**	**T**	**P**	**C**
SDG:9		**2**	**0**	**0**	**2**

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):

18thBoS 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):
18thBoS 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 SDG: 8	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
		1	0	2	2

COURSE OBJECTIVES:

COB1: To explore the hardware and software components of thecomputer

COB2: To learn the structured and procedural programming concepts usingC.

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) :

18th BoS of CSE held on 26.07.2021

Academic Council:

17th AC held on 15.07.2021

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

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

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

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

SEMESTER II

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

COURSE OBJECTIVES:

COB1: To train students to use appropriate vocabulary in academic and technical contexts
COB2: To facilitate students to speak effectively while exchanging ideas and making presentations
COB3: To develop students' listening skill for comprehending and analysing information
COB4: To develop their reading skill through sub skills like skimming, scanning and critical reading of a text
COB5: To sharpen their academic writing skills
COB6: To expose them to the correct usage of language and help them to apply that knowledge appropriately

MODULE I HUMAN RESOURCES 10

L: Listening to short texts – short formal & informal conversations.
S: Introducing one self – exchanging personal info.
R: Process of reading purposes, Reading comprehension, improving comprehension skills, Reading activities – short comprehension passages, practice in skimming & scanning.
W: Scientific & Technical Writing, Editing skills, Activities – completing sentences, developing hints - Paragraph Writing
Voc. development: Prefixes, Suffixes
Lang. development: Articles, Countable and Uncountable nouns, Present tense, Wh–Questions, Yes or No questions.

MODULE II TRANSPORT 10

L: Listening to long scientific talks
S: Sharing personal information – greeting, leave taking.
R: Comprehension passages with multiple choice questions / Wh–questions/ openended questions - Reading longer technical texts & completing exercises based on them.
W: Use of reference words & discourse markers on a text, jumbled sentences, describing a process – flow chart, use of sequence words.
Voc. development: Guessing meanings of words in context, vocabulary used in formal letters, e-mails & reports.
Lang. development: Preposition of Time, Place & Date, Past tense, Conjunctions, Impersonal passive voice, Question tags, Numerical Adjectives.

MODULE III ENERGY 9

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

S: Asking about routine actions & expressing opinions.

R: Locating Specific Information

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

Voc. development: Sequence words, misspelt words.

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

MODULE IV OUR LIVING ENVIRONMENT 8

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

S: Speaking about one's friend.

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

W: Argumentative writing.

Voc. Development: Synonyms, antonyms, phrasal verbs.

Lang. development: If clauses, Subject - Verb Agreement

MODULE V TECHNOLOGY 8

L: Listening to talks (General & Scientific).

S: Short group conversations.

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

W: Short essays, Dialogue writing.

Voc. Development: Idioms & Phrases.

Lang. development: Modal verbs.

L – 45; Total Hours – 45

TEXT BOOKS:

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

REFERENCES:

1) Perry, Carol Rosenblum (2011). The Fine Art of Technical Writing, Create Space Independent Publishing Platform, New Delhi.
2) Dutt, P.K. Rajeevan G. andPrakash, C.L.N. (2007). A course in Communication Skills, Cambridge Univesity Press, India.
3) Sen, Leena(2004). Communication Skills, Prentice Hall, New Delhi.
4) Matt Firth, Chris Sowton et.al (2012). Academic English An Integrated Skills Course for EAP, Cambridge University Press, Cambridge.

5) Bailey,Stephen 2011. Academic Writing: A practical guide for students, New York, Rutledge.
6) Redston, Chris&Gillies (2005). Cunningham Face2Face (Pre-intermediate Student's Book&Workbook) Cambridge University Press, New Delhi.
7) Dutt P. Kiranmai and RajeevanGeeta (2013). Basic Communication Skills, Foundation Books.

COURSE OUTCOMES:

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

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

CO3: Comprehend conversations and short talks delivered in English

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

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

Board of Studies (BoS) :
13th BoS 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.

		L	T	P	C
MAD 1283	**PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS**	**L**	**T**	**P**	**C**
SDG: 4		**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) :
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	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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 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 1203	**BASIC ELECTRICAL ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 3, 5, 8, 11, 12		**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 machines.

COB4: To impart knowledge on the fundamentals of transformer and AC rotating machines.

COB5: To acquaint the students with different methods of electric power generation.

MODULE I DC CIRCUITS & MEASUREMENTS 12

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 & MEASUREMENTS 18

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 MCB

MODULE III ELECTROMAGNETISM & DC MACHINES 16

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. (Qualitativetreatment only).

MODULE IV AC MACHINES 16

Transformers: Principle of operation and construction of single-phase transformers (core and shell types) - EMF equation, efficiency and voltage regulation.

Synchronous Generators: Principle of operation; Types and constructional features - EMF equation.

Three Phase Induction Motors: Concept of rotating magnetic field - Principle of

operation, types and constructional features - Slip and its significance - Applications of squirrel cage and slip ring motors - Necessity of a starter - star-delta starter.
(Qualitative treatment only)

Practical: Load Characteristics of single-phase transformer and three-phase induction motor.

MODULE V ELECTRICAL POWER SOURCES 13

Introduction to Wind, Solar, Fuel cell, Tidal, Geo-thermal, Hydroelectric, Thermal-steam, diesel, gas, nuclear power plants; Concept of cogeneration, and distributed generation.

PRACTICALS

List of Experiments

1. Verification of KCL and KVL (ii) Measurement of voltage, current and power in DC circuits.
2. (i) Resonance of RLC series circuit
   (ii) Measurement of voltage, current, power and power factor in single phase & three phase AC circuits.
3. (i) Magnetization characteristics of DC generator
   (ii) Load Characteristics of DC shunt motor,
4. Load characteristics of single-phase transformer and three-phase induction motor.
5. Site visit to any thermal / hydro / wind / solar power generating station.

L – 45 ; P – 30 ; Total Hours – 75

REFERENCES:

1. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 12th Edition, 2016.
2. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, McGraw Hill Education, First Edition, 2017.
3. Cotton H, “Electrical Technology”, CBS Publishers, 7th Edition, 2007.
4. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2015.
5. Hayt and Kimberly, “Engineering Circuit Analysis”, Tata McGraw Hill, 2012
6. Kulshreshtha D.C., “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
7. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall, India, 2009.
8. SahdevRitu, “Basic Electrical Engineering”, Khanna Book Publishing Co., 2018.

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 DC motor for specific applications based on the motor characteristics.

CO4: interpret the specifications of different AC machines used in industries.

CO5: explain the methods by which electrical energy can be generated.

Board of Studies (BoS) :
8th BoS of CSE held on 25.08.2020

Academic Council:
17th AC held on 14.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H		H	L	M		M		L	L	M	L			
CO2	H		H	L	M		M		L	L	M	L			
CO3	H		H	L			M		L	L	M	L			
CO4	H		H	L			M		L	L	M	L			
CO5	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 electronics systems can help in designing systems to promote good health and well being.

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

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

SDG 11: Sustainable cities and communities
Statement: Understanding the renewable energy sources helps in building sustainable cities and communities.

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

		L	T	P	C
EID 1201	**NETWORK ANALYSIS AND SYNTHESIS**				
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To explore various network reduction techniques and theorems.

COB2: To introduce the concept of transient analysis of first and second order linear circuits.

COB3: To explore the concept of two port networks.

COB4: To introduce the elements of network synthesis.

COB5: To introduce basic theory about the design of filters and attenuators.

MODULE I NETWORK THEOREMS FOR DC AND AC NETWORKS 9

Superposition, Thevenin's, Norton's, Maximum Power Transfer and Reciprocity theorems

MODULE II TRANSIENT ANALYSIS OF FIRST AND SECOND ORDER LINEAR CIRCUITS 9

Transient response of RL, RC and RLC circuits using Laplace transform for DC input and A.C. sinusoidal input.

MODULE III TWO PORT NETWORKS 9

Network terminals and ports: – Z-parameters, T-equivalent of reciprocal network, Y-parameter, π-equivalent of reciprocal networks, h-parameters and g-parameters.

MODULE IV TRANSFER FUNCTION SYNTHESIS 9

Reliability of one port network – Hurwitz polynomials and properties – Positive Real functions and properties – Synthesis of RL, RC and LC one port networks using Foster and Cauer methods.

MODULE V DESIGN OF FILTER 9

Design of filters -Low pass filters, high pass filters, band pass filters, band reject filters, Butterworth filters, m-derived filters, constant k-filters

L – 45; Total Hours – 45

TEXT BOOKS:

1. Franklin F.Kuo, "Network Analysis and Synthesis" Wiley India Pvt Ltd, New Delhi, 5th Edition, 2012.
2. Hayt.W.H.,Kemmerly.J.E., Durbin.S.M., "Engineering Circuit Analysis", 7th Edition, Tata McGraw Hill, New Delhi, 2010.

REFERENCES:

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", 5th edition, McGraw Hill Education (India) Private Limited, 2015.
2. M. E. Van Valkenburg and T.S. Rathore, "Network Analysis", Revised Third Edition, Pearson Education India, 2019.
3. Edminister, J.A. and Nahvi, M., "Electric Circuits", 6th Edition, Schaum'sOutline series, McGraw-Hill, New Delhi, 2013.

COURSE OUTCOMES:

CO1: Solve the electrical circuits using the network theorems.

CO2: Understand the transient analysis of first and second order linear networks.

CO3: Capable of determining Z, Y, h and ABCD parameters.

CO4: Ability to realize RL, RC and LC networks using Cauer and Foster form.

CO5: Capable of designing different types of filters and attenuators

Board of Studies (BoS) :
16th BoS meeting held on 23.6.2021

Academic Council:
17th meeting of Academic council held on 15.7.2021

	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	H	L	L					L	L	L	L	M	
CO2	L	L	L	L	L					L	L	L	L	H	
CO3	M	M	L	L	L					L	L	L	M		
CO4	M	M	L	L	L					L	L	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 : The understanding of solving the electrical circuits promotes lifelong learning opportunities.

EID 1202	**ELECTRON DEVICES**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

SDG: 4, 9, 12

COURSE OBJECTIVES:

To acquaint the students with construction, theory and characteristics of the following

COB1: P-N Junction Diode, LED, LCD and Opto-electronic devices

COB2: Bipolar Junction Transistor

COB3: Field Effect Transistor

COB4: Rectifier, Filters and Regulators

MODULE I SEMICONDUCTORDIODE AND DISPLAY DEVICES 8

Construction, working, characteristics and Applications**:** PN junction diode, Energy band diagram of PN junction diode, Biasing, Zener diode- Avalanche breakdown, Zener break down, Tunnel diode, Schottky Diode, Gunn Diode, LED, LCD, Solar cell.

MODULE II BIPOLAR JUNCTION TRANSISTORS 7

NPN -PNP -Operations-Early effect -Current equations — Input and Output characteristics of CE, CB, CC – Hybrid -π model – h-parameter model, Ebers Moll Model- Gummel Poon-model, Multi Emitter Transistor.

MODULE III FIELD EFFECT TRANSISTORS 7

JFETs — Drain and Transfer characteristics, -Current equations -Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics — Comparison of MOSFET with JFET.

MODULE IV POWER SUPPLY DEVICES 8

Half Wave and Full Wave Rectifier, Inductor filter, Capacitor filter, L- section filter, p-section filter, Multiple L- section and Multiple π section filter and comparison of various filter circuits in terms of ripple factors. Zener diode characteristics-Zener Reverse characteristics – Zener as regulator.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jacob Millman & Christos C. Halkias, “Electronic Devices and Circuits” Tata McGraw-Hill, 1991.
2. Millman J and Gabriel A, “Microelectronics”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 3rd Edition, 2000.

REFERENCES:

1. Thomas. L. Floyd, Electronic Devices- Elctron flow Version- 9th Edition, Pearson Education- Prentice Hall of India, 2012
2. S. Salivahanan, N. Sureshkumar and A. Vallavaraj, Electronic Devices and Circuits, TMH, 2008.
3. S.M. Sze, Semiconductor Devices – Physics and Technology, 2nd Edn., John Wiley, 2002.
4. Donald A Neaman, Semiconductor Physics and Devices, Fourth Edition, Tata Mc Graw-Hill Inc. 2012.

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1: Understand the basics of semiconductor, Optoelectronic Devices and their working mechanism.

CO2: Analyze the working of BJT (Bipolar Junction Transistor) using different models.

CO3: Acquire knowledge in different types of FET (Field Effect Transistor).

CO4: Gain knowledge about the working of Rectifiers, Filters and Regulators and its applications.

Board of Studies (BoS) :
16th BoS meeting held on 23.6.2021

Academic Council:
17th AC meeting held on 15.7.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2	PSO3
CO1	H	M					L						L		
CO2	M	L										L	L		
CO3	M	L										L	L		
CO4	H	M	H								H		L	L	

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

SDG 4: To give quality education in basic electronics.

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

SDG 12: To design low power consuming basic electronic circuits.

The course gives in-depth knowledge in basic electronic components which improves the understanding of advanced electronics in future this results in improving quality of education.

This course enlightens students in promoting industrial applications of electronic components.

The holistic understanding of electronic components leads to construction of efficient DC power supply.

		L	T	P	C
EID 1203	**ELECTRON DEVICES AND NETWORK SYNTHESIS LABORATORY**	**L**	**T**	**P**	**C**
SDG: 12		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To provide in depth knowledge on the working of basic Semiconductor devices and DC power supply.

COB2: To get practical experience on electric circuits and verification of theorems.

COB3: To gain practical knowledge about series and parallel electric circuits.

COB4: To get exposed to Pspice/ Matlab/ Scilab to simulate various electric circuits

PRACTICALS

List of Experiments:

1. Characteristics of PN Junction Diode and Zener Diode
2. CE, CB configuration of BJT
3. JFET and MOSFET Characteristics
4. Half wave and Full wave rectifier with and without filter
5. Design of DC power supply
6. Experimental verification of network theorems (Thevenin's, Norton's, Superposition, maximum power transfer Theorem and reciprocity theorem).
7. Experimental determination of time constant of series RL, RC and RLC circuits.
8. Determination of frequency response of current in RLC circuit with sinusoidal ac input
9. Design and Simulation of series and parallel resonance circuits.
10. Determination of z and h parameters for a network and computation of Y and ABCD parameters.
11. Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values.

P – 30; Total Hours – 30

TEXT BOOKS:

1. Franklin F.Kuo, "Network Analysis and Synthesis" Wiley India Pvt Ltd, New Delhi, 5th Edition, 2012.
2. Geert van der Plas, Georges Gielen Willy Sansen, "A Computer-Aided Design and Synthesis Environment for Analog Integrated Circuits", Kluwert Academic Publishers, United States, 2002. (ISBN: 978-0-7923-7697-2).

REFERENCES:

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", 5th edition, McGraw Hill Education (India) Private Limited, 2015.

2. M. E. Van Valkenburg and T.S. Rathore, “Network Analysis”, Revised Third Edition, Pearson Education India, 2019.
3. Dennis Fitzpatrick, “Analog Design and Simulation using OrCAD Capture and PSpice”, Newnes, 2nd edition, United Kingdom, 2017.
4. Karavokyros, L.,Katsiotis, N., Tzanis, E., Batis, G., and Beazi-Katsioti, M., “The Effect of Mix-Design and Corrosion Inhibitors on the Durability of Concrete”, Journal of Materials Science and Chemical Engineering, Vol. 8, pp. 64-77, 2020. https://doi.org/10.4236/msce.2020.84005
5. http://www.leanconstruction.org/readings.html
6. Harvard University. *Soft robotic gripper for jellyfish* [Video], 2019. https://www.youtube.com/watch?v=guRoWTYfxMs

COURSE OUTCOMES:

CO1: Understand and apply circuit theorems and concepts in engineering applications.

CO2: Familiarize with electrical simulation software

Board of Studies (BoS) :
16th BoS meeting, on 23.6.2021

Academic Council:
17th AC meeting held on 15.7.2021

	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	H	H	M	M					L	H	H	H	M	
CO2	M	M	M	M	H					L	H	H	L		

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

SDG 12: Ensure sustainable consumption and production patterns

Statement: The practical knowledge on solving network theorems, developing electrical circuits will ensure sustainable consumption and production

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

.

Board of Studies (BoS) :

11th BoS of Chem held on 17.06.2021

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	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

		L	T	P	C
EID 2101 **SDG : 4,9**	**DIGITAL ELECTRONICS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

- To study various number systems, Boolean expressions and simplifications
- To study, analyze and design of the combinational logic circuits for arithmetic operations
- To study, analyze and design of sequential circuits, registers and counters
- To study, analyze and design asynchronous sequential circuits
- To learn memory components, PLA, PAL and the basic of HDL

MODULE I BOOLEAN ALGEBRA AND LOGIC GATES 9

Review of number systems – Arithmetic operations in binary number system – Binary codes – Boolean algebra and rules – Boolean functions: Simplifications: standard / canonical form of SOP and POS, Simplification using Karnaugh Map and Tabulation methods – Basic logic gates – Universal gates.

MODULE II COMBINATIONAL LOGIC 9

Combinational circuits – Analysis and design procedures – Circuits for arithmetic operations: Full adder, Carry look-ahead adder, binary adder, adder-subtractor, comparators – Code conversion – Decoders and Encoders – Multiplexers and De-multiplexers. Realization of combinational logic circuits using decoders and multiplexers.

MODULE III SYNCHRONOUS SEQUENTIAL LOGIC 12

Sequential circuits – Flip flops: Triggering, types, conversions, excitation tables – Analysis and design procedures – State reduction and state assignment – Shift registers – Counters: MOD counters, up-down counter, ring counters – Sequence detectors.

MODULE IV ASYNCHRONOUS SEQUENTIAL LOGIC 12

Design of Asynchronous sequential circuits: state diagram; state assignment,state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

MODULE V MEMORY AND PROGRAMMABLE LOGIC DEVICES 9

RAM and ROM types – Memory decoding - Programmable logic devices: Programmable Array Logic – Programmable Logic Array –CPLD - FPGA – Hardware Description Language: Introduction - HDL for combinational logic circuits - HDL for Sequential logic circuits.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Thomas L. Floyd, “Digital Fundamentals”, 11th Edition, Prentice Hall, 2015.

2. Donald P Leach, Albert Paul Malvino and GoutamSaha, “Digital Principles and Applications”, 8 th Edition, McGraw-Hill, 2014.
3. Morris Mano, M. and Michael D. Ciletti, “Digital Design with an Introduction to the Verilog HDL”, 5th Edition, Prentice Hall, 2013

REFERENCES:

1. Fundamentals of Logic Design, “Charles H Roth and Larry L KInney”, 6th Edition, Cengage Learning, 2013
2. John F. Wakerly, “Digital Design Principles and Practices”, Pearson Education, 2008
3. NPTEL video lectures on “Digital systems Design”,Prof. D. Roychoudhury IIT Kharagpur

COURSE OUTCOMES:

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

- Apply mathematical knowledge of number systems, Boolean expressions / functions to simplify and realize logical expression, understand and contrast different logic families
- Analyze and design combinational logic circuits.
- Analyze and design of sequential logic circuits.
- Analyze and design synchronous and asynchronous logic circuits
- Understand memory types and get exposed to building blocks of different Programmable Logic devices.

Board of Studies (BoS):

17th BoS of EIE held on 16.12.21

Academic Council:

18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	M	H	L	M	L	M	L	M	-	L	M	H	M	-
CO2	H	M	H	L	H	L	M	L	M	-	L	M	H	M	-
CO3	H	M	H	L	H	L	M	L	M	-	L	M	H	M	-
CO4	H	M	H	L	M	L	M	L	M	-	L	M	H	M	-
CO5	H	M	H	L	H	L	M	L	M	-	L	M	H	M	-

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

SDG 4: Quality Education

This course ensures complete knowledge about digital electronics and promotes lifelong learning opportunities.

SDG 9: Industry, Innovation and Infrastructure

They course play a key role in providing the basic knowledge for designing logical circuits which is used to promote the new technologies that generate employment and income.

		L	T	P	C
EID 2102	**LINEAR INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
SDG: 9,12		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

COB1: To study the characteristics and applications of Operational Amplifier

COB2: To build Filters and Waveform generator circuits

COB3: To acquaint the students with construction and theory of ADC and DAC

COB4: To design various applications of 555 timers and PLL

COB5: To study the working of AD623, LM78XX, LM317

MODULE I CHARACTERISTICS OF OPAMP 8

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting Amplifiers, summer, differentiator and integrator-V/I & I/V converters, Instrumentation amplifier and its applications for transducer Bridge.

MODULE II ACTIVE FILTERS AND WAVEFORM GENERATORS 10

First and Second order active filters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector.

MODULE III ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 10

Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2 Ladder type, Voltage Mode and Current-Mode R – 2R Ladder types – switches for D/A converters high speed sample-and-hold circuits, A/D Converters – specifications – Flash type – Successive Approximation type – Single Slope type – Dual Slope type – A/D Converter using Voltage-to-Time Conversion – Over-sampling A/D Converters, Sigma – Delta converters.

MODULE IV TIMER ICs, PHASE LOCKED LOOPS AND ANALOG MULTIPLIERS 9

Functional block, characteristics of 555 Timer and its PWM application — IC-566 voltage-controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

MODULE V SPECIAL ICs, VOLTAGE REGULATORS AND LINEAR POWER SUPPLY SYSTEMS 8

AD623 Instrumentation Amplifier and its application as load cell weight measurement — IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply — LM317, 723 Variability voltage regulators.

PRACTICALS **30**

1. Design of Inverting and Non-inverting Amplifiers, summer, differentiator and integrator.
2. Design of comparators and Instrumentation amplifier.
3. Design of first and second order active filters.
4. Design of Analog to Digital Converter.
5. Design of Digital to Analog Converter.
6. Any two applications of 555 timer.
7. Design of Load cell.

L - 45 ; P - 30 ; TOTAL HOURS - 75

TEXT BOOKS:

1. Ramakant A. Gayakwad, “Op-amps and Linear Integrated Circuits”, 4th edition, Pearson Education, 2019 / PHI.

2. Sergio Franco, —Design with Operational Amplifiers and Analog Integrated Circuits‖, 4th Edition, Tata Mc Graw-Hill, 2018.

REFERENCES:

1. D. Roy Choudhary, Shail B. Jain, “Linear Integrated Circuits”, Fifth edition, New Age, 2018.
2. S. Salivahanan & V.S. Kanchana Bhaskaran, —Linear Integrated Circuits‖, TMH,2nd Edition, 4th Reprint, 2018.
3. Gray and Meyer, —Analysis and Design of Analog Integrated Circuits‖, Wiley International,5th Edition, 2019.

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

CO1: Create a basic amplifier and analog arithmetic circuits using Op-amp.

CO2: Design a filter circuit to filter the specified frequency and a circuit to generate various waveforms.

CO3: Evaluate the working of different types of ADC and DAC.

CO4: Formulate Astable and Bistable multivibrator using 555.

CO5: Create an Instrumentation amplifier and Voltage regulator.

Board of Studies (BoS):

17th BoS of EIE held on 16.12.21

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	L	L	L	L	L	L	L	L	L	L	L	M	L
CO2	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO3	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO4	M	M	M	L	L	L	L	L	L	L	L	L	L	L	L
CO5	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L

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

SDG 9: Industry, Innovation and Infrastructure.
Statement: This course enlightens students in promoting industrial applications of electronic components.

SDG 12: Responsible, Consumption and Production.
Statement: The holistic understanding of electronic components leads to construction of efficient DC power supply.

		L	T	P	C
EID 2103	**TRANSDUCERS ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 4,8,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To give knowledge about basic measurement Systems and Units & standards.

COB2: To provide an introductory knowledge about transducers.

COB3: To give adequate knowledge about the characteristics of transducer.

COB4: To have in depth knowledge about Resistive, capacitive and inductivetransducers.

COB5: To introduce basic knowledge about other types of transducers like Piezoelectric, magnetostrictive transducers and smart transducers.

MODULE I SCIENCE OF MEASUREMENT 7

Units and Standards - Importance of measurement – Functional blocks of a measurement system - Errors - Classification of errors – Error analysis – Statistical methods – Odds and uncertainty and its analysis- Calibration methods.

MODULE II CLASSIFICATION & CHARACTERISTICS OF TRANSDUCERS 9

Definition of transducers - classification of transducers - Static characteristics : Accuracy, precision, resolution, sensitivity, linearity, threshold, hysteresis, bias, range, span and loading effect - Dynamic characteristics: Mathematical model of transducer – Zero, I and II order transducers - Response to impulse, step, ramp , sinusoidal and nonlinear inputs.

MODULE III VARIABLE RESISTANCE TRANSDUCERS 7

Principle of operation, construction details, characteristics and applications of resistance potentiometer, strain gauge, resistance thermometer, thermistor, hotwire anemometer, piezo-resistive sensor and humidity sensor.

MODULE IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 8

Inductive Transducers: Principle of operation, Construction details,-Induction potentiometer – variable reluctance transducers – EI pick up – LVDT– synchro – MicroSyn. Capacitive transducers: Principle of operation, Construction details three types - capacitor microphone – capacitive pressure sensor - proximity sensor.

MODULE V OTHER TRANSDUCERS 7

Piezoelectric transducer – Hall Effect Transducers- magnetostrictive transducer – Introduction to IC sensors -Thick & Thin film sensors (Bio Sensor & Chemical sensor), Introduction to MEMS – Digital transducers– Smart Transducer – Fiber optic transducer- Introduction to nano materials - Nano transducers – different types of nano position sensors - nano actuators – applications.

L – 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1. Doebelin E.O, and Manik D.N., "Measurement Systems – Applications and Design", Tata McGraw Hill, New York, 2011.
2. Neubert, H.K.P., "Instrument Transducers – An introduction to their Performance and Design", Oxford University Press, Cambridge, 2003

REFERENCES:

1. A.K. Sawhney, "A course in Electrical & Electronic Measurement and Instrumentation", Dhanpat Rai and Co (P) Ltd., 2014.
2. D. Patranabis, "Sensors and Transducers", Prentice Hall of India, 2010.
3. John P. Bentley, "Principles of Measurement Systems", 3rd edition, Pearson Education,2004.
4. D.V.S Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2010.
5. Renganathan S., "Transducer Engineering", Allied Publishers, New Delhi, 2003.

COURSE OUTCOMES:

CO1: Carry out error analysis and find the probable error in a measurement system

CO2: Analyze the static and dynamic characteristics of the transducers

CO3: Compare the construction, characteristics and operation of different variable resistance transducers and choose them for specific application

CO4: Select the appropriate variable inductance and capacitive transducers for industrial applications

CO5: Evaluate the characteristics and applications of piezoelectric, magnetostrictive, digital, and smart transducers and nano transducers and select them for specific industrial applications.

Board of Studies (BoS) :
17th BoS of EIE held on 16.12.21

Academic Council:
18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	-	M	L	L	-	-	-	L	L	H	L	-
CO2	M	M	L	-	M	L	L	-	-	-	L	L	M	L	-
CO3	M	M	M	-	M	L	L	-	-	-	L	L	M	M	-
CO4	H	M	M	-	M	L	L	-	-	-	L	L	H	M	-
CO5	L	L	L	-	L	L	M	H	H	H	H	L	-	-	-

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

SDG 4: Quality Education

The entire arrangement of the course syllabus provides quality education.

SDG 8: Decent work and economic growth

The study of this course help to identify sensors and transducers and measurement systems which provides economic growth and decent work

SDG 9: Industry, Innovation & Infrastructure

New technological application to transducer and measurement systems helps to innovate, improve the industry and infrastructure of the nation

SDG 12: Responsible consumption and production

The optimal usage of raw material and production is key factor in any process industries and this course provides the responsible consumption and production.

EID 2104	**ELECTRICAL, ELECTRONIC AND PHYSICAL MEASUREMENTS**	**L**	**T**	**P**	**C**
SDG: 4,8,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce the student to the various measurement of electrical parameters

COB2: To provide the analog and digital meters used for measurements

COB3: To bring out the importance of bridges for measurement of electrical parameters

COB4: To introduce knowledge of signal generators and analyzers

COB5: To provide awareness of measurement using Oscilloscopes.

MODULE I MEASUREMENT OF ELECTRICAL PARAMETERS 9

Galvanometers – Ballistic, D' Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type, Electrodynamometer type wattmeter – Theory & its errors – Methods of correction – LPF wattmeter – Phantom loading.

MODULE II ANALOG AND DIGITAL METERS 12

D.C, A.C voltmeters, ammeters - multimeter, Energy meter, power meter, Q-meter, true RMS meter, vector impedance meter, vector voltmeter, component measuring instrument, Electronic ohm meter, Differential Voltmeter - Instrument Transformers, Digital Voltmeters, Digital Multimeter, Digital Frequency meter, Electronic counter, Digital Tachometer.

MODULE III BRIDGES 9

DC Bridges-Wheatstone bridge – Kelvin double bridge - A.C bridges – Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge – Hay's bridge – Schering bridge—High voltage Schering bridge – Anderson bridge – Universal Impedance bridge– Bridge sensitivity - Errors, Wagner Earthing Device.

MODULE IV SIGNAL GENERATORS & ANALYZERS 8

Sine wave generator – Frequency synthesized sine wave generator – Sweep frequency generator, pulse and square wave generator—Triangular wave generator Wave analyzer – Applications – Harmonic distortion analyzer –Total harmonic distortion analyzer- spectrum analyzer.

MODULE V OSCILLOSCOPE 7

General purpose oscilloscope - Specification of Oscilloscope - Special oscilloscopes: Digital Storage oscilloscopes – Sampling oscilloscope – Comparison between Analog and Digital oscilloscopes.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Golding E.W., and Widdis F. C., "Electrical Measurements and Measuring Instruments", 5th Edition, Reem Publications,2011.
2. Sawhney A.K., "Electrical & Electronic Measurements and Instrumentation", Dhanpath Rai & Co (P) Ltd, 2014.

REFERENCES:

1. Gupta J.B., "A Course in Electronic and Electrical Measurements and Instrumentation", S.K. Kataria & Sons, Delhi, 2008.
2. Kalsi H.S., Electronic Instrumentation, McGraw-Hill Education, New Delhi, 2010.
3. Martia Reissland U., "Electrical Measurement", New Age International (P) Ltd., 2001.
4. Oliver B.M., and Cage J.M., "Electronic Measurements & Instrumentation", McGraw Hill International Edition, 2009.
5. Bell D. A., "Electronic Instrumentation and Measurements", Prentice Hall of India, 2010.

COURSE OUTCOMES:

On completion of this course the student will be able to

CO1: choose proper meters for measurement of electrical parameters

CO2: suggest / Identify typical analog and digital meters for specific applications

CO3: measure electrical parameters using bridges

CO4: generate and analyze different test signals using analyzers

CO5: choose proper Oscilloscopes during measurements for different applications

Board of Studies (BoS) :
17th BoS of EIE held on 16.12.21

Academic Council:
18th AC 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	L	-	L	L	-	L	L	L	L	L	L	H	L	-
CO2	M	M	L	L	L	-	L	L	L	L	L	L	M	L	-
CO3	M	M	L	L	L	-	L	L	L	L	L	L	H	L	-
CO4	M	M	L	L	M	-	L	L	L	L	L	L	H	L	-
CO5	H	M	M	L	M	-	L	L	L	L	L	L	H	L	-

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

SDG 4: Quality Education
The entire arrangement of the course syllabus provides quality education

SDG 8: Decent work and economic growth
The study of this course help to identify measurement system and monitoring devices which provides economic growth and decent work

SDG 9: Industry, Innovation & Infrastructure
New technological application to measurement systems helps to innovate, improve the industry and infrastructure of the nation

		L	T	P	C
EID 2105	**DIGITAL ELECTRONICS LABORATORY**	**L**	**T**	**P**	**C**
SDG: 4, 9,12		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To study Boolean function and implementation using basic gates.

COB2: To design and implement combinational and sequential circuits using basic gates and specialized ICs

List of Experiments:

1. Realization of basic gates using universal logic gates
2. Design and implementation of Adders and Subtractors using logic gates.
3. Design and verification of code converters using logic gates
4. To exhibit the use of IC 7483 as 4–bit binary Adder/ Subtractor and BCD Adder
5. To design and implement a 2 Bit Magnitude Comparator using logic gates and 8 Bit Magnitude Comparator using IC 7485
6. Design and implementation of encoder and decoder using logic gates and study of IC 7445 and IC 74154
7. Design and implementation of Multiplexer and De-multiplexer using logic gates and study of IC 74150 and IC 74154
8. Implementation and study of SR , JK, D, T Flip Flops.
9. Design and implementation of 3-Bit synchronous counter
10. Construction and verification of Asynchronous counters
11. Implementation of universal shift registers / Modulo counters using ICs.
12. Design of combinational / sequential logic circuit for instrumentation application such as Alarm / Interlock.

P – 30; TOTAL HOURS – 30

COURSE OUTCOMES:

On Completion of this course the student will be able to

CO1: design, implementation and operation of combinational circuits like adders, subtractors, code converters, multiplexer – demultiplexer, encoder – decoder and magnitude comparator.

CO2: design, implementation and operation of sequential circuits like flip flops, counters and shift registers.

CO3: solve engineering problems in the area of digital logic circuit.

Board of Studies (BoS) :
17th BoS held on 16.12.21

Academic Council:
18th AC held on 24.02.2022

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

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

SDG 4: Quality Education

This course is used to substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

Goal 9: Industry, Innovation and Infrastructure

It is used to promote inclusive and sustainable industrialization by significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries.

GOAL 12: Responsible Consumption and Production

It is used to strengthen the scientific and technological capacity to move towards more sustainable patterns of consumption and production.

EID 2106	**TRANSDUCERS AND MEASUREMENTS LABORATORY**	**L**	**T**	**P**	**C**
SDG: 4,8,9		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To provide practical knowledge in sensors and transducers.

COB2: Emphasis on static, dynamic characteristics and response of various transducers like resistive, inductive and capacitive type.

COB3: To measure resistance, inductance and capacitance using bridge circuits

COB4: To calibrate the electrical instruments like Wattmeter, Energy meter, Ammeter and Voltmeter.

COB5: To provide practical knowledge in sensors and transducers.

PRACTICALS

List of Experiments:

1. Characteristics of LDR and phototransistor
2. Characteristics of Temperature Transducer (RTD, thermocouple and thermistor)
3. Characteristics and signal conditioning of Strain Gauge and Load cell
4. Characteristics of Capacitive Transducer
5. Characteristics of Position transducer (Potentiometer- Loading Effect of potentiometer, LVDT)
6. Characteristics of Hall Effect Voltage Sensor
7. Characteristics of Piezoelectric Transducer
8. Step response of RTD and thermocouple
9. Response of Digital transducer
10. Measurement of resistance using Kelvin Double Bridge and Wheatstone Bridge
11. Measurement of Capacitance using Schering Bridge and Anderson Bridge for inductance measurement
12. Calibration of Voltmeter and Ammeter using potentiometer
13. Calibration of single phase Energymeter and Wattmeter

P – 30 ; TOTAL HOURS – 30

REFERENCES:

1. Sawhney A.K., “Electrical & Electronic Measurements and Instrumentation”, Dhanpath Rai & Co (P) Ltd, 2014.
2. Gupta J.B., “A Course in Electronic and Electrical Measurements and Instrumentation”, S.K. Kataria & Sons, Delhi, 2008

COURSE OUTCOMES:

After completion of this course the students will able to

CO1: understand the concept of measurement and about error

CO2: analyze the static and dynamic characteristics of a transducer

CO3: get the knowledge in characteristics of various transducers like resistive, inductive and capacitive type.

CO4: use transducer for Instrument and control systems applications.

CO5: know to work as a team to execute any task

Board of Studies (BoS):
17th BoS of EIE held on 16.12.21

Academic Council:
18th AC held on 24.02.2022

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

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

SDG 4: Quality Education
The entire arrangement of the course syllabus provides quality education

SDG 8: Decent work and economic growth
The study of this course help to identify sensors and transducers and measurement systems which provides economic growth and decent work

SDG 9: Industry, Innovation & Infrastructure
New technological application to transducer and measurement systems helps to innovate, improve the industry and infrastructure of the nation

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

COURSE OBJECTIVES:

COB1:To enable them to make effective business presentations

COB2:To train them to participate in group discussions

COB3: To enhance the problem-solving skills

COB4: To train students in solving analytical problems

MODULE I ORAL DISCOURSE 07

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

MODULE II VERBAL COMMUNICATION 08

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

MODULE III BASIC NUMERACY 08

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

MODULE IV ANALYTICAL COMPETENCY 07

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

L – 30; TOTAL HOURS 30

REFERENCES:

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
2. Swan, Michael (2005). Practical English Usage, Oxford University Press
3. Bhattacharya. Indrajit (2008). An Approach to Communication Skills, DhanpatRai& Co., (Pvt.) Ltd. New Delhi.
4. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
5. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
6. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
7. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive

Examinations, 3e, Pearson India , 2016

8. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
9. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

COURSE OUTCOMES:

CO1: Make effective business presentations

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

CO3: To apply the various problem-solving techniques

CO4: Understand and solve aptitude problem

Board of Studies (BoS) :

13th BoS of the Department of English held on 17.6.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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

EID 2201	**INDUSTRIAL INSTRUMENTATION – I**	**L**	**T**	**P**	**C**
SDG: 4, 9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To make the students understand the various measuring techniques for force, torque, speed, acceleration, vibration, density, level, temperature and pressure

COB2: To make the students understand the construction, working principle, application and selection of various transducers used for the measurement of force, torque and speed.

COB3: To give the students knowledge about various methods of acceleration, vibration and density measurement practiced in industries.

COB4: To provide knowledge on different pressure and temperature measurement techniques and its selection.

COB5: To learn about measuring high temperatures with pyrometers.

MODULE I MEASUREMENT OF FORCE, TORQUE AND VELOCITY 8

Different types of load cells: Magneto-elastic load cells, Strain gauge load cell, piezoelectric load cell– Different methods of torque measurement: Strain gauge, relative regular twist. Speed measurement: Revolution counter, Capacitive tacho, drag cup type tacho, D.C. and A.C. tacho generators – Stroboscope.

MODULE II MEASUREMENT OF ACCELERATION AND VIBRATION 8

Accelerometers: LVDT, piezoelectric, strain gauge and variable reluctance type accelerometers – Mechanical type vibration instruments – Seismic instrument as an accelerometer and vibrometers – Calibration of vibration pickups.

MODULE III PRESSURE MEASUREMENT 10

Modules of pressure – Manometers – Different types – Elastic type pressure gauges: Bourdon tube, bellows, Diaphragms – Electrical methods: Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor - Measurement of Vacuum: McLeod gauge– Thermal conductivity gauges - Ionization gauge – Testing, calibration and selection of pressure gauges – Dead weight tester. Differential Pressure Transmitter

MODULE IV TEMPERATURE MEASUREMENT 9

Definitions and standards-Different types of filled in system thermometer -Bimetallic thermometer – Electrical methods of temperature measurement, signal conditioning of industrial RTD and their characteristics - three lead and four lead RTD. Types of thermocouples - Response of thermocouple -Fabrication of industrial thermocouples – signal containing of thermocouples - commercial circuits for cold junction compensation -Thermograph, Temperature switches and thermostats smart temperature transmitter and its advantages.

MODULE V HIGH TEMPERATURE MEASUREMENTS 8

Radiation method of Temperature measurements - Radiation fundamentals, Total Radiation and selective Radiation, Optical Pyrometer-Two colour radiation pyrometers. Fibre optic temperature measurements systems–thermopile-Temperature sensor selection, Installation and Calibration

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Doebellin, E.O. and Manik D.N., "Measurement systems Application and Design", 5th Edition, Tata McGraw Hill Education Pvt. Ltd, 2008.
2. Jones. B.E., "Jones"s Instrument Technology", Vol.2, Butterworth-Heinemann, 4thEdition, Elsevier, 2016.

REFERENCES:

1. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 4th Edition, 2012.
2. Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
3. Eckman D.P., "Industrial Instrumentation", Wiley Eastern Limited, 2016.
4. Singh,S.K., "Industrial Instrumentation and Control", Tata Mc-Graw-Hill Education Pvt. Ltd., 3 rd Edition, New Delhi, 2010.
5. AlokBarua, "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IIT Kharagpur.
6. Jayashankar, V., "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IIT Madras.

COURSE OUTCOMES:

After completion of this course the students will be able to

CO1: compare instruments used for measurement of force, torque, speed, acceleration, vibration, density, level, pressure and temperature.

CO2: select instruments according to the application.

CO3: calibrate measuring instruments.

CO4: design compensation techniques for measuring instruments

CO5: design signal conditioning circuits for various transducers.

Board of Studies (BoS):

17th BoS of EIE held on 16.12.21

Academic Council:

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	M	H	H	M	H	M	L	L	-	M	M	H	H	-
CO2	H	M	H	H	M	H	M	L	L	-	M	M	H	H	-
CO3	H	M	H	M	M	H	M	L	L	-	M	M	H	H	-
CO4	H	M	H	M	M	H	M	L	L	-	M	M	H	H	-
CO5	H	M	H	M	M	H	M	L	L	-	M	M	H	H	-

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

SDG 4: Quality Education

This course is used to substantially increase the number of youth and adults who have technical knowledge about sensors and transducers for employment, decent jobs and entrepreneurship

Goal 9: Industry, Innovation and Infrastructure

The knowledge about various sensors is used to promote inclusive and sustainable industrialization by significantly raise industry’s share of employment and gross domestic product, in line with national circumstances.

GOAL 12: Responsible Consumption and Production

It is used to strengthen the scientific and technological capacity to move towards more sustainable patterns of consumption and production of various sensors

EID 2202	**CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 4,8,9,12		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To prepare the student to understand the open loop and closed loop systems.

COB2: To provide knowledge about mathematical modeling, transfer function model and state variable model.

COB3: To acquaint the student to understand time domain and frequency domain analysis of control systems required for stability analysis.

COB4: To provide the student to learn the compensation technique that can be used to stabilize the control systems.

MODULE I INTRODUCTION TO CONTROL SYSTEM 6

Concept of automatic controls, Open loop and closed loop systems, Feedback control system concepts, Control system components, Introduction to controllers.

MODULE II MODELING OF PHYSICAL SYSTEMS 10

Mathematical model of physical systems - Transfer function models - Mechanical systems and Electrical systems, Block diagram reduction technique, Signal flow graph- Mason's gain formula.

MODULE III TIME DOMAIN ANALYSIS 10

Standard input signals, type & order of the system, first order and second order system response to step, ramp and impulse inputs, time domain specifications, generalized error series, steady state error, System stability: Routh's-Hurwitz Criterion, Root Locus method.

MODULE IV FREQUENCY DOMAIN ANALYSIS 10

Frequency domain specification, Frequency plots - Polar plots, Bode plot, Nichol's Chart, M & N circles, Nyquist stability criterion.

MODULE V DESIGN OF COMPENSATORS 9

Compensators – Introduction - Design Specification – Lag-Lead, Lag & Lead Compensator design using Bode plot technique.

L – 45; T – 15; TOTAL HOURS – 60

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
2. Gopal, M., "Control Systems, Principles and Design", Tata McGraw-Hill Pub. Co., 2nd

Edition, New Delhi, 2012.
3. Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5th Edition, 2010.

REFERENCES:

1. Benjamin C. Ku and Farid Golnaraghi, “Automatic Control Systems”,10th edition McGraw-Hill Education, 2017
2. Richard C.Dorf., Robert H.Bishop., “Modern Control Systems”, Education Pearson, Third Impression 2009.
3. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.

COURSE OUTCOMES:

On completion of the course the student will be able to

CO1: derive the transfer function for the given electrical & mechanical systems.

CO2: obtain the transfer function using block diagram reduction technique and Mason’s gain formula.

CO3: perform time domain analysis for a first and second order systems.

CO4: perform frequency domain analysis using Polar, Bode and Nyquist plots.

CO5: design suitable compensators for the given specifications.

CO6: determine the stability of the system using Root Hurwitz, root locus & Nyquist stability criterion.

CO7: work in teams to complete the given task pertaining to the course.

Board of Studies (BoS):

17th BoS of EIE held on 16.12.21

Academic Council:

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	H	L	L	-	M	L	L	-	-	-	L	L	-	-	M
CO2	H	L	L	-	M	L	L	-	-	-	L	L	-	-	M
CO3	L	L	M	L	M	L	M	-	-	L	M	L	-	L	H
CO4	L	L	M	L	M	L	M	-	-	L	M	L	-	L	H
CO5	H	L	M	L	H	L	M	-	-	L	M	L	-	-	H
CO6	M	L	L	L	M	L	M	-	-	L	M	L	-	L	M
CO7	-	-	-	L	-	-	-	M	H	H	M	-	-	-	L

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

SDG 4: Quality Education

The entire arrangement of the course syllabus provides quality education

SDG 8: Decent work and economic growth

The study of this course improves automation and provides economic growth in industries

SDG 9: Industry, Innovation & Infrastructure

This course will help to in cultivate new technology thereby improving the infrastructure of the nation

SDG 12: Responsible consumption and production

The optimal usage of raw material and production is key factor in any process industries and this course provides the responsible consumption and production

EID 2203	**MICROPROCESSOR AND MICROCONTROLLER**	**L**	**T**	**P**	**C**
SDG: 8, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

During the course the student will be able

COB1: to understand the concepts of 8086 microprocessors.

COB2: to acquire knowledge on interfacing devices.

COB3: to know the concept of 8051 microcontrollers.

COB4: to design simple applications of microcontroller.

COB5: understand the concepts of advanced microcontrollers.

MODULE I INTRODUCTION TO 8086 PROCESSOR 9

8086 architecture- functional diagram, Register organization, memory segmentation, programming model, Memory addresses, physical memory organization, Signal descriptions of 8086–Interrupts, Addressing modes, instruction set, assembler directives. Simple programs involving logical, branch and call instructions.

MODULE II PERIPHERAL INTERFACING 9

Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8237, 8251, 8279, - A/D and D/A converters & Interfacing with 8086,

MODULE III INTRODUCTION TO MICROCONTROLLERS 9

Overview of 8051 microcontroller, Architecture, I/O ports, Memory organization, addressing modes and instruction set of 8051, Simple programs using Assembly and Embedded C.

MODULE IV APPLICATIONS OF 8051 9

Application – Stepper motor control, speed and position control of dc motors, closed loop control of servo motor, control of physical parameters like temp, pressure, flow and level, case study - home protection system, Traffic light control, Smart card application- simple project using 8051.

MODULE V ADVANCED MICROCONTROLLERS 9

Architecture, Memory Organization, I/O Ports, Timers/ Counters of:
LPC 2148 Microcontroller, Aurdino Uno - ATmega328.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Douglas V. Hall, "Microprocessors and Interfacing", Tata McGraw Hill, Revised Third Edition 2017.

2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "THE 8051 MICROCONTROLLER AND EMBEDDED SYSTEMS: USING ASSEMBLY AND C", 2nd Edition, Pearson Education. 12th impression 2018.

REFERENCES:

1. Krishna Kant, "Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096'', PHI, 2007, 7th Reprint, 2017.
2. Kenneth J. Ayala., "The 8051 Microcontroller, 3rd Edition, Thompson Delmar Learning'', 2018.
3. A.K. Ray, K.M. Bhurchandi, "Advanced Microprocessor and Peripherals'', 3rd Edition, Tata McGraw-Hill, 2nd Edition, 2017.
4. ARM System-on-Chip Architecture, Second Edition, by Steve Furber, PEARSON, 2018.
5. Mark Torvalds, "Arduino Programming: Step-by-Step Guide to Master Arduino Hardware and Software" Createspace Independent Pub, 2017.

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

CO1: Program 8086 processors for simple applications.

CO2: Interface external I/O devices with 8086 microprocessors.

CO3: utilize the instructions effectively and develop an assembly language program using 8051.

CO4: Design and develop applications using 8051 Microcontroller.

CO5: Gain knowledge on advanced Microcontrollers.

Board of Studies (BoS):
17th BoS of EIE held on 16.12.21

Academic Council:
18th AC 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	L	L	L	L	L	L	L
CO2	M	L	M	L	L	M	L	L	L	L	L	L	L	L	M
CO3	M	L	L	L	L	L	M	L	L	L	L	M	L	L	L
CO4	M	L	L	L	L	L	L	L	M	L	M	L	M	L	L
CO5	M	L	H	L	L	L	L	L	L	L	M	M	L	L	L

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

SDG 8: Decent work and economic growth.

Statement: This course motivates to design projects addressing the issues faced by industries in their economic growth.

SDG 9: Industry, Innovation and Infrastructure.

Statement: This course enlightens students in promoting industrial applications of programable devices.

EID 2204	**PYTHON FOR INSTRUMENTATION ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To learn the basics of simple data types, expressions with pertinence to python programming

COB2: To learn the control structures of Python programming

COB3: To learn indexing methods, scope of variables used in function

COB4: To acquire programming skills with inheritance concepts

COB5: To describe the various application programming with Python

MODULE I INTRODUCTION TO PYTHON 8

Basic Elements of Python - object, expression and numeric type -variables and assignment types - data types - Input statements - Branching program s-Looping programs -strings - IDE basic syntax – While loop

MODULE II FUNCTIONS AND STRUCTURES 9

Functions and scoping - function definitions - keyword arguments - default values - scoping - specifications - recursion – global variables – modules – tuples – lists – Dictionaries.

MODULE III CLASSES AND OBJECTES 9

Static and Dynamic classes – classes – inheritance – multiple level of inheritance – substitution principles – Encapsulation –Information hiding.

MODULE IV FILES AND EXCEPTION 10

Reading the text files – using parameter and Return value – keyword arguments – Default parameter – accessing dictionary values – handling Expections – Network programming.

MODULE V PYTHON AND MCU APPLICATION 9

Introduction to Raspberry Pi – GPIOs – serial port – SPI interface – I/O modules with Raspberry Pin – WIFI controlled led – Working with ThingSpeak to display sensor's output-Home automation – camera interface.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Zelle,John M.Python Programming: An Introduction to Computer Science.1st ed.Frankin Beedle & Associates ,2003

REFERENCES:

1. Mark Lutz," Learning Python,Powerful OOPs,O'reilly,2011
2. Robert Sedgewick,Kevin Wayne ,Robert Dondero,Intro Programming in Python, Pearson, 2016.
3. Mark J.Guzdial,Barbara Ericson, "Introduction to Computing & Programming in Python,4th Edition Pearson,2015.
4. Budd, Timothy. Exploring Python. McGraw-Hill science, 2009. Science. 1st ed. Franklin Beedle& Associates, 2003.

COURSE OUTCOMES:

CO1: Apply the concepts and techniques of Python in various related fields.

CO2: Form the ontology for different domains and generate the equivalent representations.

CO3: Use various inheritance techniques in various application areas

CO4: Implementing programs in Raspberry pi

CO5: Apply Sensor interfacing techniques and analysis

Board of Studies (BoS):
17th BoS of EIE held on 16.12.21

Academic Council:
18th AC held on 24.02.2022

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

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

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

Statement: Information retrieval can provide organizations with immediate value-while it's important to try to figure out ways to capture tacit knowledge, information retrieval provides a means to get at information that already exists in electronic formats. Thus, learning the various information retrieval techniques helps in promoting inclusive and sustainable industrialization and foster innovation.

MED 2281	THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To study the fundamentals and laws of thermodynamics

COB2: To gain knowledge on power generating machines

COB3: To familiarize about various types of compressors, refrigeration and air conditioning systems

COB4: To learn the fundamental concepts of fluid mechanics

COB5: To acquire knowledge on hydraulic turbines and pumps

MODULE I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9

Basic concepts - Types of thermodynamic systems - Property, state, path and process - Quasi-static process - Work, modes of work -Zeroth law of thermodynamics – Concept of temperature and heat -Concept of ideal and real gases - First law of thermodynamics : Application to closed and open systems -Internal energy - Specific heat capacities – Enthalpy - Steady flow process - Second law of thermodynamics :Kelvin's and Clausius' statements.

MODULE II POWER GENERATING MACHINES 9

Layout of thermal and gas turbine power plants - Combined cycle power plants–Otto cycle, Diesel cycle, Rankine cycle and Brayton cycle: P-V, T-S planes and thermal efficiency - Working of SI and CI engines – Recent trends in IC engines.

MODULE III COMPRESSORS, REFRIGERATION AND AIR CONDITIONING SYSTEM 8

Air compressor: Classifications and working principle - Vapour compression refrigeration system: Working principle and performance calculations, Air conditioning systems: Classifications, working principle- Heat transfer -Modes of heat transfer: Conduction, convection and radiation - Simple problems.

MODULE IV FUNDAMENTALS OF FLUID MECHANICS 9

Introduction - Properties of fluids - Density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and Capillarity - Concept of fluid static pressure, absolute and gauge pressures – Pressure measurements by manometers and pressure gauges.

Types of fluids - Classification of fluid flows -Concepts of streamline and stream tube - Principles of continuity, energy, momentum and Bernoulli's equation – Flow measurement: Orifice meter, venturi meter and pitot tube.

MODULE V HYDRAULIC TURBINES AND PUMPS 10

Turbines**:** Definition and classifications – Impulse and Reaction turbines: Working principles, velocity triangle, work done, specific speed, efficiencies and performance curves

Pumps: Definition and classifications – Centrifugal pump: working principle, velocity triangle, specific speed, efficiency and performance curves – Reciprocating pump: Classifications, working principle

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. Nag. P.K., Engineering Thermodynamics, 5th Edition, TataMcGraw-Hill, 2013
2. Bansal. R.K Fluid Mechanics and hydraulics Machines, Revised 9^{th} edition, Laxmi Publications (P) Ltd, New Delhi, 2015.

REFERENCES:

1. YunusCengel and Michael Boles, Thermodynamics: An Engineering Approach, NinthEdition –Tata McGraw Hill, 2019
2. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi, 2017
3. Kumar.K.L., “Engineering Fluid Mechanics “, Eurasia Publishing House(P) Ltd, New Delhi, Eightedition, 2014.
4. White, F.M., Fluid Mechanics”, Tata McGraw Hill, 8^{th} Edition, NewDelhi-2016

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: apply the fundamentals of thermodynamics to quantify energy transfer.

CO2: describe and evaluate the performance of power generating machines

CO3: demonstrate the various types of compressors, refrigeration and air conditioning systems

CO4: explain the fundamental concepts of fluid mechanics

CO5: analyze the performance of hydraulic turbines and pumps

Board of Studies (BoS):

17^{th} BoS of EIE held on 16.12.21

Academic Council:

18^{th} AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	H	M	L		M		M					L			
CO2	H	M	L		M		M					L			
CO3	H	M	L		M		M					L			
CO4	H	M	L		M		M					L			
CO5	H	M	L		M		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 understanding of thermodynamic and fluid mechanics principles enables to design and develop sustainable thermal and fluid power systems.

EID 2205	**INDUSTRIAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 4, 9,12	**LABORATORY- I**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To provide good hands-on experience on industrial instruments.

COB2: To familiarize with pressure Instruments, vacuum Instruments, pyrometers.

COB3: They may able to tackle any problem when working in core industry.

COB4: To expose the students pertaining to various lab instruments which they will come across in the industry.

LIST OF EXPERIMENTS

1. Measurement of Pressure using Bourdon tube.
2. Measurement of acceleration, velocity displacement using Accelerometer.
3. Torque measurement.
4. Vacuum pressure measurement
5. Measurement of temperature using IR thermometer and IC sensor
6. Measurement of Absorbance and Transmittance of Test solutions using UV- Spectrometer
7. Speed control of stroboscope
8. Signal conditioning of RTD
9. Cold junction compensation of thermocouple.
10. Radiation pyrometer.
11. Blood pressure measurement, ECG and Oximetry
12. Study on industry standards
13. Study on Three way and Five-way manifold

P – 30; TOTAL HOURS – 30

COURSE OUTCOMES:

After completion of this course the students will be able to

CO1: test the characteristics of various pressure and speed measuring instruments

CO2: estimate the concentration of unknown substance using analytical instruments

CO3: design, implementation and testing of temperature measuring instruments

CO4: test the characteristics of health care instruments

CO5: Interpret the results of analysis and draw meaningful conclusions

Board of Studies (BoS):	**Academic Council:**
17th BoS of EIE held on 16.12.21	18th AC held on

24.02.2022

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

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

SDG 4: Quality Education

This course is used to substantially increase the number of youth and adults who have technical knowledge about sensors and transducers for employment, decent jobs and entrepreneurship.

Goal 9: Industry, Innovation and Infrastructure

The knowledge about various sensors is used to promote inclusive and sustainable industrialization by significantly raise industry's share of employment and gross domestic product, in line with national circumstances.

GOAL 12: Responsible Consumption and Production

It is used to strengthen the scientific and technological capacity to move towards more sustainable patterns of consumption and production of various sensors

EID 2206	**MICROPROCESSOR AND MICROCONTROLLER LABORATORY**	**L T P C**
SDG: 4, 8, 9		**0 0 2 1**

COURSE OBJECTIVES:

COB1: To know the concept of 8085 microprocessors.

COB2: To know the concept of 8051 microcontrollers.

COB3: To acquire knowledge on interfacing devices.

COB4: To learn about simple applications of microcontroller.

COB5: To familiarize with advanced microcontrollers.

LIST OF EXPERIMENTS:

1. Arithmetic operations using 8086
    a. Addition and subtraction of 8-bit numbers
    b. Addition and subtraction of 16-bit numbers
    c. Multiplication and division of 8-bit numbers
    d. To find largest and smallest number in a number series
    e. To arrange the number series in ascending and descending order.
2. Arithmetic operations using 8051
    a. Addition and subtraction of 8-bit numbers
    b. Addition and subtraction of 16-bit numbers
    c. Multiplication and division of 8-bit numbers
    d. To find largest and smallest number in a number series
    e. To arrange the number series in ascending and descending order.
2. Logical operations using 8051.
3. To transfer a block of data from one memory zone to the others.
4. Stepper motor interfacing with 8051
    a. for full and half step rotation
    b. for rotating motor in clockwise and anticlockwise direction
5. Interfacing of D/A converter MODULEs with 8051 to generate the following waveform and to measure the time period and frequency of each waveform.
    a. Saw tooth waveform
    b. Triangular waveform
    c. Square waveform
6. Interfacing traffic light control system
7. Interface 8279 with 8051 to perform the following functions

a. To display different alphabets and numbers in the 7-segment display

b. to read various keys form the keyboard

8. Study of Arduino UNO board, Arduino IDE and ‘C’ Programming
9. Interfacing LED and LCD with Arduino UNO
10. Design of Load cell using Arduino UNO

P – 30; TOTAL HOURS – 30

COURSE OUTCOMES: At the end of this course,

CO1: The students will effectively carryout programming of microprocessor and microcontroller interfacing for industrial applications.

CO2: The students will be able to design mini projects using sensors and microcontrollers for industrial applications.

Board of Studies (BoS) :

17th BoS held on 16.12.21

Academic Council:

18th AC 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	M	L	L	L	L	L	L	L	L	L	L	M	L	L
CO 2	H	H	M	H	L	L	L	L	L	L	L	L	L	L	H

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

SDG 8 : To design projects involving economic growth.

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

The course gives in-depth knowledge in basic microprocessor and microcontrollers which improves the understanding of advanced electronics in future this results in improving quality of education.

This course motivates to design projects addressing the issues faced by industries in their economic growth.

This course enlightens students in promoting industrial applications of programable devices.

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

COURSE OBJECTIVES:

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

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

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

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

MODULE I EXTENSIVE READING & WRITING 07

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

MODULE II INTENSIVE READING & WRITING 08

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

MODULE III QUANTITATIVE APTITUDE 08

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

MODULE IV LOGICAL COMPETENCY 07

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

L – 30; TOTAL HOURS - 30

REFERENCES:

1. Sharma, R.C. and Mohan, Krishna (2010). Business Correspondence and Report Writing. 4th edition. Tata McGraw Hill Education Private Limited, New Delhi
2. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016

7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

COURSE OUTCOMES:

CO1: Demonstrate reading skills with reference to business related texts

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

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

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

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

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

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

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

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

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

MODULE I INTRODUCTION AND BASIC INFORMATION ABOUT INDIAN CONSTITUTION 8

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

MODULE II FUNDAMENTAL RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES 7

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

MODULE III GOVERNANCE IN INDIA 8

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

MODULE IV HUMAN RIGHTS AND INDIAN CONSTITUTION 7

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

L – 30; TOTAL HOURS – 30

TEXT BOOKS:

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

REFERENCES:

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

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

CO1: describe the emergence and evolution of Indian Constitution.

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

CO3: compare the various structure of Indian government.

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

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

Academic Council:
17th AC held on 15.07.2021

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

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

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Application of human, legal and political rights leading to empowerment in real-life situations for protection of fundamental freedoms and freedom from violence, abuse, trafficking and exploitation are at the core of human rights.

SEMESTER V

EID 3101	**PROCESS CONTROL**	**L**	**T**	**P**	**C**
SDG: 4, 12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To impart basic knowledge in the analysis and design of process control systems required for an instrumentation engineer

COB2: To develop mathematical model of selected processes from first principle

COB3: To illustrate the characteristics of different control modes and selection of appropriate control mode for a given application

COB4: To provide clear concept about the importance and methods of finding the optimum controller settings

COB5 : To illustrate the construction, characteristics and design of the control valves

COB6 : To provide knowledge about the important advanced control techniques used in process industries along with case studies

MODULE I INTRODUCTION TO PROCESS CONTROL 9

Need for process control – Hierarchical decomposition of control functions – Servo and regulatory operations – Continuous and Batch processes – Mathematical Modeling of Processes: Level, Flow and Thermal processes – Lumped and Distributed parameter models – Degrees of Freedom – Interacting and non-interacting systems – Self regulation – Linearization of non-linear systems

MODULE II FINAL CONTROL ELEMENTS 9

Actuators: Pneumatic and electric actuators – I/P converter – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Valve body: Commercial valve bodies – Control Valve Sizing for sizing Control Valves – Cavitation and flashing– Control Valve Selection.

MODULE III CONTROL ACTIONS 9

Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller –PID Implementation Issues: Bumpless Auto/manual Mode transfer, Anti-reset windup Techniques and Direct/reverse action.

MODULE IV CONTROLLER TUNING METHODS 9

PID Controller Design Specifications: Criteria based on Time Response and Frequency Response - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method, Damped oscillation method, Direct synthesis method, Auto tuning – Model based control schemes - Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller.

MODULE IV MULTI-LOOP REGULATORY CONTROL 9

Cascade control – Feed-forward control – Ratio control – Inferential control – Split-range– Adaptive Control - Introduction to Multi-loop Control Schemes – Control Schemes for Distillation Column, Three-element Boiler drum level control.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. George Stephanopoulos, "Chemical Process Control – An Introduction to Theory and Practice", Prentice Hall of India, 2005.
2. Eckman, D.P., "Automatic process control", Wiley Eastern Ltd.,New Delhi,1993.

3. Seborg, D.E., Mellichamp, D.P., Edgar, T.F., and Doyle,F.J., III, "Process Dynamics and Control", John Wiley and Sons, 4th Edition,2017.
4. Bequette, "Process Control: Modeling, Design, and Simulation", Prentice Hall of India, 2004.

REFERENCES:

1. Antonio Visioli, "Practical PID Control" Springer- Verlag London, 2006.

3. Aidan O'Dwyer, "Handbook of PI and PID Controller Tuning Rules", Imperial College Press, 2009.

COURSE OUTCOMES:

CO1: Know about process dynamics and be able to develop process model.

CO2: Gain knowledge about the construction, operation, characteristics and selection of control valves

CO3: Get familiarized with the basic control modes and PID implementation issues.

CO4: Determine the optimum controller (P, PI, PID) settings using various tuning methods and be able to develop suitable control schemes for any industrial application

CO5 : Get familiarized with different multi loop control schemes and their applications

Board of Studies (BoS) :	**Academic Council:**
18th BOS meeting held on 12.7.2022	19th AC held on 29.09.22

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	PO 11	P O 12	PS O1	PS O2	PS O3
CO1	H	L	H	L	L					L	L	L			H
CO2	L	M	H		L							L	H		
CO3	M	M	L		L							L			H
CO4	M	M	L	L	H							L			H
CO5	M	M	L	L	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

Need for automatic and distributed control paves way for lifelong opportunities to develop new technologies.

SDG 12: Responsible Consumption and Production

Design of optimal controllers and control system provides an efficient consumption of raw materials and good yield.

		L	T	P	C
EID 3102	**INDUSTRIAL INSTRUMENTATION II**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide knowledge on density, viscosity, humidity and moisture measurements.

COB2: To familiarize with area flow meters, mass flow meters and calibration techniques.

COB3: To expose various types of level measurements adopted in industrial environment

COB4: To provide knowledge on quantity flow meters and mass flow meters

COB5: To expose various types of electrical type flow meter

MODULE I MEASUREMENT OF DENSITY, VISCOSITY, HUMIDITY AND MOISTURE 13

Modules of density, specific gravity and viscosity used in industries – Baume scale, API scale – Pressure head type densitometer – Float type densitometer– Ultrasonic densitometer –– Viscosity – Saybolt viscometer, Redwood Viscometer. Case Study - density Analysis. Humidity terms – Dry and Wet bulb psychrometers – Hot wire electrode type hygrometer – Dew cell – Commercial type dew point meter - Different methods of moisture measurement - Moisture measurement in granular materials, solid penetrable materials like wood, web type material. Case Study - humidity analysis.

MODULE II VARIABLE HEAD FLOW METERS AND VARIABLE AREA METERS 8

Flow measurement: Introduction and definitions - Reynolds number. Theory of fixed restriction variable head type flow meters –Orifice plate – Venturi tube – Flow nozzle – Dall tube – Pitot tube- Installation of head flow meters – Piping arrangement for different fluids. Rota meter– Theory and installation

MODULE III QUANTITY FLOW METERS AND MASS FLOW METERS 8

Positive displacement flow meters – Constructional details and theory of operation of nutating disc, oval gears and helix type flow meters- Angular momentum mass flow meter – Coriolis mass flow meters – Thermal mass flow meters - Calibration of flow meters – Dynamic weighing method

MODULE IV ELECTRICAL TYPE FLOW METER 8

Principle and constructional details of electromagnetic flow meter – Different types of excitation schemes used -Ultrasonic flow meters – transit time-frequency difference type – Coriolis - Vortex shedding flow meter–Solid flow rate measurement– Guidelines for selection of flow meter.

MODULE V LEVEL MEASUREMENT 8

Gauge glass techniques – Float type level indication – Different schemes – Level switches, level measurement using displacer and torque tube – Bubble system. Boiler drum level measurement – Differential pressure method – Hydra step systems – Electrical types of level gauges using resistance, capacitance, nuclear radiation, Radar, and Doppler sensors

L –45 ; TOTAL HOURS: 45

TEXT BOOKS:

1. E.O. Doebelin, ―Measurement Systems – Application and Design‖, Tata McGraw Hill publishing company, 2004.
2. R.K. Jain, ―Mechanical and Industrial Measurements‖, Khanna Publishers, New Delhi, 2010
3. D.S.Kumar, ―Mechanical measurements and control‖, 3rd edition, Metropolitan
4. Liptak, B.G., ―Mechanical and Industrial Measurements‖ Khanna Publishers, Delhi, 1999.

REFERENCES:

1. S.K. Singh, ―Industrial Instrumentation and Control‖, Tata McGraw Hill, 2003.

2. D.P. Eckman, ―Industrial Instrumentation‖, Wiley Eastern Ltd
3. D. Patranabis, ―Principles of Industrial Instrumentation‖, Tata McGraw Hill Publishing Company Ltd, 1996.
4. A.K. Sawhney, ―A Course on Mechanical Measurements, Instrumentation and Control, Dhanpath Rai and Co, 2004.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Select the methods to measure density, humidity, moisture and viscosity

CO2: Select the variable head flow meters and variable area meters for different applications

CO3: Choose the quantity flow meters and mass flow meters for specific applications

CO4: Analyze and select the electrical type flow meter for specific applications.

CO5: Select appropriate instruments for liquid level, solid level measurement

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

The understanding of field instruments promotes lifelong learning opportunities.

		L	T	P	C
ECD 3182	**COMMUNICATION ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To discuss methods of analog communication and their significance

COB2: To analyze digital communication methods for high bit rate transmission

COB3: To apply the concepts of source and line coding techniques for enhancing transmission rate and minimizing the errors in transmission.

COB4: To choose an appropriate multiple access techniques of wire and wireless communication

COB5: To select an appropriate transmission medium for a communication system

PREREQUISITE:

Basics of electronics devices and circuits, analog and digital IC concept.

MODULE I INTRODUCTION TO COMMUNICATION 12

Basic Communication systems: Types- Electromagnetic Spectrum allocation for different applications-Elements of communication systems-Need for modulation. DSB, DSBSC, design of transceiver, Analog Modulation and detection: AM, FM

MODULE II DIGITAL COMMUNICATION 9

Pulse modulations – concepts of sampling and sampling theorems, PAM, PWM, PPM, PTM, quantization and coding: DCM, DM, ASK, FSK, PSK Transmitter and Receiver.

MODULE III INFORMATION THEORY & SOURCE CODING TECHNIQUES 6

Introduction-Information & Entropy, Source Coding Theory, Discrete Memory less Channel, Mutual Information Channel Capacity, Channel Coding Theory.

MODULE IV MULTIPLE ACCESS TECHNIQUES 9

Introduction - FDMA, TDMA, CDMA, SDMA - application in wired and wireless communication - Latest techniques OFDMA.

MODULE V SIGNAL TRANSMISSION MEDIA 9

Transmission media - Guided Transmission Media: Twisted pair, Coaxial cable, optical fiber, Wireless Transmission, Terrestrial microwave, Satellite microwave. Wireless Propagation: Ground wave propagation, Sky Wave propagation, LoS Propagation. Evolution of communication: 2G, 2.5G, 4G, 5G.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Taub & Schiling, “Principles of Communication Systems” 4th edition, Tata McGraw Hill, 2013.

2. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 4th edition, Oxford University Press, 2010.

REFERENCES:

1. S. Haykin “Digital Communications”5th edition, McMaster University, John Wiley 2013.
2. William Stalling, “Data and Computer Communications”, 10th Ed., Prentice-Hall, 2013.
3. Kennedy and Davis “Electronic Communication Systems” Tata McGraw hill, 6th Edition, 2017.
4. Sklar “Digital Communication Fundamentals and Applications“ 2nd edition, Pearson Education, 2001.

COURSE OUTCOMES:

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

CO1: Differentiate the methods of analog communication and their significance

CO2: Analyze the pulse and digital communication methods

CO3: Apply the concepts of source and channel coding techniques

CO4: Discuss the multiple access techniques in wired and wireless communication

CO5: Choose a specific communication system based on transmission media.

Board of Studies (BoS) :
23rd BOS meeting (ECE) held on 13.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	M	L	L		M	H	L	M	H	L	M
CO2	H	H	H	H	M	L	L		M	H	L	M	H	L	M
CO3	H	H	H	H	-	-	-	M	-	H	L	-	H	L	M
CO4	H	H	H	H	-	-	-		-	H	L	-	H	L	M
CO5	H	H	H	H	M	-	-		M	H	L	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 apply the fundamentals of communication engineering in wired and wireless environments and its significance for day to day applications.

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

Statement: The holistic understanding of communication engineering techniques and its systems leads to the construction of flexible infrastructure and sustainable industrialization.

EID 3103	DIGITAL SIGNAL PROCESSING	L	T	P	C
SDG: 4		3	1	0	4

COURSE OBJECTIVES:

COB1: To impart knowledge about Signals and systems & their mathematical representation

COB2: To make the students familiarize with Discrete time systems

COB3: To make the students analyze the transformation techniques & their computation.

COB4: To make the students design Digital Filters based on the Filter specifications

COB5: To impart knowledge about Programmable digital signal processors and quantization effects.

MODULE I INTRODUCTION 12

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

MODULE II DISCRETE TIME SYSTEM ANALYSIS 10

Z-transform and its properties, inverse z-transforms; difference equation – Solution by Z transform, application to discrete systems – Stability analysis, frequency response – Convolution – Discrete Time Fourier transform, magnitude and phase representation.

MODULE III DISCRETE FOURIER TRANSFORM AND COMPUTATION 12

Discrete Fourier Transform- properties, magnitude and phase representation – Computation of DFT and IDFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

MODULE IV DESIGN OF DIGITAL FILTERS 14

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

MODULE V DIGITAL SIGNAL PROCESSORS 12

Introduction – Architecture – Features – Addressing Formats – Functional modes – Introduction to Commercial DS Processors-Signal processing tool box

L – 45 ,T - 15; TOTAL HOURS – 60

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2003.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.
3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

REFERENCES:

1. Poorna Chandra S, Sasikala. B, Digital Signal Processing, Vijay Nicole/TMH, 2013.
2. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning, 2014.
3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010 3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2009.
4. Sen M.kuo, Woon-Seng S.Gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013.
5. Dimitris G.Manolakis, Vinay K. Ingle, applied Digital Signal Processing,Cambridge,2012.

COURSE OUTCOMES:

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

CO1: Ability to understand the importance of Fourier transforms digital filters and DS Processors.

CO2: Perform frequency transformations of the signals

CO3: Perform FFT using radix 2 algorithms

CO4: Design Digital Butterworth IIR filter and FIR filters

CO5: Have knowledge on programmable digital signal processor & quantization effects

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

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

SDG 4: It aims at ensuring inclusive and equitable quality education and promotes lifelong learning opportunities for all.

The knowledge in this course will enable the students to grow with technological developments in the field of Digital signal processing

		L	T	P	C
EID 3104	**PROCESS CONTROL LABORATORY**	**L**	**T**	**P**	**C**
SDG: 12		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To impart practical knowledge in PC based data acquisition, analysis and control of different process trainers.

COB2: To familiarize the process modeling and control using simulation tools.

COB3: Learn the procedure for obtaining the servo and regulatory responses of process control loops such as level, pressure, flow and temperature.

COB4: Understand the procedure for obtaining the optimum controller settings using various tuning methods by experimental and mathematically described processes.

CO5: Learn and analyze multiloop control schemes and multivariable control on an interacting process

LIST OF EXPERIMENTS:

1. Develop the mathematical model for a given process and obtain its transfer function model.
2. Study of interacting and non-interacting tank system and develop its transfer function model.
3. Characteristics of Control Valve and study of control valve (with and without Positioner)
4. Tuning of P, PI and PID Controllers for the given process using different standard technique (Z-N method, Cohen-coon method). Compare the performance of the controllers for each method and compare the tuning methods.
5. Study of Different Process trainers.[Temperature, Pressure, Level, Flow]
6. Study of implementation of on-off control for a temperature process.
7. Performance Analysis of P, PI and PID control schemes for level process.
8. PID Implementation Issues, PID Enhancements –Reset windup and Auto-tuning of PID Controller
9. Design and implementation of Cascade, Feed forward and ratio control schemes for a real time process set up and analysis of the control schemes with conventional PID control scheme.
   i. Design and implementation of Multi-loop PID schemes on the simulated model of a process.
   ii. Performance Analysis of Multi-input Multi-output (2x2) system.
10. 11. Design and implementation of Multi-loop PID schemes for a two tank interacting process setup.

P – 30; TOTAL HOURS – 30

REFERENCES:

1. George Stephanopoulos, “Chemical Process Control – An Introduction to Theory and Practice”, Prentice Hall of India, 2005.
2. Eckman, D.P., “Automatic process control”, Wiley Eastern Ltd.,New Delhi,1993.

3. Bequette, “Process Control: Modeling, Design, and Simulation”, Prentice Hall of India, 2004.

COURSE OUTCOMES:

CO1: Conduct the experiments and obtain the servo and regulatory responses of process control loops such as level, pressure, flow and temperature.

CO2: Arrive the optimum controller settings using various tuning methods by experimental and mathematically described processes

CO3: Analyze and design multiloop control schemes such as cascade, feed-forward and ratio control for any suitable processes

CO4: Analyze and design control schemes for multivariable processes

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	L	M		M							L	L		H
CO2	H	M	H	L	H							L			H
CO3	H	M	H	L	H							L			H
CO4	H	M	H	L	H							L			H

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

SDG 12 : Ensure sustainable consumption and production patterns

Understanding of control schemes will enable the student to design automatic control for any industry and this will help in proper consumption of raw materials and economic production.

EID 3105	**INDUSTRIAL INSTRUMENTATION II**	**L**	**T**	**P**	**C**
SDG: 4	**LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

- The aim of this lab is to impart an adequate knowledge and expertise to handle equipment generally available in an industry.

LIST OF EXPERIMENTS :

1. Determination of Discharge coefficient of Orifice plate
2. Measurement of flow rate using Orifice, Venturi.
3.Level Measurement using DP transmitter.
4. Electrical level measurement using resistance and capacitance methods
5. Measurement of conductivity of test solutions.
6. Measurement of pH values of test solutions.
7. Calibration of temperature transducers
8. Calibration of pressure gauges
9. Characteristics of P /I and I /P Converters.
10. Determination of Viscosity using Saybolt and Redwood Viscometer
11. Study of smart transmitter and smart valve positioner.

COURSE OUTCOMES:

At the end of the course, the student should be able to

- Understand and analyze Instrumentation systems and their applications to various industries.

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

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

The understanding of field instruments promotes lifelong learning opportunities.

GED 3101 SDG: 4	COMMUNICATION SKILLS FOR CAREER SUCCESS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

COB1: To develop students' proficiency in English at CEFR B2 level (Business Vantage)

COB2: To develop students' receptive skills (Listening and Reading) in a wide range of situations

COB3: To develop students' productive skills (Speaking and Writing) in a wide range of situations

COB4: To expose students to the nuances of the English language, grammar and usage.

MODULE I BRIEF EXCHANGES OF COMMUNICATION 08

Listening to telephonic conversations - gap filling exercises- short conversations – Promoting a product-Reading short passages and answering matching tasks-Writing short notes and messages. - Framing questions

MODULE II WORKPLACE COMMUNICATION 07

Listening to monologues - gap filling exercises - Mini presentations- role play-Reading longer texts – gap filling- Writing memo , emails and Fax - Writing reports on conferences, seminars

MODULE III INTERPERSONAL COMMUNICATION 08

Listening to conversations – Collaborative discussion using prompts - Reading comprehension-multiple choice-texts - Writing enquiry letters & replies to customers

MODULE IV NEGOTIATING AND PERSUADING 07

Listening to interviews - Group Discussions - Multiple choice and gap filling-writing work reports- cause and effect - Complaint letter and sales letter

P-30: TOTAL HOURS - 30

REFERENCES:

1. Guy Brook-Hart, 'Business Benchmark-Upper Intermediate, 2nd edition, Cambridge University Press, Shree Maitrey Printech Pvt. Ltd, Noida, 2016.
2. Leo Jones, 'New International Business English' Students book. Cambridge University Press, Cambridge, 2003.

3. Simon Sweeney, ‘Communicating in Business’ Teacher’s Book. Cambridge University Press, Cambridge, 2004.
4. Simon Sweeney, ‘Communicating in Business’ Student’s Book. Cambridge University Press, Cambridge, 2003.
5. Bill Mascull. ‘Business Vocabulary in Use’. Advanced. Cambridge University Press, Cambridge, 2004

COURSE OUTCOMES:

CO1: Use the LSRW skills effectively in business and general situations

CO2: Demonstrate receptive skills effectively in various formal and informal communication situations.

CO3: Demonstrate productive skills effectively in various formal and informal communication situations

CO4: Use appropriate grammar and vocabulary in any context.

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

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O 3	PSO 4	PSO 5
CO1									M	H							H
CO2									M	H							H
CO3									M	H							H
CO4										H							M

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

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

This course helps the students to enhance their communication skills, critical thinking, problem solving, conflict resolution, team building and public speaking. This course also helps them to achieve success in their professional and personal life.

SEMESTER VI

		L	T	P	C
MSD 3281	**ENTREPRENEURSHIP**	**L**	**T**	**P**	**C**
SDG: All 1-17.		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the fit between individual and their entrepreneurial ambitions.

COB2: To identify the customers and find a problem worth solving.

COB3: To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas

COB4: To develop a solution for customers' problem and analyze the problem solution fit & product market fit.

COB5: To build and demonstrate a Minimum Viable Product (MVP) for startup

MODULE I PROBLEM IDENTIFICATION AND OPPORTUNITY DISCOVERY 9

Entrepreneurial Thinking, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study

MODULE II CUSTOMER, SOLUTION AND BUSINESS MODEL 10

Customers and Markets, Identification of Customer Segment, Niche Segment, Customers Jobs, Pain and Gain, Early Adopters, Value Proposition Canvas-Case Study, Basics of Business Model-Lean Canvas-Case Study.

MODULE III VALIDATION AND FINANCIALS 10

Blue Ocean Strategy, Solution Demo, Problem – Solution Fit, Minimum Viable Product- Product Market Fit, Prototype – Case Study. Cost, Revenues, Pricing, Profitability Checks, Bootstrapping, Initial Financing and Pitching.

MODULE IV GO TO MARKET 8

Positioning and Branding, Golden Circle model: Sinek's theory value proposition, Branding Elements, Market Penetration Strategy, Collaboration Tools and Techniques, Channels – Case Study

MODULE V MANAGING GROWTH AND FUNDING 8

Sales Planning, Customer Acquisition Strategy, Selling Skills, Identifying

Funding Sources, Mapping Start-Up Cycle to Funding Options, Funding Plan, , Creating business valuation

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Entrepreneurship Rajeev Roy oxford, 2012.
2. https://web.nen.wfglobal.org/en/home - Wadhwani Foundation
3. W. Chan Kim , Renée A. Mauborgne, “Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant”, Harvard Business Press, 2015.

REFERENCES:

1. Anil Lamba , “Romancing the Balance Sheet: For Anyone Who Owns, Runs Or Manages a Business”, HarperCollins Publishers India, 2016.
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.
3. “Anatomy of Business Plan” – Linda Pinson, OMIM publication , Seventh Edition, 2008.
4. Running Lean: Iterate From Plan A To a Plan That Works, Ash Maurya, "O'Reilly Media, Inc.", 28-Feb-2012.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Build an entrepreneurial mindset and reach out the customer to identify the problem using design thinking process

CO2: Craft solution to the problem through value proposition canvas and develop a business model using lean canvas

CO3: Provide product solution demo and deliver a minimum viable product

CO4: Work as a team and create brand strategy marketing for product/service

CO5: Prepare, make an outstanding sale pitch for startup

		L	T	P	C
GED 3201	**REASONING AND APTITUDE FOR ENGINEERS**				
SDG: 4		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To develop students' critical reading skills

COB2: To foster their writing skills

COB3: To enlighten the various methods of solving quantitative problems

COB4: To make students ready for clearing placement and competitive examination

MODULE I OBJECTIVE ENGLISH 07

Reading Comprehension - Sentence Rearrangement - Cloze Test – Error Spotting

MODULE II VOCABULARY DEVELOPMENT 08

Vocabulary (Synonyms and Antonyms, one word Substitutes, Spellings, Idioms and Phrases, etc) - Fill in the blanks - Paragraph Completion

MODULE III GENERAL MENTAL ABILITY 08

Time speed and Distance –Problems on Trains – Boats and Streams - Permutation and Combination - Probability

MODULE IV 07

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

P- 30, TOTAL HOURS 30

REFERENCES:

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK.
2. Swan, Michael (2005). Practical English Usage, Oxford University Press.
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal

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

COURSE OUTCOMES:

CO1: Demonstrate their reading ability

CO2: Exhibit their vocabulary and writing skills

CO3: Apply the problem-solving techniques

CO4: Gain confidence mentally and be successful in their career

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

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										M		
CO2										H		
CO3										L		
CO4												M

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

SDG 4 : Give Quality Education to all the Engineers

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

		L	T	P	C
EID 3201	**EMBEDDED SYSTEM AND RTOS**	**L**	**T**	**P**	**C**
SDG:4, 9		**2**	**0**	**1**	**3**

COURSE OBJECTIVES:

COB1: To explain the concepts of embedded systems and software development skills

COB2: To describe the aspects of the Operating systems and Real-time Operating Systems

COB3: To analyze MicroC / OS-II features and services.

COB4: To develop real time embedded system applications using RTOS.

COB5: To choose the scheduling algorithms for real time embedded systems.

PREREQUISITE:

Fundamentals of digital electronics, microprocessor and microcontrollers

MODULE I EMBEDDED COMPUTING PLATFORM 7

Embedded computing – classification, characteristics and challenges –embedded system design process- overview of processors and hardware units in an embedded system- Host and target machines- Model of programs - Assembly, Linking and Loading - Embedded application.

MODULE II EMBEDDED C 8

Basics of Embedded C - ARM architecture - IDE - simulation - debugging techniques- I/O port programming- interfacing LED- Reading switches – on chip ADC- serial communication- UART – Timer.

MODULE III REAL TIME OPERATING SYSTEMS (RTOS) 7

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- RTOS application.

MODULE IV MICROC/OS-II 8

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.

LIST OF EXPERIMENTS:

1. Interfacing LED with ARM 32 bit microcontroller
2. Reading switch using ARM 32 bit microcontroller
3. Programming on chip Timer microcontroller
4. Serial communication- UART programming
5. Programming of on chip ADC with ARM 32 bit microcontroller
6. Implementation of multitasking using Real Time Operating Systems.
7. Implementation of scheduling algorithms using Real Time Operating Systems.

L – 30; P-30 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Marilyn Wolf, "Computers as components", Elsevier 4th edition 2016.
2. Rajkamal, "Embedded Systems Architecture, Programming and Design",3rd Edition, Tata McGraw-Hill, 2017
3. Qing Li and Caroline,"Real Time Concepts for Embedded Systems", CRC PRESS, 2017.
4. Jean J. Labrosse, "MicroC/OS – II The Real Time Kernel", CMP Books, 2002.

REFERENCES:

1. Steve Heath, "Embedded System Design", 2nd Edition, Elsevier, 2004.
2. 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: Describe various task assignment and scheduling methods of operating system and real time operating system.

CO3: Analyze MicroC/OS-II task management and scheduling scheme

CO4: Describe the application of real time operating system

CO5: Adapt the scheduling algorithms using Real Time Operating Systems.

Board of Studies (BoS) :

23rd BOS meeting (ECE) held on 13.7.2022

Academic Council:

19th AC held on 29.09.22

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
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.

SEMESTER VII

EID 4101	**INDUSTRIAL AUTOMATION**	**L**	**T**	**P**	**C**
SDG: 9		3	0	1	4

COURSE OBJECTIVES:

COB1: Learn and familiarize with the technologies which typically exist in an industrial facility.

COB2: Study of components used in data acquisition systems interface techniques.

COB3: To educate on the components used in PLC, DCS and SCADA

COB4: To introduce the communication networks used in automation industries

MODULE I PROGRAMMABLE LOGIC CONTROLLERS 9

Evolution of PLCs - Hard Relay Logic - Programmable logic controllers - Organization - Hardware details - I/O - Power supply - CPU - Programming of PLC — relay logic — Ladder logic — Functional blocks programming – Programming Timers, Counters.

MODULE II PLC INTERMEDIATE FUNCTIONS & COMMUNICATION IN PLCS 9

Program control instructions-Data manipulation Instructions-Arithmetic instructions - Sequencer instructions- Design of interlocks and alarms using PLC - Requirement of communication networks for PLC — connecting PLC to computer — Use of Embedded PC as PLC - PLC applications in Industrial Automation

MODULE III LARGE SCALE CONTROL SYSTEM - SCADA 9

SCADA: Introduction - SCADA Architecture - Different Communication Protocols - Common System Components - Supervision and Control - HMI - RTU and Supervisory Stations - Trends in SCADA - Security Issues

MODULE IV DISTRIBUTED CONTROL SYSTEM 10

Introduction to DCS-Evolution, Architectures-Hybrid, centralized computer control, Generalized DCS. Architectures-Comparison, Local control unit, LCU-Configurations, Comparison, Process interfacing issues, Communication facilities- Low level and High level operator interfaces, Operator displays, Low level and High level engineering interfaces, Factors to be considered in selecting DCS

MODULE V INDUSTRIAL COMMUNICATION NETWORKS 8

Introduction - Evolution of signal standard - HART communication protocol and communication modes - HART and OSI model - Modbus - Profibus - Foundation field bus - Introduction to AS-Interface (As-i) - Device net and Industrial Ethernet

Practicals:

- Configuration of Input/Output, power supply, CPU in Siemen's PLC and Allen Bradley PLC
- Implement Logic gates operations, Timing and counter operations using PLC.
- Implement math operations, Program control instructions and Data manipulation instructions using Programmable Logic Controller (PLC).
- Control of any sequential operation (Bottle Filling/Motors) using PLC.
- Real-Time Control of a plant (Level, pressure or temperature process) using PLC.
- Interfacing HMI and SCADA system using PLC.
- Programming HMI and SCADA for an application.
- Configure Functional Blocks and develop SCADA using Function Blocks in any Distributed Control System (DCS).
- On-line monitoring and control of a plant using a DCS.

L – 45; P -15;Total Hours – 60

TEXT BOOKS:

1. Petrezeulla, "Programmable Controllers", tenth edition, Mc-Graw Hill, 2010.
2. Michael P.Lucas, "Distributed Control System", Van Nastrand Reinhold Company, New York,1986.
3. Romilly Bowden, "HART application Guide", HART Communication Foundation, 1999.

REFERENCES:

1 W. Bolton," Programmable Logic Controllers ",(Fifth Edition), Newnes, 2009.
2. G.K.Mc-Millan, "Process/Industrial Instrument and controls and handbook", McGraw Hill, New York, 1999
3. Hughes T, "Programmable Logic Controllers", ISA Press, 1989.

COURSE OUTCOMES:

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

CO1: Evaluate the hardware components of PLC and develop basic wiring diagrams

CO2: Develop industrial automation system and identify the requirements of communications networks in PLC

CO3: Design a SCADA, HMI system for any industrial application

CO4: Compare the different architectures of DCS and analyze the configurations of local control unit

CO5: Able to select and use most appropriate networking technologies and standards for a given application

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO 2	PO3	PO 4	P O 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	H	H	H	H	M	M	M		L		L	M	L		H
CO2	H	H	H	H	M	M	M		L		L	M	L		H
CO3	H	H	H	H	M	M	M		L		L	M	L		H
CO4	H	H	H	H	M	M	M		L		L	M	L		H
CO5	H	H	H	H	M	M	M		L		L	M	L		H

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

SDG 9: These technologies connect citizens around the world, monitor and track environmental impact, and optimize industrial inefficiencies

The technologies in Industrial Automation connect citizens around the world, monitor and track environmental impact, and optimize industrial inefficiencies

EID 4102	**BIOMEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 3, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide an acquaintance of the physiology of the heart, lung, brain and bio potentials

COB2: To introduce the student to the various electrodes and amplifiers used for bio signals

COB3: To make the students understand the typical measurement devices of electrical origin and provide awareness of electrical safety of medical equipments

COB4: To provide the latest ideas of non-electrical bio signal parameter measurement.

COB5: To bring out the important and modern methods of imaging techniques and latest knowledge of medical assistance / techniques and therapeutic equipments

.

MODULE I PHYSIOLOGY AND BASIC CONCEPTS OF MEDICAL INSTRUMENTATION 7

Generalized Medical Instrumentation system – Medical and physiological parameters - Structure of nervous system, neurons - synapse – transmitters and neural communication – Cardiovascular system – respiratory system - Resting and Action Potential – Bio potentials

MODULE II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 6

Electrodes and types – Practical hints in using electrodes. Bio potential amplifiers: Basic requirements – Amplifiers – Preamplifiers, differential amplifiers - ECG preamplifiers and ECG isolation amplifiers

MODULE III BIOMEDICAL SIGNAL ACQUISITION AND ANALYSIS 10

Types and Classification of biological signals – Electrical parameters acquisition: Origin, recording schemes – ECG, EEG, EMG, ERG – Lead systems and recording methods – Typical waveforms – case study of ECG, EEG. Noise and artifacts – Electrical safety: Physiological Effect of Electrical Current, shock hazards – leakage current.

MODULE IV MEASUREMENT OF NON ELECTRICAL PARAMETERS 10

Measurement of blood pressure – Cardiac output – Blood flow – Heart rate – Heart sound – Pulmonary function measurements – Spirometer – Photo Plethysmography, Body Plethysmography– Blood Gas analyzers, pH of blood – fingertip oximeter – blood glucose measurement - Case studies.

MODULE V ASSISTING AND THERAPEUTIC EQUIPMENTS 12

Computer tomography – PET - MRI – Ultrasonography – Endoscopy – thermal imaging - patient monitoring - Pacemakers – Defibrillators - Diathermy – Dialysers - Diathermy – Heart – Lung machine – Audio meters –Therapeutic and Prosthetic Devices – Infant Incubators – Drug Delivery Devices – Surgical Instruments-Artificial limb and hands – Case studies in medical imaging and therapeutic equipments

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. R.S.Khandpur, "Hand Book of Bio-Medical instrumentation', 3rd Edition, Tata McGraw Hill Publishing Co Ltd., 2014.

2. J.Webster, "Medical Instrumentation – Application and Design", 5th Edition, John Wiley & Sons, 2020.
http://fa.bme.sut.ac.ir/Downloads/AcademicStaff/3/Courses/4/Medical%20instrumentation%20application%20and%20design%204th.pdf

REFERENCES:

1. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2017

2. L.A. Geddes and L.E.Baker, "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 1975.

3. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements", 2nd Edition, Prentice Hall of India, 2014

COURSE OUTCOMES:

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

CO1: Identify physiological parameters for measurement

CO2: Select electrodes and design amplifiers for acquiring biosignals

CO3: Analyze typical waveforms of bio potentials of the human system and provide electrical safety during measurement

CO4: Identify non electrical medical devices used to correct and improve health care

CO5: Suggest diagnostic methods for treatment and therapy

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	1	2	1	2	1	1	1	1	3	1	1
CO2	2	2	2	2	3	2	2	2	1	1	2	2	3	2	2
CO3	2	3	1	1	1	1	1	1	1	1	2	2	2	1	2
CO4	2	1	1	2	2	2	2	2	1	1	1	1	2	1	2
CO5	2	2	2	2	1	2	1	2	1	2	1	2	3	1	2

Note: 1- Low Correlation 2 - Medium Correlation 3 -High Correlation

SDG 3 : Engineering solutions are key to empowering local health workers to provide accessible, quality healthcare.

SDG 9 : An effective, efficient and equitable data infrastructure will generate value for the succeeding generations and foster innovation

SEMESTER VIII

EID 4201	**PROJECT WORK**	**L**	**T**	**P**	**C**
SDG : 4,8,9		**0**	**0**	**18**	**9**

COURSE OBJECTIVES:

COB1: To design, develop, and deploy advanced state-of-the-art instrument systems and custom application software in support of the ongoing experimental research efforts

COB2: To provide in-house solutions to assist the researcher through a complete life cycle of system development.

COB3: To gain competency in analyzing experimental data and in comparing the results to data and theories in the literature

COB4: To acquire more knowledge in designing of hardware as well as applications of softwares like CAD tool, Matlab, LabVIEW & embedded C.

COB5: To apply basic and contemporary science, engineering, and experimentation skills to identifying manufacturing problems and developing practical solutions

COURSE OUTLINE

Project shall be carried out in the following areas

- Design/ fabrication of sensors and transmitters
- Microcontroller based digital control system design
- Embedded system design for automation
- Micro-electronics and VLSI Design
- Applications of Digital image processing for process industries,
- Analysis and design of advanced process control techniques
- Medical imaging and instrumentation
- Micro-sensors and Micro-actuators design
- MEMS in instrumentation and biomedical

SOFTWARE:

MATLAB/SIMULINK, PSPICE, LabVIEW and CAD tool, embedded C, MEMS software

COURSE OUTLINE

Project shall be carried out in the following areas

- Design/ fabrication of sensors and transmitters
- Microcontroller based digital control system design
- Embedded system design for automation
- Micro-electronics and VLSI Design
- Applications of Digital image processing for process industries,
- Analysis and design of advanced process control techniques
- Medical imaging and instrumentation
- Micro-sensors and Micro-actuators design
- MEMS in instrumentation and biomedical

SOFTWARE:

MATLAB/SIMULINK, PSPICE, LabVIEW and CAD tool, embedded C, MEMS software

COURSE OUTCOMES:

On completion of the course the student will be able to

CO1: Apply Knowledge of Mathematics, Science and Engineering

CO2: Design, model, analyze and improve a manufacturing process or system utilizing modern technologies

CO3: Design and conduct experiments, as well as to analyze and interpret data

CO4: Identify, formulate and solve engineering problems

CO5: Use the techniques, skills and modern engineering tools necessary for engineering practice

CO6: Function on multi-disciplinary teams and to communicate effectively

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO2	PSO 3
CO1	H	H	H	H	H	H	H	H	H	H	H	H	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H	H	H	M	M	M
CO3	H	H	H	H	H	H	H	H	H	H	H	H	M	M	M
CO4	H	H	H	H	H	H	H	H	H	H	H	H	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H	H	H	M	M	M

Note: 1- Low Correlation 2 - Medium Correlation 3 -High Correlation

SDG 4 : Quality Education

The knowledge incurred through the team projects will enable the students to grow with technological developments in the engineering field.

SDG :8 Decent Work & Economic Growth

The knowledge in the advanced techniques will help the students to get new and better employment opportunities and provide greater economic security for all.

SDG 9 : Industry, Innovation & Infrastructure

The technologies used to implement the students projects can connect citizens around the world, monitor and track environmental impact, and optimize industrial inefficiencies

LIST OF PROFESSIONAL ELECTIVE COURSES
Specialization I- Instrumentation Engineering

EIDX 01	**FIBRE OPTIC AND LASER INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide knowledge on the basic concepts of optical fibres and their properties.

COB2: To impart exposure to the industrial applications of optical fibres

COB3: To provide adequate knowledge on the fundamentals of Laser and their industrial applications

COB4: To provide exposure to holography and medical applications of Laser

MODULE I OPTICAL FIBRES AND THEIR FUNDAMENTALS 8

Principles of light propagation through a fibre – Fibre optic materials and their Characteristics-Different types of fibres and their properties - Transmission characteristics of optical fibre- Absorption losses -Scattering losses – Dispersion losses.

MODULE II OPTICAL SOURCES AND DETECTORS 8

Introduction to Optical sources LED-structures, Types, characteristics, Applications, LD. Optical detectors: PIN structures, Types, characteristics, Applications, APD - Wavelength Division Multiplexing.

MODULE III INDUSTRIAL APPLICATIONS OF OPTICAL FIBRES 8

Fibre optic sensors- Fibre optic instrumentation System-Different types of modulators – Detectors-Application in instrumentation- Interferometric method of Length measurement-Moire fringes-Measurement of pressure, Temperature, current, Voltage, liquid level and strain.

MODULE IV LASER FUNDAMENTALS 9

Fundamental characteristics of laser-Three level and four level lasers-Properties of lasers-Laser modes-Resonator configuration-Q-switching and mode locking-Cavity dumping-Types of laser-Gas laser, solid laser, liquid laser, semiconductor laser.

MODULE V HOLOGRAPHY , MEDICAL AND INDUSTRIAL APPLICATION OF LASER 12

Laser for measurement of distance, length, velocity, acceleration, current, voltage, and atmospheric effect-Material processing-Laser heating, welding, melting and trimming materials, removal and vaporization Holography- Basic principle, methods-Holographic interferometer and applications –Holography for nondestructive testing-Holographic components-Medical application of lasers-laser and tissue interaction-Removal of tumors of vocal cards-Plastic surgery-Endoscopy.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Gerd Keiser, “Optical Fibre Communications”, McGraw-Hill, International Edition, 2010

REFERENCES:

1. D.C.O’shea, Russel Callen, “Introduction to lasers and their applications”, Mc Millan, 1977.
2. John and Harry, “Industrial lasers and their applications”, McGraw Hill, 1974.
3. John senior, “Optical communications”, PHI
4. John F Ready, “Industrial applications of lasers”, Academic press, 1978.
5. Monte Ross, “Laser applications”, McGraw Hill, 1968.

COURSE OUTCOMES:

After completion of this course the students will be able to

CO1: Classify the optical fibers based on their properties and characteristics and to analyze various losses.

CO2: Identify the optical sources and detectors used in fiber communication

CO3: Design fibre optic systems and apply in various fields

CO4: Understand the Laser fundamentals and their types

CO5: Apply the concept of laser in various Industries

CO6: Apply the knowledge about lasers in Medical field and holography.

Board of Studies (BoS) :

17th BoS of EIE held on 16.12.21

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	M	L	L	L					L	L	L	H		
CO2	H	M	M	L	L					L	L	L	H		
CO3	H	H	M	L	L					L	L	L	H	L	L
CO4	H	M	L	L	L					L	L	L	H		
CO5	H	H	M	L	L					L	L	L	H	L	L
CO6	H	M	H	L	L					L	L	L	H	L	L

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

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

SDG 9: To promote Innovations and Infrastructure developments in Communication Technology.

The understanding and identification of proper optical and laser instruments for use in communication industries promotes innovations and lifelong learning opportunities

EIDX 02	**ADVANCED SENSORS**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide knowledge on different methods of measurement of strain, pressure and displacement.

COB2: To impart knowledge on light radiation sensors and various temperature detectors and measurements

COB3: To deliver information on electronic and smart sensors technology.

COB4: Being Engineering practitioners, help to solve Industries technological problem

COB5: To Identify sensors and design circuits for various real time applications

MODULE I STRAIN AND PRESSURE MEASUREMENT 8

Resistance strain gauge, piezoelectric pressure gauge, load cells, Interferometers, optical strain gauges, electronic circuits for strain measurements. Aneroid pressure gauges, capacitance pressure gauge, ionization gauge, case studies and applications.

MODULE II DISPLACEMENT & NON CONTACT MEASUREMENT 12

Linear displacement- Capacitive, Inductive, Accelerometer systems, piezoelectric devices. Rotation sensors - Encoders, optical, magnetic. Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors, Reed switch, magnet and Hall-effect modules, Doppler detectors, liquid level detectors, flow sensors, smoke sensors.

MODULE III LIGHT RADIATION SENSORS 8

Light transducer, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic sensors. solid-state devices, liquid crystal devices, UV radiation sensor.

MODULE IV HEAT AND TEMPERATURE 8

Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector, Electronic circuit design and applications.

MODULE V ELECTRONIC & SMART SENSORS 9

Signal conditioning, compensation, non-linearity approximation and regression, information, coding processing, data communication, standards for smart sensor interface, automation. Thin film sensors, semiconductor IC technology, MEMS, Nano sensors.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Doebelin, E O, "Measurement Systems, Application and Design", McGraw Hill, 5th Edition, 2004.
2. Jack P Holman, "Experimental Methods for Engineers", 7th edition, McGraw Hill, USA, 2001

REFERENCES:

1. Lan R Sinclair, "Sensors and Transducers", 3rd edition, Newnes publishers, 2001.
2. Robert G Seippel, "Transducers, Sensors and Detectors", Reston Publishing Company, US

COURSE OUTCOMES:

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

CO1: Identify sensor for particular application and design a signal conditioning circuits for the measurement of strain and pressure

CO2: Select sensors for measuring displacement and light radiation related to industrial applications.

CO3: Apply the common methods for converting a physical parameter into an electrical quantity for measurement of temperature for industrial applications

CO4: Apply the concepts of electronic sensors for distance, velocity, flow, level and smoke detection

CO5: Design electronic circuits and will have relevant knowledge on the latest trends in smart sensor technology

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	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	M	M	M	M	M	M	L	L	L	M	L	L	H	M	L
CO2	M	M	M	M	M	M	L	L	L	M	L	L	H	M	L
CO3	M	M	M	M	M	M	L	L	L	M	L	L	H	M	L
CO4	M	M	M	M	M	M	L	L	L	M	L	L	H	M	L
CO5	M	M	M	M	M	M	L	L	L	M	L	L	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 and help in developing technological capabilities

SDG 9: These technologies connect citizens around the world, monitor and track environmental impact, and optimize industrial inefficiencies

The understanding of the selection and design of sensors promotes real life applications and learning opportunities. The technological capabilities help in new product development and enhance entrepreneurship capacity of an individual.

		L	T	P	C
EIDX 03	**ULTRASONIC INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To impart knowledge about the basic principles and generation of ultrasonic waves

COB2 : To provide the various testing methods and measurements of ultrasonic waves

COB 3 : To impart knowledge on applications of ultrasonic waves in medical field, Imaging field and nondestructive testing

MODULE I PHYSICS OF ULTRASOUND AND ITS CHARACTERISTICS 9

Basic principle of Ultrasound - Pulse echo Technique - Producing beam of ultrasound, Interaction of ultrasound with matter, properties of ultrasonic transmission, reflection and transmission coefficients, intensity and attenuation of sounds beam, attenuation, power level, medium parameters.

MODULE II ULTRASONIC WAVE GENERATION AND TEST METHODS 9

Generation of ultrasonic waves: magneto-strictive and piezoelectric effects, search unit types, construction and characteristics Test methods: Ultrasonic test methods: pulse echo, transit time, resonance, direct contact and immersion type and ultrasonic methods of flaw detection.

MODULE III ULTRASOUND MEASUREMENT AND DISPLAY MODES 9

Ultrasound measurement: measuring thickness, depth and flow, variables affecting ultrasonic testing in various applications Ultrasonic Display modes: A-mode, B-mode, Time position mode, Ultrasonic Probe construction.

MODULE IV ARTIFACTS AND RESOLUTION IN ULTRASOUND IMAGING 9

Display of false echoes - Reverberation between Probe and structure, omission of echoes from display – Acoustic Shadowing, Off-Normal incidence, Distortion of echoes. Beam width and lateral resolution, factors affecting lateral and longitudinal resolution, Hazardous effects of ultrasound.

MODULE V ULTRASONIC APPLICATIONS 9

Ultrasound quality assurance, Acoustic power and bio-effects: Acoustic power and intensity of pulsed ultrasound, Applications in medicine: Echo-Cardiography, Obstetrics and Gynaecology, Liver, Biliary systems, Kidneys and Adrenals.

L – 45;TOTAL HOURS – 45

TEXT BOOKS:

1. James A. Zagzebski, “Introduction to Essential of ultrasound”, Mosby, Incorporated, 1996

2. Jerold T. Bushhery, J. Antony Siebert, Edwin M. Leidholdt, John M Boone, “The Essential Physics of Medical Imaging”, Lippincott Williams & Wilkins, 3rd Edition 2011.

3. Liptac, “Process Design and Instrumentation”, John wiley and sons, 2003

4. R.S.Khandpur, “Hand Book of Bio-Medical instrumentation”, Tata McGraw Hill Publishing Co Ltd., 2003.

REFERENCES:

1. David J Cheeke. N “Fundamentals and Applications of Ultrasonic Waves”, CRC Press 2002.
2. Dale Ensminger, Ultrasonic: “Fundamentals, Technology, Applications”, CRC press, 1988, Second Edition.
3. Perter Hoskins, Kevin Martin and Abigail Thrush, “Diagnostic ultrasound: Physics and Equipment”, Cambridge University Press, 2nd Edition, 2010.
4. Josef Krautkrämer, Herbert Krautkrämer “Ultrasonic Testing of materials”, Springer Verlag, Berlin,New York,2013
5. Wells N T, “Biomedical Ultrasonic”, Academic Press, London, 1977.

COURSE OUTCOMES:

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

CO1: Detect the defects in test specimen and capable of measuring various physical quantities using ultrasonic waves

CO2: Compare different types of ultrasonic wave generation.

CO3: Analyze the various ultrasound methods to measure the physical quantities

CO4 : Detect and analyze various flaw in products

CO5: Implement the different ultrasonic measurement methods

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

The knowledge in this course will enable the students to grow with technological developments in the field of Sensors and Transducers

		L	T	P	C
EIDX 04	**ANALYTICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To introduce analytical instruments, properties, sampling and common process parameters and the various regions of the Electromagnetic spectrum

COB2: To provide knowledge on various components and performance of visible ultraviolet and IR spectrophotometers

COB3: To give unique methods of separation of closely similar materials, using chromatography

COB4: To study important methods of industrial gas analyzers

COB5: To study characteristics of NMR and mass spectrometers SEM and TEM

MODULE I FUNDAMENTALS OF ANALYTICAL INSTRUMENTS 9

Introduction to Analytical Instruments – Elements of an analytical instruments - Applications of chemical composition measurement in industries - Classifications of analytical instruments based on properties - Sample – Sampling points –- performance requirements of analytical instruments: Errors in chemical analysis – Calibration and verification – Advantages of automated analysis - Common process parameters and its application - Electromagnetic radiation, spectrum - Beers Lambert’s Law – Deviation from Beer’s Law

MODULE II SPECTROPHOTOMETERS 9

UV spectroscopy - Radiation sources: Blackbody sources, Discharge Lamps, Lasers - Detectors: Photovoltaic, Photoemissive, Photomultiplier tube, silicon diode detectors – Infrared Spectroscopy - Radiation sources – Detectors: Quantum Type Detector, thermal Detectors – FTIR spectrophotometers – Atomic absorption spectrophotometers – Sources and Detectors - Typical Industrial applications to measure particle size and distribution – estimation – qualitative and quantitative analysis.

MODULE III CHROMATOGRAPHY 9

Chromatography - Gas chromatograph: Carrier Gas / Mobile phase, Sample Injection system, Chromatographic column – Detectors: Thermal Conductivity detector, Flame Ionization detector, Flame photometric detector, electron capture detector –Liquid Chromatographs – Liquid chromatography: Column, thin layer, paper partition – HPLC – Detectors: Refractive index detectors, Thermal detectors, Electrical Conductivity detectors - Typical Industrial applications- qualitative and quantitative analysis

MODULE IV INDUSTRIAL ANALYSERS 9

Water Analysis: pH, Conductivity, Silica, Dissolved Oxygen, Hydrocarbons analyzer, Sodium analyzer - Chlorine analyzer- Analysis of DM water – Flame Photometer - Flue gas analysis: Paramagnetic and diamagnetic – Insitu - Infrared Gas analyzer – Carbon Monoxide analyzer – Sulphur dioxide analyzer – Nitrogen Oxides analyzer – smoke detection: Ringleman Chart - Dust analyser - Typical Industrial applications

MODULE V ELECTROMAGNETIC RESONANCE AND MICROSCOPIC TECHNIQUES 9

Nuclear Magnetic Resonance Spectroscopy: NMR Spectrometers – Constructional Details of NMR spectrometer – Constructional Details of ESR spectrometer – SEM : principle and applications – TEM: principle and applications – Mass spectrometers: Components and applications – Typical Industrial applications

L –45 ; TOTAL HOURS –45

TEXT BOOKS:

1. R.S. Khandpur, “Handbook of Analytical Instruments”, Tata McGraw Hill publishing Co. Ltd., 2008
2.H.H. Willard, L.L.
3. Merritt, J.A. Dean, F.A. Settle, “Instrumental Methods of Analysis”, CBS publishing & distribution, 1995.

REFERENCES:

1. Douglas A. Skoog, “Principles of Instrumental Analysis” (7th International Edition), Thomson Brooks/Cole 2017
2. Robert D. Braun, “Introduction to Instrumental Analysis”, McGraw Hill, Singapore, 1987.
3. G.W. Ewing, “Instrumental Methods of Analysis”, McGraw Hill, 2008.

4. D.A. Skoog and D.M. West, “Principles of Instrumental Analysis”, Holt, Saunders Publishing, 1985.

COURSE OUTCOMES:

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

CO1: Identify common process parameters and analyze the function and general requirements of analytical instruments

CO2: Effectively compare the components and performance of visible - UV spectrophotometers and IR spectrophotometer

CO3: Select the type of Chromatography for a specific type of applications

CO4: Select suitable gas analyzer for industrial applications

CO5: Evaluate the characteristics of Microscopic techniques, NMR and mass spectrometers

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	L	H	L	L	M	M	H	L	L	L	M	M	H	L	L
CO2	L	L	L	H	M	L	L	L	L	L	M	M	M	L	L
CO3	M	H	L	L	H	L	L	M	L	L	M	L	H	L	L
CO4	M	H	L	L	H	L	L	M	L	L	M	L	H	L	L
CO5	L	M	L	H	M	H	L	M	L	L	L	L	M	L	H

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

SDG 9: The use of Analytical Instrumentation in Industries supports the growth of Industry and innovation. The aspects of analytical instrumentation will help the industry to evaluate the characteristics of different components using suitable analysers for many industrial applications and foster innovation

EIDX 05	**INSTRUMENTATION SYSTEM DESIGN**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**1**	**3**

COURSE OBJECTIVES:

COB1: To impart the knowledge on the designing aspects of signal conditioning circuits for the measurement of Level, temperature and PH.

COB2: To understand the designing concepts of Transmitters

COB3: To impart the designing skills needed to test Analog/ Digital PID controller, Data Loggers and Alarm Annunciator

COB4: To familiarize with the design of orifice, rotameters and control valve sizing

COB5 : To understand the safety issues concerned with the system design

MODULE I DESIGN OF SIGNAL CONDITIONING CIRCUITS 9

Design of V/I Converter and I/V Converter- Analog and Digital Filter design – Signal conditioning circuit for pH measurement –Compensation circuit - Signal conditioning circuit for Temperature measurement - Cold Junction Compensation – software and Hardware approaches -Thermocouple Linearization – Software and Hardware approaches

Practical :

1. Design of V/I and I/V converters
2. Design of low pass and high pass filters
3. Design of a FIR digital filter
4. Design of instrumentation amplifiers
5. Design of cold– junction compensation circuit for thermocouples

MODULE II DESIGN OF TRANSMITTERS 9

RTD based Temperature Transmitter – Thermocouple based Temperature Transmitter- Design of Capacitance based Level Transmitter – Air-purge Level Measurement – Design of Smart Flow Transmitters.

Practical :

1. Design of signal conditioning circuits for strain gauge and RTD
2. Measurement of level using capacitance method.

MODULE III DESIGN OF DATA LOGGER AND PID CONTROLLER 9

Design of ON / OFF Controller using Linear Integrated Circuits- Electronic PID Controller – Microcontroller Based Digital PID Controller - Micro - controller based Data Logger – Design of PC based Data Acquisition Cards

Practical :

1. Design of on-off controller, PID controllers using operational amplifier
2. Design of digital PID using Microcontroller

MODULE IV ORIFICE AND CONTROL VALVE SIZING 9

Orifice Sizing: - Liquid, Gas and steam services - Control Valves – Valve body:- Commercial valve bodies – Control valve sizing – Liquid, Gas and steam Services – Cavitation and flashing –Selection criteria – Rotameter Design.

Practical :

1. Determine the coefficient of discharge using orifice plate
2. Determine the nominal valve size for a control application.

L – 30 P -15; TOTAL HOURS – 45

TEXT BOOKS:

1. Bela G. Liptak, "Instrument Engineers Handbook - Process Control and Optimization", 4th Edition, Vol.2, CRC Press,2005

2. Eckman, D.P., "Automatic process control", Wiley Eastern Ltd.,New Delhi,1993

3. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005

4. RamakantGayakwad, "Op-amps and Linear Integrated Circuits", 4th Edition, Prentice Hall, 2000.

REFERENCES:

1. C. D. Johnson, "Process Control Instrumentation Technology", 8th Edition, PrenticeHall, 2006

2. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005.

3. R.W. Miller, "Flow Measurement Engineering Handbook", Mc-Graw Hill, New York1996.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Apply the knowledge of science in signal conditioning circuit design for different applications

CO2: Design transmitters and smart transmitters for different applications

CO3: Facilitate various systems for data acquisition and control and also to measure the real time system parameters

CO4: Design flow meters and final control element for suitable applications

CO5: Analyze safety instruments for any industrial processes.

Board of Studies (BoS) :	**Academic Council:**
18th BOS meeting held on 12.7.2022	19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	H	M	M		M							L	M	H	
CO2	M	M	M		M							L	H	M	L
CO3	M	M	M		M							L	M	L	M
CO4	M	M	M		M							L	H		L
CO5	M	L	L		M							L	M		

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

SDG 9: Build resilient infrastructure, promote inclusive and sustainable

industrialization and foster innovation

Facilitate sustainable and strong technological development through proper design of systems and promotes innovation in industries.

EIDX 06	**ADVANCED INSTRUMENTATION SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature

COB2: To explore the various types of analyzers used in industrial applications

COB3: To make the students to understand the requirement of safety instrumented system, standards and risk analysis techniques

COB4: To make students familiarize with Instrumentation standards such as BS1042, ISA 75, ISA 84 and ISA 88

COB5: To make students familiarize with Instrumentation Symbols, Abbreviations and Identification for Instruments, Process Flow diagrams, Instrument Loop diagrams, Instrument Hookup diagrams and Piping and Instrumentation Diagrams

MODULE I MEASUREMENT OF PROCESS PARAMETERS 9

Review the various Measurement techniques of temperature, pressure, flow and level – application -selection of sensors– calibration methods

MODULE II INSTRUMENTS FOR ANALYSIS 9

Ion selective electrodes : Gas & Liquid Chromatography - Oxygen analyzers for gas and liquid – CO,CO2, NO and SO Analyzers- Hydrocarbon and HS Analyzers – Dust Analyzers, smoke Analyzers, Toxic gas Analyzers and radiation monitoring

MODULE III SAFETY INSTRUMENTATION 9

Introduction to Safety Instrumented Systems – Hazards and Risk – Process Hazards Analysis (PHA) – Safety Life Cycle – Control and Safety Systems - Safety Instrumented Function - Safety Integrity Level (SIL) – Selection, Verification and Validation.

MODULE IV INSTRUMENTATION STANDARDS 9

Instrumentation Standards - significance of codes and standards – overview of various types -Introduction of various Instrumentation standards – review, interpretation and significance of specific standards - examples of usage of standards on specific applications.

MODULE V DOCUMENTATION IN PROCESS INDUSTRIES 9

Block Diagram of a Typical Process – Instrumentation Symbols, Abbreviations and Identification for Instruments: - Mechanical Equipment, Electrical Equipment, Instruments and Automation Systems -Process Flow Diagram (PFD) – Piping and Instrumentation Diagram (P&ID) -Instrument Lists and Specification – Logic Diagrams – Instrument Loop Diagrams - Instrument Hookup Diagrams – Location Plans for Instruments - Cable Routing Diagrams – Typical Control / Rack Rooms Layout –Vendors Documents and Drawings

L-45;TOTAL HOURS – 45

TEXT BOOKS:

1. B.G.Liptak, Instrumentation Engineers Handbook (Process Measurement and Analysis), Fourth Edition, Chilton Book Co, CRC Press, 2005.

REFERENCES:

1. Swapan Basu, Plant Hazard analysis and Safety Instrumentation systems Academic Press, 2016
2. Al.Sutko,Jerry.D.Faulk, Industrial Instrumentation, Delmar publishers, 1996.
3. Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., Safety Instrumented Systems: Design, Analysis, and Justification, 2ndEdition, ISA 2006.
4. Safety – ANSI/ISA84.00.01-2004, Part 1: Framework, Definitions, System Hardware and Software Requirements; ANSI/ISA84.00.01-2004, Part 2: Functional Safety: Safety Instrumented Systems for the Process Industry Sector; ANSI/ISA84.00.01-2004, Part 3: Guidance for the Determination of the Required Safety Integrity Levels-Informative
5. Standards- ANSI/ISA-75.01.01-2002 (60534-2-1 Mod): Flow Equations for Sizing control Valves; ISA84 Process Safety Standards and User Resources, Second Edition, ISA, 2011; ISA88 Batch Standards and User Resources, 4th Edition, ISA, 2011.
6. Documentation Standards – ANSI/ISA5.4-1991 – Instrument Loop Diagrams; ANSI/ISA5.06.01-2007 – Functional Requirements Documentation for Control Software Applications; ANSI/ISA20-1981 – Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

COURSE OUTCOMES:

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

CO1: Understand the instrumentation behind flow, level, temperature and pressure measurement

CO2: Acquire basic knowledge on the various types of analyzers used in typical industries

CO3: Understand the role of Safety instrumented system in the industry

CO4: Explain Standards for applying Instrumentation in Hazards Locations

CO5: Design, develop, and interpret the documents used to define instruments and control

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	H	H	H	L	M	M	M			M		L	H	H	
CO2	H	H	H	L	M	M	M			L		L	H	H	
CO3	H	H	H	L	M	H	M			H		L	H	H	
CO4	H	H	H	L	M	M	M			M		L	H	M	
CO5	H	H	H	H	H	M	H			H		L	H	M	

SDG 9: These technologies connect citizens around the world, monitor and track environmental impact, and optimize industrial inefficiencies
The technologies in this course connect citizens around the world through its advancements in instrumentation systems

EIDX 07	**VIRTUAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 4,9		**2**	**0**	**1**	**3**

COURSE OBJECTIVES:

COB1: To study the basic building blocks of virtual instrumentation

COB2: To study the various graphical programming environments in virtual instrumentation.

COB3: To provide knowledge about how to control an external measuring device by interfacing a computer

COB4: Provide to become competent in data acquisition and instrument control.

MODULE I FUNDAMENTALS OF VIRTUAL INSTRUMENTATION(VI) 8

Introduction-Graphical system design model-Design flow with GSD-VI-Hardware and software-VI for test ,control and design-VI in the Engineering Process-Introduction to LabVIEW-Data types-Modular Programming-Creating a Standalone application-For and while loop-Shift register-Control timing-Local and global variables

Practical :

1. Creating Virtual Instrumentation for simple applications
2. Programming exercises for loops and charts

MODULE II ARRAYS and CLUSTER OF INSTRUMENTS IN VI SYSTEM 7

Creating two dimensional and multidimensional arrays using loops--Array functions-auto indexing-matrix operations with array, creating cluster controls and indicators-creating cluster constant-order of cluster elements-cluster operations-assembling clusters-disassembling clusters- conversion between clusters and arrays-error handling-error cluster.

Practical :

1. Programming exercises for clusters and graphs.
2. Programming exercises on case and sequence structures, file Input / Output.

MODULE III STRUCTURES, STRINGS AND FILE I/O 7

Case structures-sequence structures-customizing structures-timed structures-Formula nodes-Event structures-Lab VIEW mathscript-creating string control-String functions-editing, formatting and parsing strings-Configuring string controls and indicators- Basics of file I/O-Choosing a file I/O format-file I/O Vis

Practical :

Programming exercises on case and sequence structures, file Input / Output.

MODULE IV INSTRUMENTATION CONTROL AND DATA ACQUISITION 8

GPIB COMMUNICATION – Hardware and software architectures – Instrument I/O control – VISA – Instrument Drivers – Serial Port communication – Other interfaces, DAQ – Hardware and software architecture, DAQ assistant – channels and task configuration, Selecting and configuring a data acquisition device, Components of computer based measurement system.

Practical :

1. Real time data acquisition through Virtual Instrumentation.
2. Real time temperature control using Virtual Instrumentation.

L – 30; P - 15; TOTAL HOURS – 45

TEXT BOOKS:

1. Gupta,"Virtual Instrumentation Using Lab View", Tata McGraw Hill, New Delhi,1st Edition, 2008
2. Jerome Jovitha, "Virtual Instrumentation and LABVIEW", PHI Learning, New Delhi, 1st Edition, 2010
3. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003

REFERENCES:

1. S.Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument society of America, 1994.
2. Ronald W. Larsen, "LabVIEW for Engineers", Prentice Hall Ltd, USA Jan 2010
3. Sanjay Gupta and Joseph John, " Virtual Instrumentation using LabVIEW", Tata McGraw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2005
4. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000.
5. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.
6. LabVIEW: Basics I & II Manual, National Instruments, 2005.

COURSE OUTCOMES:

CO1: Acquire knowledge on the application of virtual instrumentation for data acquisition and instrument control

CO2: Create arrays and clusters for a suitable application

CO3: Create Structures, Strings and File I/O for any application

CO4: Familiarize with the DAQ interfaces and bench level instruments

CO5: Work as a team and be able to develop a virtual instrument

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	H	M	M		M		L					L	H		M
CO2	M	M	H		H		L					L	H		L
CO3	M	M	H		H		L					L	H		L
CO4	M	M	H		H		L					L	M		M
CO5	M	M	M		M		L		M		M	L	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
Modern industrial developments will always promote lifelong learning opportunities.

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

New versions in the tool will pave the way for sustainable industrialization.

EIDX 08	**POWER PLANT INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide an overview of different methods of Power Generation, with a particular emphasis on thermal power Generation.

COB2: To get knowledge about the various measurements involved in power generation plants

COB3: To provide knowledge about the different types of analysers used for analysis

COB4: To impart knowledge about the different types of controls and control loops.

COB5: To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control

MODULE I OVERVIEW OF POWER GENERATION 9

Brief survey of methods of power generation – Hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – Thermal power plants – Block diagram – P & I diagram of boiler – Cogeneration

MODULE II MEASUREMENTS IN POWER PLANTS 9

Measurements – Flow of feed water, fuel, air and steam with correction factor for temperature – Steam pressure and steam temperature – Drum level measurement – Smoke density measurement – Dust monitor

MODULE III ANALYSERS IN POWER PLANTS 9

Flue gas oxygen analyser – Analysis of impurities in feed water and steam – Dissolved oxygen analyser – Chromatography – pH meter – Fuel analyser – Pollution monitoring instruments, conductivity meter; Silica Analyser.

MODULE IV CONTROL LOOPS IN BOILER & PROTECTION 9

Combustion control - Air fuel ratio control – Furnace draft control – Drum level control – Main steam and reheat steam temperature control – Super heater control – Air temperature – Deaerator Control – Distributed control system in power plants – Interlocks in boiler operation

MODULE V TURBINE MONITORING 9

Speed, vibration, shell temperature monitoring and control – Lubricant oil temperature control – Cooling system - Interlocks In turbine operation

L – 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1. Sam G.Dukelow, —The Control of Boilers‖, Instrument Society of America, 1991.
2. P.K.Nag, —Power Plant Engineering‖, Tata McGraw Hill, 2001.

Modern Power Station Practice‖ Vol. 6, Instrumentation controls and Testing, Pergaman Press

REFERENCES:

1. S.M.Elonka and A.L.Kohal, —Standard Boiler Operations‖, Tata McGraw Hill,New Delhi, 1994.
2. R.K.Jain,—Mechanical and Industrial Measurements‖, Khanna Publishers,New Delhi, 1995

3. E.Al. Wakil, —Power Plant Engineering‖, Tata McGraw Hill, 1984.

COURSE OUTCOMES:

At the end of the course the students will be able

CO1: Evaluate different methods of power generation and boiler operation in thermal power plants

CO2: Select suitable instrument for the measurement of different parameters in a boiler

CO3: Compare the working principle and performance of different analyzers used in thermal power plants

CO4: Design the important control loops and interlocks in boiler

CO5: Analyze the parameters to be monitored and controlled in steam turbines

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	H	H	M	M						M		H	M	H
CO2	M	H	H	M	M						M		H	M	H
CO3	L	H	M	H	M						H		H	M	H
CO4	M	M	H	M	M						M		H	M	H
CO5	M	H	M	M	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

The understanding of the power plant process promotes lifelong learning opportunities.

		L	T	P	C
EIDX 09	**SPACE AND NAVIGATIONAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 8, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To equip the students on the knowledge of Space Environment

COB2: To make the students understand the importance of Space Elements

COB3: To acquire basic knowledge about the principle and theory of Spacecraft

COB4: To understand the importance of physics behind Navigation

COB5 : To familiarize the students with the Landing System

MODULE I SPACE ENVIRONMENT AND DESIGN 9

Introduction to space and applications – Orbit – Mission requirements of LEO – GEO – GTO – HEO – Lunar orbits – Solar aspects angle variations – Space craft structure and astronauts – Manned space missions – Effect on satellite life time.

MODULE II ELEMENTS OF SPACE 9

Early airplanes, Biplanes, Monoplanes, Launch vehicles and Missiles – Developments in aerodynamics, Materials, Structures and Propulsion over the years – different types of flight vehicles – Classifications – Conventional control and powered control.

MODULE III PRINCIPLES OF FLIGHT AND SPACECRAFT STRUCTURE 9

Physical properties and structure of the atmosphere – Temperature, Pressure and altitude relationships – Evolution of lift, Drag, Moment ant thrust – Maneuvering principles – Spacecraft Design philosophy – Design for launch – Configuration examples – Design Verification – Future scope of space structures.

MODULE IV CONCEPTS OF NAVIGATION AND INERTIAL SENSORS 9

Fundamentals of space craft navigation systems and position fixing – Geo metric concepts of navigation – Earth in inertial space – Earth's rotation – Revolution of earth – Different coordinate systems – Coordinate transformation – Euler angle formulations – Direction cosine formulation – Quaternion formulation – Accelerometers – Gyroscopes – MEMS System.

MODULE V LANDING SYSTEMS AND AIR TRAFFIC MANGEMENT 9

Instrument landing system – Microwave landing system – GPS based landing system – Ground controlled approach system – Transponder landing system – Surveillance system – Airborne collision avoidance systems.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Anderson J.D.,” Introduction to Flight” McGraw-Hill,6th Ed., 2010.
2. Dave Doody,” Basics of Space Flight”, NASA/JPL-Caltech,2011.
3. Paul D. Groves. Principles off GNSS, Inertial and Multi sensor Integrated Navigation Systems, Artech House 2013.

REFERENCES:

1. Wijer J.J.,” Spacecraft Structures”, Springer-Verlag Berlin Heidelberg, 2018.

2. Nagaraj N.S. Elements of Electronic Navigational, Tata McGraw-Hill Pub. Co. New Delhi 2nd Edition 2015.

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1: Create a basics of Space Environment

CO2: Explain the Elements of Space

CO3: Design Spacecraft structure

CO4: Create a Concept of different axis systems and select suitable system.

CO5: Perform data fusion and Sensor integration

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO2	PO3	PO4	PO5	PO 6	P O7	PO 8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2	PSO 3
CO1	M	M											L	L	L
CO2	M	L										L	L	L	L
CO3	M	L										L	L	L	L
CO4	M	M	M								L		L	L	L
CO 5	M	L											L	L	L

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

SDG 8 : Descent work and economic growth .

Statement: This course enlightens students in promoting economic growth by focusing on global transportation sector.

SDG 9 : Industry, Innovation and Infrastructure.

Statement: The holistic understanding of space and navigation leads to Innovation in areas such as defense and space exploration.

		L	T	P	C
EIDX 10	**SAFETY INSTRUMENTATION**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Create awareness of basic concepts of safety instrumentation, standards and risk analysis techniques

COB2: Understand different layers of protection and safety Instrumentation applications

COB3: To know potential events and impact of failures

COB4: To make students aware of design, installation and maintenance procedures for safety of instruments

MODULE I INTRODUCTION 8

Safety Instrumented System (SIS): Need, features, components, difference between basic control system and SIS - Risk: How to measure risk, risk tolerance, Standards and Regulation, Usage of standards on specific applications.

MODULE II PROTECTION LAYERS AND SAFETY REQUIREMENT 10

Prevention Layers: Process Plant Design, Process Control System, Alarm Systems, Shutdown, Interlock, Physical Protection - Mitigation Layers: Containment Systems, Scrubbers and Flares, Fire and Gas (F&G) Systems, Evacuation Procedures - Safety specification requirements as per standards, causes for deviation from the standards

MODULE III SAFETY INTEGRITY LEVEL 10

Safety integrity levels- SIL determination methods-ALARP-Risk matrix-Risk graph-LOPA- examples for design of SIL

MODULE IV INSTRUMENTATION FOR INDUSTRIAL SAFETY 9

Electrical and Intrinsic Safety - Explosion Suppression and Deluge systems – Conservation and emergency vents - Flame, fire and smoke detectors - Leak Detectors - Metal Detectors.

MODULE V SELECTION OF TECHNOLOGY FOR SAFETY MANAGEMENT 8

Relay systems-solid state systems-microprocessor based systems-PLC based systems-safety PLCs-safety system complexity-communication with other systems.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. B.G.Liptak, “Instrumentation Engineers Handbook (Process Measurement & Analysis)”, Fourth Edition, Chilton Book Co, 2003

2. Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., “Safety Instrumented Systems: Design, Analysis, and Justification”, ISA, 2nd Edition, 2006.

REFERENCES:

1. John G Webster, “The Measurement, Instrumentation, and Sensors Handbook”, CRC and IEEE Press, 1999.

2. Safety - ANSI/ISA84.00.01-2004, “Part 1: Framework, Definitions, System Hardware and Software Requirements; ANSI/ISA84.00.01-2004”, “Part 2: Functional Safety: Safety Instrumented Systems for the Process Industry Sector; ANSI/ISA84.00.01- 41 2004”, “Part 3: Guidance for the Determination of the Required Safety Integrity Levels Informative”

COURSE OUTCOMES:

The students will be able to

CO1: Apply different industrial standards and regulations

CO2: Identify the various safety requirements in industries

CO3: Apply various integrity levels adopted in industries.

CO4: Choose the needed instrument technology for the proposed safety instrumentation system

CO5: Select suitable technology for the implementation of safety instrumentation

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

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

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

The understanding of the safety instrumentation in industries and domestic purposes helps in protecting ourselves and the society. The technological capabilities help in new contributions and also enhance entrepreneurship capacity of an individual.

EIDX 11	PIPING AND INSTRUMENTATION LAYOUT IN PROCESS INDUSTRIES	L	T	P	C
SDG: 4,12		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn about flow sheet and its symbols

COB2: To provide in depth knowledge on piping and instrumentation diagram

COB3: To study the interlocks and area classification

COB4: To learn about detail engineering

COB5: To study the uses of P&ID in various stages

MODULE I FLOW SHEET DESIGN 9

Types of flow sheets, flow sheet presentation, flow sheet symbols, line symbols and designation, process flow diagram, synthesis of steady state flow sheet, flow sheeting software

MODULE II PIPING AND INSTRUMENTATION DIAGRAM EVALUATION AND PREPARATION 9

P & I D Symbols, line numbering, line schedule, line diagram symbols, representation of line diagram, P & I D development, various stages of P & ID-P& ID for pumps, compressors process vessels, absorber, evaporator.

MODULE III CONTROL SYSTEMS AND INTERLOCKS FOR PROCESS OPERATION 9

Introduction and description, need of interlock, types of interlocks, interlock for pumps, compressor, heater-control system for heater, distillation column, expander

MODULE IV APPLICATION OF P&ID'S 9

Applications of P& ID in design state, construction stage, commissioning state, operating stage revamping state, applications of P&ID in HAZAPS and risk analysis.

MODULE V CASE STUDY 9

Case Study - Power plant - Cement Plant - Sugar plant - Chemical plant

L –45 ; TOTAL HOURS : 45

TEXT BOOKS:

1. Ernest E.Ludwig, "Applied Process Design for Chemical and Petrochemical Plants Vol-I", Gulf Publishing Company, Houston, 1989.

2. Max. S. Peters and K.D. Timmerhaus, “Plant Design and Economics for Chemical Engineers”, 4th Edition, McGraw Hill Inc., New York, 1991

REFERENCES:

1. Anil Kumar, “Chemical Process Synthesis and Engineering Design”, Tata McGraw Hill, New Delhi, 1982.

2. A.N Westerberg et al., “Process Flow sheeting”, Cambridge University Press, New Delhi, 1979

COURSE OUTCOMES:

At the end of the course the students will be able

CO1: To create flow sheets for various process

CO2: To develop P&IDs for various processes and can prepare the I/O schedule.

CO3: To define interlocks for the process so that control schemes can be developed

CO4: To apply in various stages like construction, commissioning and revamping of a project

CO5: Can work as maintenance, installation and commissioning engineer

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	H	H	M	M						M		H	M	H
CO2	M	H	H	M	M						M		H	M	H
CO3	L	H	M	H	M						H		H	M	H
CO4	M	M	H	M	M						M		H	M	H
CO5	M	H	M	M	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

The understanding of understanding the P&IDs promotes lifelong learning opportunities.

SPECIALIZATION II –CONTROL ENGINEERING

EIDX 21	**CONTROL SYSTEM COMPONENTS**	**L**	**T**	**P**	**C**
SDG: 4,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide knowledge on Control System Parameters

COB2: To provide knowledge on Gears & Gyroscope

COB3: To give acquaintance on Potentiometer & Synchros.

COB4: To make the students to understand Servomotors & Stepper Motors

COB5: To make the students to understand Tachometers

MODULE I INTRODUCTION 6

Introduction - Accuracy and Mode of Control - Closed Loop Control System - Components of Control System

MODULE II GEARS AND GYROSCOPES 10

Introduction - Types of Gears: Spur Gear and Pinion, Rack and pinion, Helical Gear, Herringbone Gear, Bevel Gear, Worm Gear - Gear for Load Matching, Design of Gear Trains - Backlash in Gears Introduction - Gyroscopic effect - Positional References - Construction of the Gyroscope - Working and application of Horizontal Gyroscope - Construction and use of vertical gyroscope - Equations of Gyroscope - Application of Gyroscope

MODULE III POTENTIOMETERS AND SYNCHROS 10

Introduction - Types of potentiometers - Applications of Potentiometers - selection of Potentiometers - Synchro Construction and Operation - Charactersitics - Application - Synchro pair as error detector

MODULE IV SERVO AND STEPPER MOTOR 10

Introduction - DC Servo motors: Transfer function of DC Servomotor, Transfer function of field controlled DC Servomotor, Armature controller DC Servomotor, AC Servo motor : Construction, Theory of operation of Induction Motor, Ac Servomotor Introduction - Permanent Magnet stepper motor - Variable Reluctance motor - Hybrid Stepper Motor - Applications

MODULE V TACHOMETERS 9

Introduction - Characteristic requirements of tachogenerator - DC Tachogenerator : Construction, working, Advantages & Disadvantages, EMF equation - AC Tachogenerators : AC Induction Tachogenerator, working, sources of error - Tachometer applications : Position control, Tachometer as an integrator

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. M.D. Desai, ‘Control System Components’ PHI Learning, New Delhi - 110 001, 2008, ISBN 9788120336056.

REFERENCES:

1. Benjamin C. Ku and Farid Golnaraghi, “Automatic Control Systems”,10th edition McGraw-Hill Education, 2017
2. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.

COURSE OUTCOMES:

On completion of the course the student will be able to

CO1: Identify the components suitable for closed loop control of a process

CO2: Apply the components for automation solutions

CO3: Understand the construction of the different control system components

CO4: Integrate the required components to build a control loop

CO5: Design the components to assess the performance for a particular application

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

SDG 4: Quality Education

The need for control system components provides quality education

SDG 9: Industry, Innovation & Infrastructure

This course will help to in cultivate new technology in control components design thereby improving the industrial growth

EIDX 22 **MODERN CONTROL SYSTEM**

SDG : 4

L	T	P	C
3	0	0	3

OBJECTIVES:

COB1: To provide the students a comprehension about the state space model and to understand the importance of the system state

COB2 : To make the students able to apply nonlinear system analysis

COB3: To provide knowledge on design state feedback control and state observer

COB4: To give basic knowledge in describing function analysis

COB5: To provide students an understanding of basic analysis and synthesis of control systems and to provide opportunities for students to gain practical experience in the use of computer design and analysis tools in Matlab and Simulink

MODULE I STATE SPACE ANALYSIS OF SYSTEMS 9

Concept of state variables, state model for typical linear systems, construction of state model from differential equations, block diagram representation of state models, state space model for electrical circuits, mechanical systems, electro-mechanical system-DC motors, State space model to transfer function model, transfer function model to state space model.

MODULE II STATE FEEDBACK AND OBSERVER DESIGN 9

Concept of controllability and observability of systems, state feedback controller design using pole placement method- Ackerman's formula, design of full state and reduced order observers. State feedback and observer design using control system toolbox

MODULE III NONLINEAR CONTROL SYSTEMS 9

Introduction to nonlinearities and non linear phenomenon, Nonlinear system behavior. Methods of linearization, Phase Plane Analysis: Concepts of Phase Plane Analysis, Phase Portraits, Singular Points, Symmetry in Phase Plane Portraits, Methods of Constructing Phase Portraits: Analytical method, the method of Isoclines.

MODULE IV NONLINEAR MODELS AND LINEARIZATION 9

Methods of linearization-Taylor series expansion-Jacobian method, Role of Eigen values and Eigen vectors-State transition matrix and its properties-stabilizability and delectability, Nonlinear system models- Hammerstein and Weiner models, case study.

MODULE V DESCRIBING FUNCTION METHOD 9

Basic concepts, describing functions for common nonlinearities, stability analysis by describing function approach, lyapunov stability criterion, popov's stability criterion.

L – 45; Total Hours – 45

TEXT BOOKS

1. Gopal, M., "Digital Control and State Variable Methods", 3rd Edition, Tata McGraw Hill, 2008.

2. Gopal, M., "Modern Control Engineering", New Age International, 2005

REFERENCES:

1. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 8th Edition, Pearson Education, 2004.
2. Gopal, M., "Control Systems: Principles and Design", 2nd Edition, Tata McGraw Hill, 2003.
3. Katsuhiko Ogata, "Discrete-Time Control Systems", Pearson Education, 2002.

COURSE OUTCOMES:

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

CO1: Determine state space model of electrical, mechanical and electromechanical systems

CO2: Convert a transfer function model to state space model and vice versa

CO3: Design state feedback controller and state observer

CO4: Suggest linearization different techniques

CO5: Analyze nonlinear systems using describing function method

Board of Studies (BoS) :	**Academic Council:**
18th BOS meeting held on 12.7.2022	19th AC held on 29.09.22

	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	H	H	M	M	M		L		L	M	L		H
CO2	H	H	H	H	M	M	M		L		L	M	L		H
CO3	H	H	H	H	M	M	M		L		L	M	L		H
CO4	H	H	H	H	M	M	M		L		L	M	L		H
CO5	H	H	H	H	M	M	M		L		L	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 and help in developing technological capabilities

The knowledge in this course will enable the students to grow with technological developments in the field of Control Systems

		L	T	P	C
EIDX 23	**INDUSTRY 4.0**	**L**	**T**	**P**	**C**
SDG: 9, 12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

During the course the student will be able

COB1: To understand the Concept of Smart Industry

COB2: To plan a Smart Industrial Architecture

COB3: To analyze the application of Artificial Intelligence in Industry 4.0

COB4: To analyze the application of Cloud Computing in Industry 4.0

COB5: To design application of Industry 4.0

MODULE I INTRODUCTION TO INDUSTRY 4.0 9

Introduction to industry 4.0 evolution – Industry 1.0, Industry 2.0, Industry 3.0, Industry 4.0 – Definition of Industry 4.0 – Components of Industry 4.0 – Digitalization and the networked economy – Smart factory – Comparison of Industry 4.0 factory and today's factory – Technological pillars of Industry 4.0, Scenario in India preparing for Industry 4.0.

MODULE II A TECHNICAL ROUTE TO INDUSTRY 4.0 9

Introduction to internet of things – Industrial internet of things concept – Convergence of automation and IoT smart manufacturing – Peer(M2M) communication, IT tools and methods, Role of identification, Sensing, Actuation & control – challenges – Smart devices and products – Smart logistics – Predictive analytics.

MODULE III IIOT & ARTIFICIAL INTELLIGENCE 9

Introduction – Fourth revolution – Sustainability assessment of manufacturing in industry – Lean production system – Smart factory connectivity, Key ingredients – Digital twins – Definition of artificial intelligence, Fundamentals of heuristics – Markov decision process, Artificial neural networks & machine learning.

MODULE IV CLOUD COMPUTING & SMART SENSORS 9

Introduction to cloud computing, Cloud computing and Industry 4.0 – Introduction to smart sensor – Components – Industrial sensors – Actuators – Transducers – SCADA.

MODULE V CASE STUDIES FOR INDUSTRY 4.0 9

Case studies in robotics – Additive manufacturing – Nanotechnology – Adaptive machines – Oil, Chemical and pharmaceutical industry – Milk processing and package industry.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. The Fourth Industrial Revolution by Klaus Schwab, World Economic Forum, 2020
2. Internet of Things – A Hands on Approach by ArsheepBahga and Vijay Madisetti, University Press, 2018
3. Kevin Knight, Elaine Rich and Shiv Nair, Artificial Intelligence, Hill Education, 2017.

REFERENCES:

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, A Press 2017.

2. The Fourth Industrial Revolution, Crown Business,2017.

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1: Write in scientific language about evolution of Industry 4.0

CO2: Analyze a technical route to design process involved in Industry 4.0

CO3: Give solutions to conceptual problems involving AI in IIoT

CO4: Design Industry 4.0 based solutions to some of the traditional Industrial applications

CO5: Suggest solutions for complex problems using cloud computing with smart sensors

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	M											L		L
CO2	M	L										L	L	L	L
CO3	M	L										L	L	L	L
CO4	M	M	M								L		L		L
CO 5	M	L											L		L

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

SDG 9: Industry, Innovation and Infrastructure.

Statement: This course enlightens students about the latest innovation in smart Industries.

SDG 12: Sustainable cities and communities.

Statement: The holistic understanding of IoT leads to construction of smart cities and smart homes.

		L	T	P	C
EIDX 24	**ROBOTICS AND AUTOMATION**	**L**	**T**	**P**	**C**
SDG 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To learn the fundamentals of robot systems.

COB2: To study about the end effectors and control systems required for robot system.

COB3 : To gain knowledge about the kinematics and sensors of robots.

COB 4: To inculcate the programming language required for the robot systems.

COB 5: To give insight about robot automation and industrial applications.

MODULE I FUNDAMENTALS OF ROBOTIC SYSTEMS 9

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system.

MODULE II END EFFECTORS AND ROBOT CONTROLS 10

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

MODULE III ROBOT TRANSFORMATIONS AND SENSORS 10

Robot kinematics -Types- 2D, 3D Transformation-Scaling, Rotation, Translation-Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors -Tactile sensor – Proximity and range sensors – Robotic vision sensor - Force sensor - Light sensors, Pressure sensors.

MODULE IV BASICS OF ROBOT PROGRAMMING 9

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 V ROBOT CELL DESIGN AND APPLICATIONS 7

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle. Introductions-Robot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

L:45 ; TOTAL HOURS- 45

TEX BOOKS:

1. Deb .S.R, "*Robotics Technology and flexible automation"*, Tata McGraw-Hill Education, 2009.
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, *"Technology Programming and Applications"*, McGraw Hill, 2012
3. Tsuneo Yohikwa, "*Foundations of Robotics Analysis and Control"*, MIT Press., 2003.
4. John J. Craig, *"Introduction to Robotics Mechanics and Control*", Third Edition, Pearson, 2008

REFERENCES :

1. Radhakrishnan .P, Srivatsavan .R, Mohan Ram .P.V and Radharamanan .R, CAD/CAM, "Robotics and factories of the future, Proceeding of the 14th International Conference on CAR and FOF", 98 editors, Narosa Publishing house, 2003.
2. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", Phi Learning., 2009.

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: Explain the fundamentals of robotics system**.**
CO2: Select the appropriate end effectors.
CO3: Describe the robot kinematics and its sensors
CO4: Elucidate the robot programming language used in robot systems.
CO5: Express about the robot automation and industrial applications

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	M	M	L	L	L	M	L	L	L	L	M	M	L	L
CO2	M	M	M	L	L	L	M	L	L	L	L	M	M	L	L
CO3	H	H	H	H	L	L	M	L	L	L	L	M	M	L	L
CO4	M	M	M	L	L	L	M	L	L	L	L	M	M	L	L
CO5	M	M	M	L	L	L	M	L	L	L	L	M	M	L	L

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

SDG 9 : Encompasses three important aspects of sustainable development: infrastructure, industrialization and innovation

In the modern world, robotics has replaced the work carried out by human in hazardous areas. The updating of technological developments in the field of robotics will provide career opportunities.

		L	T	P	C
EIDX 25	**MODELING AND SIMULATION**	**L**	**T**	**P**	**C**
SDG : 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To give the overview of mathematical modelling

COB2: To provide knowledge on development of mathematical modelling for simple and complex systems

COB3: To study about numerical methods and empirical modelling

MODULE I OVERVIEW OF MATHEMATICAL MODELING 8

Mathematical Model, classification of model equations, Development of mathematical model, Simulation, Nonlinear Differential Equations, Conservation of Mass/Energy/Momentum, Black Box Models

MODULE II MODEL DEVELOPMENTS FOR SIMPLE SYSTEMS 9

Settling velocity of spherical particle, Vaporization from a single droplet in quiescent air, Modeling of a surge tank, Modeling of the pH process, Modeling of a Jacketed Heater, reaction, PDE model for tubular reactor with axial dispersion.

MODULE III MODEL DEVELOPMENTS FOR COMPLEX SYSTEMS 9

Isothermal CSTR, Linearization of a nonlinear equation, Bioreactor Modeling, Magnetic levitation (unstable systems), Choletts model with input multiplicities, Model for predators and Prey populations, Non-Isothermal continuous stirred tank reactor.

MODULE IV NUMERICAL SOLUTIONS OF MODEL EQUATIONS 9

Newton – Raphson's method for a system of nonlinear algebraic equations; Runge-Kutta Methods of solving numerically IVP ODEs, Numerical solution of nonlinear BVP ODEs**,** Numerical solution of nonlinear PDE, least square Curve Fitting, Variable transformation to get a linear equation.

MODULE V EMPIRICAL MODELS 10

Introduction; First order plus dead time process models; Integrator plus dead time; Discrete Time Autoregressive Models, Development of model of evaporator, boiler and distillation column

L – 45; Total Hours –45

TEXT BOOKS:

1. Bequette, B.W., "Process Dynamics: Modeling, Analysis and Simulation", Prentice-Hall International, Singapore, 1998

2. Jana, A.K., "Chemical Process Modeling and Computer simulation", Prentice-Hall-India, New Delhi, 2011
3. Finlayson, B.A., "Introduction to Chemical Engineering Computing", Wiley Student Edition, Singapore, 2006
4. Chidambaram M., "Mathematical Modeling and Simulation for Engineers", Cambridge University Press, New Delhi, 2017

REFERENCES :

1. Ramirez, W.; Computational Methods in Process Simulation , 2nd Edn., utterworths Publishers, New York, 2000
2. Luyben, W.L., Process Modelling Simulation and Control ,2nd Edn, McGraw-Hill Book Co., 1990

COURSE OUTCOMES:

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

CO1: Get an overview of the procedure used for mathematical modeling and model equations

CO2: Develop models for simple systems such as surge tank and pH process

CO3: Develop models for complex systems such as CSTR, bioreactor and levitation system

CO4: **O**btain numerical solutions for the nonlinear model equations, both ODEs and PDEs

CO5: Simulate various types of nonlinear models and find solutions using MATLAB and SCILAB

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PS O1	PS O2	PS O3
CO1	H	H	H	H	M	M	M		L		L	M			H
CO2	H	H	H	H	M	M	M		L		L	M			H
CO3	H	H	H	H	M	M	M		L		L	M			H
CO4	H	H	H	H	M	M	M		L		L	M			H
CO5	H	H	H	H	M	M	M		L		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 and help in developing technological capabilities

The knowledge in this course will enable the students to grow with technological developments in the field of Control Systems

EIDX 26	DIGITAL PROCESS CONTROL	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To represent the linear time invariant System in discrete State Space form.

COB2: To analyze the controllability, observability and stability of a Discrete time System

COB3: To estimate model parameters from input/output measurements

COB4: To Design Digital Controllers

COB5: To Design Multi-loop and Multivariable Controllers for multivariable system

MODULE I DISCRETE STATE-VARIABLE TECHNIQUE 9

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system–Stability tests of discrete-data system.

MODULE II DISCRETE TIME SYSTEMS AND CONTROLLER DESIGN 9

Z transform – inverse Z transform - mathematical representation of sampler-transfer function of zero order hold and first order hold device-Pulse transfer function – open loop and closed response of linear sample data control system for step input – stability analysis: Jury's test and bilinear transformation – Digital PID controller – Dead-beat controller, Dahlin's controller and Kalman's controller.

MODULE III SYSTEM IDENTIFICATION 9

Identification of Non Parametric Input-Output Models:-Transient analysis– Frequency analysis– Correlation analysis– Spectral analysis – Identification of Parametric Input-Output Models - Least Squares Method – Recursive Least Square Method.

MODULE IV MULTILOOP REGULATORY CONTROL 9

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.

MODULE V PREDICTIVE CONTROL 9

Introduction - Model predictive control – Dynamic matrix control – Model algorithmic control – case studies – Introduction to Generalized predictive control.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Gopal, M. Digital Control and State Variable Methods: Conventional and Intelligent Control Systems. New Delhi: Tata McGraw Hill Education Pte. Ltd, 4th edition, 2014
2. Stephanopoulos, G., “Chemical Process Control -An Introduction to Theory and Practice”, Prentice Hall of India, 2005.
3. Sigurd Skogestad, Ian Postlethwaite, “Multivariable Feedback Control: Analysis and Design”, John Wiley and Sons, 2005

REFERENCES:

1. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, “Process Dynamics and Control”, Wiley John and Sons, 3rd Edition, 2010
2. P. Albertos and A. Sala, “Multivariable Control Systems An Engineering Approach”, Springer Verlag, 2006
3. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2008
4. Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill, 2000

.

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Analyze the discrete time systems

CO2: Design digital controllers for continuous and discrete systems

CO3: Build models from input-output data using different identification tools

CO4: Design multivariable control for suitable processes

CO5: Design predictive control for suitable processes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	H	L	H	L	L							L	L		M
CO2	L	L	L	L	L							L	L		M
CO3	M	M	L	L	L							L	L		M
CO4	M	L	L	L	L							L			H
CO5	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

The digital control systems and controller design enables quality education and promotes lifelong learning.

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

The advanced control system design paves way for sustainable industrialization and innovation in industries.

		L	T	P	C
EIDX 27	**NONLINEAR CONTROL SYSTEM**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the nature of non-linear systems and to analyze the stability of such systems

COB2: To develop suitable models of non-linear systems and to develop suitable controllers for such systems

COB3: To understand the chaotic and bifurcation behavior of non-linear systems

COB4: To linearize the non-linear systems

MODULE I NONLINEAR SYSTEMS 8

Introduction to Nonlinear systems - properties of nonlinear systems - classification of nonlinearities - Inherent nonlinearities - Intentional Nonlinearities, – Numerical solutions to nonlinear differential equations

MODULE II STABILITY OF NONLINEAR SYSTEMS 10

BIBO and Asymptotic stability – Phase plane analysis (analytical and graphical methods) – Lyapunov Stability Criteria – Krasovskil's method – Variable Gradient Method – Stability Analysis by Describing function method.

MODULE III MODELLING OF NONLINEAR SYSTEMS 10

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification – On-line parameter estimation for nonlinear systems – Nonlinear PID controller - Gain scheduling control – case studies

MODULE IV CHAOS AND BIFURCATION 7

Introduction to Chaos - The Lorenz Equations – Test for chaos - Bifurcation Behavior of ordinary differential equations - Types of Bifurcations - Limit Cycle Behavior and Hopf Bifurcation.

MODULE V LINEARIZATION 10

Methods of linearization – Taylor's series expansion – Jacobean method - state model for systems – Role of Eigen values and Eigenvectors – State transition matrix and its properties – Controllability and observability.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Hangos, K.M., Bokor, J., and Szederkrnyi, G., "Analysis and control of Non-linear Process systems".Springer 2016.

2. Gopal,M., “Digital Control and State Variable Methods: Conventional and Intelligent Control Systems", Fourth Edition, Tata Mc-Graw Hill, 2012

REFERENCES:

1. Shankar Sastry, “Nonlinear Systems: Analysis, Stability, and Control”, Springer New York, 2013

2. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2008

3. Thompson, J. M. T., and Stewart, H. B.,” Nonlinear Dynamics and Chaos”, John Wiley & Sons, 2002

COURSE OUTCOMES:

CO1: Able to find numerical solution for nonlinear equations

CO2: Able to analyze the stability of nonlinear systems

CO3: Model nonlinear systems and design controllers to various applications

CO4: Apply the bifurcation methods to nonlinear systems

CO5: Able to linearize the nonlinear systems

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO1 1**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	H	H	M	L		L				L	L	L	L	L	H
CO2	H	H	M	L		L				L	L	L	L	L	H
CO3	H	H	M	L	H	L				L	L	L	L	L	H
CO4	H	H	M	L		L				L	L	L	L	L	H
CO5	H	H	M	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 and help in developing technological capabilities

The understanding of nonlinear systems and its linearization will help to develop control applications in various fields of engineering.

EIDX 28	**SYSTEM IDENTIFICATION**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

The student should be made to:

COB1 : Observe systems by their behavior using Nonparametric Identification Methods using Online and Offline Data

COB2 : Observe systems by their behavior using Parametric Identification methods using online and offline Data

COB3 : Estimate and validate the data using parametric estimation methods

COB4: Understand the concepts of closed loop identification methods

COB5: Gain knowledge in identification using intelligent techniques

MODULE I NONPARAMETRIC IDENTIFICATION 9

Transient and frequency analysis methods, impulse and step response methods, correlation method, spectral analysis.

MODULE II PARAMETRIC IDENTIFICATION 10

Steps in identification process, determining model structure and dimension, Linear and nonlinear model structures, Input signals: commonly used signals, spectral properties, and persistent excitation.

MODULE III PARAMETRIC ESTIMATION 10

Linear regression, least square estimation, statistical analysis of LS methods, Minimizing prediction error- identifiability, bias, Least squares, Instrumental Variable Method - parametric estimation using ARX, ARMAX, OE, BJ methods

MODULE IV CLOSED LOOP IDENTIFICATION 9

Identifiability considerations – direct identification – indirect identification - Subspace Identification methods: classical and innovation forms, free and structures parameterizations - Relay feedback identification of stable processes and unstable processes.

MODULE V SYSTEM IDENTIFICATION USING INTELLIGENT TECHNIQUE 7

Identification of empirical data from process using Neural networks - Neural Network ARX (NNARX), NNARMAX, Identification using Takagi Sugeno Fuzzy System

L – 45; Total Hours – 45

TEXT BOOKS:

1. Ljung .L, "System Identification: Theory for the user", Prentice Hall, Englewood Cliffs, 1987.

2. Torsten Soderstrom, Petre Stoica, "System Identification", Prentice Hall International (UK) Ltd. 1989.

3. Juang, Jer-Nan, "Applied System Identification", Prentice Hall PTR, Englewood Cliffs, New Jersey, 1994.

REFERENCES:

1. Arun K. Tangirala, "Principles of System Identification: Theory and Practice", CRC Press,2014.

2.F. Van der Heijden, R.P.W. Duin, D. de Ridder and D.M.J. Tax, "Classification, Parameter Estimation and State Estimation, An Engineering Approach Using MATLAB", John Wiley & Sons Ltd., 2004.

3. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 1996

4. C.Cortes and V.Vapnik, "Support-Vector Networks, Machine Learning", 1995

5. Karel J. Keesman," System Identification an Introduction", Springer, 2011.

6. Tao Liu, Furong Gao, "Industrial Process Identification and control design, Step-test and relay-experiment-based methods", Springer- Verilog London Ltd, 2012.

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Identify a system using transient and frequency method

CO2: Determine the model structure and dimension for identification

CO3: Estimate the system parameters

CO4: Perform closed loop identification

CO5: Identify a complex system using Intelligent techniques

Board of Studies (BoS) :

18th BOS meeting held on 12.7.2022

Academic Council:

19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O 2	PS O3
CO1	H	H	H	H	M	M	M		L		L	M			H
CO2	H	H	H	H	M	M	M		L		L	M			H
CO3	H	H	H	H	M	M	M		L		L	M			H
CO4	H	H	H	H	M	M	M		L		L	M			H
CO5	H	H	H	H	M	M	M		L		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 and help in developing technological capabilities

The knowledge in this course will enable the students to grow with technological developments in the field of Control Systems

EIDX 29	ADAPTIVE CONTROL	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To impart knowledge on adaptive control techniques

COB2: To enhance knowledge on the implementation issues and practical consideration by investigating the adaptive schemes

COB3: To illustrate the application of dynamic programming and HJB equation in the design of constrained and/or time optimal control system.

MODULE I INTRODUCTION 9

Introduction to adaptive control-Effects of process variations–Adaptive control schemes – Adaptive control problem–Applications–Real time parameter estimation-Estimating parameters in dynamical system.

MODULE II SELF TUNING REGULATOR 9

Deterministic in-direct self-tuning regulators–Deterministic direct self-tuning regulators– Stochastic self-tuning regulators – Linear Quadratic STR–Adaptive Predictive Control.

MODULE III MODEL REFERENCE ADAPTIVE CONTROL 9

The MIT rule–Lyapunov theory–Design of model reference adaptive controller using MIT rule and Lyapunov theory–Relation between model reference adaptive controller and self-tuning regulator.

MODULE IV GAIN SCHEDULING CONTROL 9

Introduction - Design of gain scheduling controller– Case studies – Application of adaptive control in distillation column and variable area tank system.

MODULE V INTRODUCTION TO OPTIMAL CONTROL AND CONSTRAINED OPTIMAL CONTROL 9

Statement of optimal control problem-problem formulation and forms of optimal control- performance measures-various methods of optimization-Linear programming - Dynamic programming– Hamilton-Jacobi-Bellman equation-LQR system using HJB equation.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. KarlJ.Astrom & Bjorn Wittenmark,“Adaptive Control”,(Pearson Education, Singapore), SecondEdition,2003.

2. NaiduD.S,Optimal Control System, CRC Press, 2003

3. Landau, I.D.,Lozano,R.,M'Saad,M.,Karimi,A.,“Adaptive Control:Algorithms, Analysis and Applications”, Series: Communications and Control Engineering,2nd edition.2011

4. Shankar Sastry,Marc Bodson,“Adaptive Control: Stability, Convergence and Robustness”, Prentice-Hall Advanced Reference Series (Engineering),1994,RepublishedbyDover Publications in2011(ISBN-10:0486482022)

REFERENCES:

1. Stephanopoulis G.“Chemical Process Control”, Prentice Hall of India,,New Delhi, 1990.

2. KirkD.E, Optimal ControlTheory,Dover publication,2004

3. https://onlinecourses.nptel.ac.in/noc23_ee22/course

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Analyze the circumstances in which adaptive control is to be used

CO2: Design deterministic and stochastic self tuning regulators

CO3: Compare the design procedure and performance of model reference adaptive controllers and self tuning regulator

CO4: Analyze the stability of adaptive controller and design adaptive controllers for selected processes

CO5: Formulate the optimization problem based on requirement and to design constrained optimal control

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	M	L	H	L	L					L	L	L			H
CO2	L	M	H		L							L	H		
CO3	M	M	L		L							L			H
CO4	M	M	L	L	H							L			H
CO5	M	M	L	L	H							L			H

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

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

This course facilitates to design advanced control in process and thereby promotes a sustainable industrialization and innovation.

		L	T	P	C
EIDX 30	**PLANT ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide in depth knowledge on Plant Engineering

COB2: To introduce the different elements of the plant

COB2: To learn about the P&ID and the different process involved in detail engineering

COB3: To learn about the support to Instrumentation from other disciplines

COB4: To study about the Installation and commissioning

MODULE I INTRODUCTION OF PLANTS 9

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location -selection of plant location

MODULE II ELEMENTS OF PLANT 9

Main Elements of a Plant, Flow sheet - Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization

MODULE III DETAIL ENGINEERING 9

P& ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase Instrument List, I/O Count, Specification Sheets, Instrument Installation (Hook ups), Control Philosophy – Detail Engineering

MODULE IV SUPPORT FROM OTHER DISCIPLINE 9

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture

MODULE V INSTALLATION AND COMMISSIONING 9

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production

L – 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1. Duncan C Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto,2014 McGraw-Hill Education.
2. Gabriel Salvendy, Handbook of Industrial Engineering – Technology and operations Management, John Wiley & Sons, 2001

REFERENCES:

1. Robert C Rosaler , Standard Handbook of Plant Engineering, Mc Graw Hill third Edition, 2004

2. R. Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001.

COURSE OUTCOMES:

At the end of the course the students will be able

CO1: To develop the plant and project description

CO2: To develop flow sheet and PFDs for a project

CO3: To review and correct P&IDs and can involve in detail engineering of a project

CO4: To coordinate with other disciplines

CO4: To do installation and commissioning of new plants

oard of Studies (BoS) : 18th BOS meeting held on 12.7.2022

Academic Council: 19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3
CO1	M	H	H	M	M						M		H	M	H
CO2	M	H	H	M	M						M		H	M	H
CO3	L	H	M	H	M						H		H	M	H
CO4	M	M	H	M	M						M		H	M	H
CO5	M	H	M	M	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

The understanding of understanding the P&IDs promotes lifelong learning opportunities.

		L	T	P	C
EIDX 31	**INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES**				
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: Understand the different oil recovery methods, oil gas separation and its processing

COB2: Learn about the most important unit operations in petrochemical industries like cracking, reforming etc

COB3: Gain knowledge on the important derivatives obtained from petroleum, its uses steps followed for ensuring intrinsic safety

COB4: Study about the different control schemes applied to processes like distillation column, PVC production unit, cracking and reforming

COB5: Study about the safety in instrumentation systems

MODULE I OIL EXTRACTION AND PROCESSING 9

Petroleum Exploration - methods of oil extraction - recovery techniques – Primary and Secondary recovery - Enhanced oil recovery - separation of gas and water from oil - control loops in oil gas separator

MODULE II PETROLEUM REFINING 9

Unit operations in refinery - thermal cracking - catalytic cracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum

MODULE III CHEMICALS FROM PETROLEUM 9

Chemicals from methane, acetylene, ethylene and propylene - production routes of important petrochemicals such as polyethylene, polypropylene, ethylene dioxide, methanol, xylene, benzene, toluene, styrene, VCM and PVC

MODULE IV CONTROL LOOPS IN PETROCHEMICAL INDUSTRY 9

Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production – Control of VCM and PVC production

MODULE V SAFETY IN INSTRUMENTATION SYSTEMS 9

Area and material classification as per National Electric Code (NEC) - Classification as per International Electro technical Commission (IEC)

L – 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1.Balchen J.G and Mumme K.I., ―Process Control Structures and Applications‖, Von Nostrand Reinhold Company, New York, 1988.

2. www.scribd.com/doc/2336259/ABB-Oil-Gas-production- Hand-Book.

REFERENCES:

1. Liptak B.G., ―Instrumentation in Process Industries‖, Chilton Book Company, 2005
2. Waddams A.L., ―Chemicals from Petroleum‖, Butter and Janner Ltd., 1968
3.Ram Prasad, ―Petroleum Refining Technology‖, Khanna Publishers, New Delhi, 2000

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1: Implement the oil recovery methods, oil gas separation and the important derivatives obtained from petroleum and its uses

CO2: Analyze the unit operations like cracking, reforming etc

CO3: Infer the important derivatives obtained from petroleum and its uses

CO4: Apply different control schemes to processes like distillation column, PVC production unit, cracking and reforming

CO5: Interpret the safety measures required for petrochemical industries

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2	PS O3
CO1	M	H	H	M	M						M		H	M	H
CO2	M	H	H	M	M						M		H	M	H
CO3	L	H	M	H	M						H		H	M	H
CO4	M	M	H	M	M						M		H	M	H
CO5	M	H	M	M	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

The understanding of the controls and Instrumentation in petroleum industries helps in career and learning opportunities.

EIDX 32	**INSTRUMENTATION AND CONTROL IN IRON AND STEEL INDUSTRIES**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To familiarize the students with raw material pertaining to making of iron, equipments like blast furnace etc.

COB2: To get knowledge about various process involved in iron making

COB3: To impart knowledge about measuring instruments pertaining to blast furnace, oxygen plant, cold rolling mill, hot rolling mill.

COB4: To expose to automation and control system in respect of steel industry

COB5: To provide an overview of computer application in iron industry

MODULE I FLOW DIAGRAM AND DESCRIPTION OF THE PROCESSES 9

Raw materials preparation, iron making, blast furnaces, stoves, raw steel making, basic oxygen furnace, electric furnace.

MODULE II CASTING OF STEEL 9

Primary rolling, cold rolling and finishing.

MODULE III MEASUREMENT & CONTROL 9

Measurement of level, pressure, temperature, flow, density, weight, thickness and shape, Information & graphic display system, alarms. Blast furnace stove combustion control system, gas and water controls in BOF furnace. Sand casting old control.

MODULE IV ANALYTICAL INSTRUMENTS 9

Oxygen flue gas, pH, conductivity, pollution monitoring instruments, dust monitor

MODULE V COMPUTER APPLICATIONS 9

Model calculation and logging, rolling mill control, annealing process control.Computer (center utilities dispatch computer).

L – 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1.Tupkary R.H, ―Introduction to Modern Iron Making‖ , Khanna Publishers ,II Edition, New Delhi1986

2. Tupkary R.H., - Introduction to Modern Steel Making‖, Khanna Publishers, IV Edition

REFERENCES:

1. Liptak B. G, Instrument Engineers Handbook, volume 2, Process Control, Third edition, CRC press, London, 1995
2. Considine D.M, Process / Industrial Instruments and Control Handbook, Fourth edition, McGraw Hill, Singapore, 1993 – ISBN-0-07-012445-0
3. D. Patrnabis, Principle of Industrial Instrumentation, Tata Mcgraw Hill publishing company

COURSE OUTCOMES:

At the end of the course the students will be able

CO1: To develop project description and flow diagrams

CO2: To work as a processing and maintenance engineer

CO3: To implement the concept of different measurement techniques and control systems in Iron and steel Industry

CO4: To select the analytical instruments for different analysis

CO5: To implement the methods of computer control in Iron and steel industry

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

The understanding of understanding the P&IDs promotes lifelong learning opportunities.

		L	T	P	C
EIDX 33	**INSTRUMENTATION AND CONTROL IN PHARMACEUTICAL INDUSTRIES**	**3**	**0**	**0**	**3**
SDG: 4					

COURSE OBJECTIVES:

COB1: To impart knowledge on the use of instrumentation in pharmaceutical industries

COB2: To know about the various instruments used in pharma industries

COB3: To deliver information on the stability testing methods and purification methods used in pharma industries

COB4: To gain acquaintance with the instruments used for bioprocessing

MODULE I INSTRUMENTATION 8

Measuring devices for temperature, pressure, density, humidity, viscosity, flow rate, transducers and pollution control. Instrumentation in processing units (tablets, capsules)

MODULE II METHODS OF ANALYSIS 10

UV-VIS spectrophotometry, theory and application; Chromatography-principle, technique and application; basic studies of X-Ray diffraction, Differential Scanning Calorimetry and Fourier Transmission Infrared, its application

MODULE III STABILITY TESTING 10

Introduction, rate equations, physicochemical and biological factors affecting stability of drugs, degradation pathways, objectives and design of stability testing, accelerated stability studies, real-time stability studies, photo stability testing, stability testing of dosage forms, prediction of shelf life, overages, ICH guidelines.

MODULE IV PURIFICATION AND GRANULATION METHODS 9

Purification of active pharmaceutical ingredients by crystallization, distillation (theory, apparatus, application, related problems); 1(c) Granulation methods for tablets; drying (apparatus, theory and problems); application of psychometric chart to drying(humidity, humidifier).

MODULE V BIO PROCESSING TECHNIQUES 8

Fermentation Technology, Process variables, state variables; batch, continuous, fed batch processes of fermentation, material balance, oxygen uptake rate, volumetric oxygen transfer coefficient, downstream processing(product recovery).

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. B.G.Liptak, "Instrumentation Engineers Handbook (Process Measurement & Analysis)", Fourth Edition, Chilton Book Co, 2003

2. Thomas M Jacobsen, "Modern Pharmaceutical Industry: Jones and Bartlett India private limited, 2020.

REFERENCES:

1. John G Webster, "The Measurement, Instrumentation, and Sensors Handbook", CRC and IEEE Press, 1999.

2. Cochrane Tom, "The Application of Statistical Process Control in the Pharmaceutical and Biotechnology Industries "Woodhead Publishing Ltd

COURSE OUTCOMES:

CO1: Able to identify instruments for use in various applications

CO2: Able to find suitable analysis methods

CO3: Ability to test the stability of chemicals using various methods

CO4: Identify the methods and instruments used for purification, granulation and filtering

CO5: Identify the various instruments used for bio processing of chemical substances.

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

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

SDG 4 : Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

The understanding of the use of instrumentation technology in pharmaceutical industries helps in learning the processing of chemical components in the field of medicine. The technological capabilities help in new product development.

		L	T	P	C
EIDX 34	**INSTRUMENTATION AND CONTROL IN CHEMICAL INDUSTRIES**	**L**	**T**	**P**	**C**
SDG: 9, 12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To equip the students on the knowledge of Measurement and Calibration in chemical Industries

COB2: To make the students understand the importance of Temperature measurement in chemical Industries

COB3: To introduce the basics of Pressure measurement in chemical Industries

COB4: To acquire basic knowledge about the principle and theory of Control Process in chemical Industries

COB5: To understand the importance of Safety Process in chemical Industries

MODULE I INTRODUCTION TO MESUREMENT AND CALIBRATION IN CHEMICAL INDUSTRY 8

Introduction-Definition of Measurement and Calibration and their application-Measurement method-Direct Method-Indirect Method-Functional elements-Static Characteristics-Dynamic Characteristics – Standards – IE 61508 – APIRP 14C – APIRP554 – Hazardous waste management in chemical industry.

MODULE II MEASURMENTS OF TEMPERATURE IN CHEMICAL INDUSTRY 9

Introduction-Expansion of Thermometer: Principle, Construction and application, spiral bimetallic thermometer –mercury in glass thermometer-Electrical Temperature sensor: Principle, Construction and application, resistance temperature detector, thermocouple and thermistor-Pyrometer: principle-Construction and application, optical and radiation.

MODULE III MEASUREMENT OF PRESSURE IN CHEMICAL INDUSTRY 9

C type Bourdon tube, Bellows and Metallic diaphragm gauge: Principle Construction and application-Force balance pressure gauge- principle, construction and application, dead weight tester. Electrical pressure transducer- principle, construction and application, LVDT and Strain gauge. Vacuum measurement- principle-construction and application, McLeod gauge.

MODULE IV CONTROL LOOPS IN CHEMICAL INDUSTRY 10

Control of binary and fractional distillation columns – Control of catalytic and thermal crackers – Control of catalytic reformer – Control of alkylation process – Control of polyethylene production – Control loops for VCM and PVC production processes.

MODULE V SAFETY IN CHEMICAL INDUSTRY 9

Area and material classifications as per national electric code (NEC) – Classifications as per international electro technical commission – Techniques used to reduce explosion hazards – Pressurization techniques – Type X, Type Y and Type Z – Intrinsic safety – Lower and upper explosion limit.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Stephanopoulos, George. Chemical process control: An Introduction Theory and practice. Pearson Education India: New Delhi, 2020, ISBN13:9789332549463.
2. Coughanowr, Donald R, LeBlanc, Steven E., Process system analysis and control., McGraw Hill International, Newyork, 2019, ISBN-13:978-0070678200
3. Balchen J.G and Mumme K.I., Process Control Structures and Applications, Von Nostrand Reinhold Company,New York 2018.
4. Ram Prasad Petroleum Refining Technology,Khana Publishers,New Delhi, 2020.

REFERENCES:

1. LiptakB.G., Instrumentation in Process Industries, Chilton Book Company, 2018
2. Waddams A.L., Chemicals from Petroleum, Butter and Janner Ltd.,2020
3. Singh S.K Industrial Instrumentation and Control McGraw Hill, New Delhi,2019, ISBN -13: 978-0073397894
4.Fundamental of Industrial Instrumentation, Wiley India pvt.Ltd. New Delhi 2021, ISBN-13: 978-8126528820.

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1: Gain Knowledge on the measurement and Calibration in Chemical Industry

CO2 Analyze Different Temperature Measurement in Chemical Industry

CO3: Compare various Pressure Measurement techniques in Chemical Industry

CO4: Design Control loops involved in chemical Industry

CO5: Importance of Safety measurements in Chemical Industry

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	M											M	L	L
CO2	M	L										L	M	L	L
CO3	M	L										L	M	L	L
CO4	M	M	M								L		M	L	M
CO 5	M	L											M	L	L

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

SDG 9: Industry, Innovation and Infrastructure.

Statement: This course enlightens students in promoting industrial measurement of various parameters this leads to innovation in efficient use of resources in industries.

SDG 12 : Responsible, Consumption and Production.

Statement: Since all manufacturing Industries need a proper measuring standard for efficient production, This course focuses on various measuring standards involved in Industries. .

Specialization III - Electrical and Electronics Engineering

EIDX 41	**MEMS AND NANO SCIENCE**	**L**	**T**	**P**	**C**
SDG: 4,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide wide knowledge of semiconductors and solid mechanics to fabricate MEMS devices

COB2: To educate on the rudiments of Micro fabrication techniques

COB3: To educate on applications of MEMS

COB4: To analyze methods involving preparation of nano scale devices

MODULE I OVERVIEW OF MEMS AND MICROSYSTEMS 7

Introduction to MEMS and Microsystems, Need for Miniaturization, MEMS and Microsystem products: Micro gears - Micro turbines – Micromotors - Micro optical devices. Microsystems and Microelectronics, Application of Microsystems in Automotive Industries: Safety - Engine and power trains - Comfort and convenience, Micro actuation: Actuation using thermal forces - actuation using shape memory alloys - Actuation using piezoelectric effect - Actuation using Electrostatic forces.

MODULE II MICROSYSTEM FABRICATION PROCESS 6

Photolithography, Ion Implantation, Diffusion, Oxidation: Thermal Oxidation-Oxidation by colour, Chemical Vapour Deposition, Physical Vapour Deposition: Sputtering, Etching: Chemical Plasma, Micromaching: Bulk Micromachining - Surface Micromachining.

MODULE III POLYMERS AND OPTICAL MEMS 7

Polymers in MEMS: Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – 90 Perylene – Fluorocarbon, Optical MEMS: Lenses and Mirrors – Actuators for Active Optical MEMS, Assembly of 3D MEMS – Foundry process.

MODULE IV MEMS 8

General Principle of Nano Fabrication, Nano products, Applications of Nano products, Quantum physics, Fluid flow in submicrometers and nanoscales: Rarefied Gas – Knudsen and match numbers – Modelling of micro and nanoscale gas flow, Heat Conduction at Nanoscale, Challenges in Nanoscale Engineering, New materials for NEMS.

MODULE V PATTERNING AND PREPARATION METHODS 7

Bottom-up Synthesis – Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, Evaporation, Molecular

Beam Epitaxy, Atomic Layer Epitaxy, MOMBE, Patterning: Introduction to optical/UV electron beam and X-ray Lithography systems and processes. Clean rooms: specifications and design, air and water purity, requirements for particular processes.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Tai Ran Hsu "MEMS and Microsystems Design: Manufacture and Nano Scale Engineering", John Wiely& Sons, INC., 2nd Edition, 2008.

2. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia, 1996).

REFERENCES:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001.
3. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
4. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999.
5. N John Dinardo, Nanoscale characterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000.

COURSE OUTCOMES:

After completion of this course the students will be able to

CO1: understand the operation of micro devices, micro systems and their applications.

CO2: design the micro devices, micro systems using the MEMS fabrication process.

CO3: understand the use of polymers for MEMS applications

CO4: understand the operation of nano devices, nano systems and their applications.

CO5: design nano devices, nano systems using the preparation methods

Board of Studies (BoS) :

17th BoS held on 16.12.21

Academic Council:

18th Academic Council held on 24.02.2022

	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	H	M	H	L	M	L	M	L	M	-	L	M	L	L	-
CO2	H	M	H	L	H	L	M	L	M	-	L	M	L	L	-
CO3	H	M	H	L	H	L	M	L	M	-	L	M	L	L	-
CO4	H	M	H	L	M	L	M	L	M	-	L	M	L	L	-
CO5	H	M	H	L	H	L	M	L	M	-	L	M	L	L	-

SDG 4 : Quality Education

This course is used to substantially increase the number of youth and adults who have the skills in MEMS technology , for employment, decent jobs and entrepreneurship.

SDG 9: Industry, Innovation and Infrastructure

The study of nanotechnology is used to promote inclusive and sustainable industrialization by significantly raise domestic product, in line with national circumstances.

SDG 12: Responsible Consumption and Production

It is used to strengthen the scientific and technological capacity to move towards more sustainable patterns of consumption and production of micro/nano materials and nano sensors.

EIDX 42 **APPLIED POWER ELECTRONICS** **L T P C**

SDG: 7, 8,9 **3 0 0 3**

COURSE OBJECTIVES:

COB1: To apply mathematics in analyzing switching converter circuit performance.

COB2: To understand the operation of DC to DC converter and apply it for electric drive system

COB3: To know the significance of multilevel converter and its real time applications

COB4: To apply power electronic converters for the control of HVDC system

COB5: To perform reactive power compensation in the power system network using power electronic devices.

MODULE I SWITCHING VOLTAGE REGULATORS 7

Switching Voltage Regulators: Introduction - Linear power supply (voltage regulators). Non-isolated dc-dc converters: Buck, boost, buck-boost, Cuk converter - Isolated dc-dc converters: Flyback, forward, half bridge, full bridge and push-pull. power factor correction at AC mains in these converters.

MODULE II DC DRIVES WITH DC-DC CONVERTERS 10

Principle of power control (motoring control) of separately excited and series motor with DC-DC Converter - Steady- state analysis - Principle of Regenerative Braking- Chopper configuration for Regenerative braking - Analysis for minimum and maximum speed for Regenerative Braking - Combined regenerative and rheostatic brake control - Two Quadrant operation - Four quadrant of DC-DC converter drive.

MODULE III MULTI LEVEL CONVERTERS 9

Need for multi-level inverters, PWM technique for multi-level converters - Multi-level inverter topologies - Diode Clamped - Flying capacitor and Cascaded H-bridge multilevel Converters configurations – multilevel inverters for electric vehicle.

MODULE IV HVDC TRANSMISSION 10

Introduction - Comparison of AC and DC transmission- HVDC system – control modes, control schemes- Multi-terminal HVDC system- Operation of 12-pulse converter as receiving and sending terminals of HVDC system - Equipment required for HVDC System its control and significance.

MODULE V FACTS DEVICES 9

Importance of reactive power compensation - Thyristor Controlled Reactor (TCR) - Fixed Capacitor Thyristor Controlled Reactor (FC-TCR) – Thyristor Switched Capacitor - STATCOM - SVC - Static Synchronous Series Compensator – UPFC.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Ned Mohan, Undeland and Robbin, "Power Electronics - converters, Application and design", John Wiley and sons.Inc, New York, Third Edition 2009.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, New Delhi, Third Edition 2011
3. P.S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi, 2012.

REFERENCES:

1. Vedam Subramanyam, "Thyristor control of Electrical Drives", Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2015
2. Pillai.S.K., "A First Course on Electrical Drives", New Age International (P) Ltd., 2nd Edition, 2015
3. Gopal K.Dubey, "Power semiconductor controlled drives", Prentice Hall international, 2013
4. KR Padiyar, "HVDC Power Transmission Systems", Willey Eastern Limited, Second edition,2013.
5. Vijay K. Sood, "HVDC and FACTS Controllers Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Boston, 2004.
6. Narain G. Hingorani, Laszlo Gyugyi, " Understanding facts: Concepts and Technology of Flexible AC Transmission Systems" 2000.

COURSE OUTCOMES:

After completion of this course the students will be able to

CO1: analyze the operation of isolated and non isolated DC-DC converter and its applications.

CO2: design, analyze and apply chopper fed drive system for real time applications

CO3: design, analyze and apply multilevel inverters for societal applications.

CO4: design, model and modify power electronic controllers for HVDC transmission system.

CO5: apply power electronic control for reactive power compensation in power system network.

Board of Studies (BoS) :

17th BoS held on 16.12.21

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

SDG 7 : Affordable & Clean Energy

Understanding the fundamentals of power electronics helps to interface quality power from clean energy sources to the utility grid.

SDG 8 :Decent Work and Economic Growth

The complete understanding of power converters leads to have sustainable industrialization and promote economic development.

SDG 9 :Industry, Innovation & Infrastructure

Understanding the fundamentals of FACTS device and HVDC transmission leads to innovative design which further enhances the industry and infrastructure

EIDX 43	**WIRELESS SENSOR NETWORKS**	**L**	**T**	**P**	**C**
SDG 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To discuss the challenges, constraints and principles of wireless sensor networks.

COB2: To analyze the physical layer issues and network layer characteristics.

COB3: To compare the characteristics of medium access control protocols

COB4: To choose the routing metrics based on requirements.

COB5: To solve attacks in sensor networks through localization and security techniques.

PRE-REQUISITES:

- Knowledge on sensor characteristics
- Fundamentals of communication engineering
- Basics of computer networks.

MODULE I WIRELESS SENSOR NETWORKS AND BASIC ARCHITECTURAL FRAMEWORK 12

Introduction - Challenges and Constraints - Application of sensor networks - Node architecture. Layered architecture **-** Physical layer **-** Basic Components, Source Encoding, The Efficiency of a Source Encoder, Pulse Code Modulation and Delta Modulation, Channel Encoding, Types of Channels, Information Transmission over a Channel, Error Recognition and Correction, Modulation, Modulation Types, Quadratic Amplitude Modulation, Signal Propagation.

MODULE II MEDIUM ACCESS LAYER 9

Overview, Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols and Hybrid MAC Protocols.

MODULE III NETWORK LAYER 8

Overview, Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols.

MODULE IV NODE AND NETWORK MANAGEMENT 8

Local Power Management Aspects, Dynamic Power Management, Basics of Time Synchronization, Time Synchronization Protocols.

MODULE V LOCALIZATION AND SECURITY 8

Ranging Techniques, Range-Based Localization, Range-Free Localization, Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks.

L – 45; TOTAL HOURS - 45

TEXT BOOKS

1. Waltenegus Dargie and Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks Theory And Practice", John Wiley & Sons Ltd., 1st edition, 2010.
2. Carlos de Morais Cordeiro and Dharma Prakash Agarwal, "Ad hoc and Sensor Network: Theory and Applications", 2nd Edition, World Scientific Publishing Co., 2011.

REFERENCES

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley and Sons, 2012.
2. G.Anastasi, Marco Conti, Mario Di Francesco and Andrea Passarella, "Energy Conservation in Wireless Sensor Networks: A Survey", Adhoc Networks, Elsevier Publications, Vol.7, No.3 May 2009, pp.537-568.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Analyze the state of art techniques in wireless sensor networks.

CO2: Select appropriate protocols to meet the challenges and constraints of a specific application.

CO3: Apply the concepts of wireless sensor networks (WSN) to various application areas.

CO4: Analyze performance characteristics of WSN and manage WSN.

CO5: Distinguish the methods in Localization tracking and security issues.

Board of Studies (BoS):

23rd BOS meeting (ECE) held on 13.7.2022

Academic Council:

19th AC held on 29.09.22

	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 wireless sensor networks and its layered architecture.

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

Statement: Able to apply the design concepts of routing mechanism to increase the network management, localization and security aspects sustainable industrialization and foster innovation.

EIDX 44	**INDUSTRIAL DRIVES AND CONTROL**	**L**	**T**	**P**	**C**
SDG : 8,9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To apply the basic concepts of electrical machines for designing industrial drive

COB 2: To apply mathematics in analyzing the performance of converter circuit fed drive system

COB 3: To understand AC-DC and DC-DC fed electric drive system

COB 4: To understand the induction motor fed electric drive system

COB 5: To understand the special electrical machines fed electric drive system

MODULE I INTRODUCTION 7

Introduction to electric drive – requirements of electric drives- Characteristics of DC motors, Induction motors, Synchronous motors - Constant torque and constant HP operations – Four quadrant operations –nature of load torque- load equalization - Rating of motors - Selection of drives

MODULE II CONVERTER FED DC DRIVES 10

Conventional methods of speed control for DC motor - Single phase semi and full converter fed dc motor (series, shunt and separately excited motor) - CCM, DCM - Three phase semi and full converter fed dc motor - Motoring and braking of DC motor- closed loop operation

MODULE III CHOPPER FED DC DRIVES 9

Operation of Class A, B, C, D, E chopper fed DC drives - four quadrant operations – closed loop chopper fed drives - design of controllers- transfer function of chopper fed drives

MODULE IV INDUCTION MOTOR DRIVES 10

Starting and braking of induction motor- AC voltage controller fed induction motor drive – VSI and CSI fed drives – closed loop stator controlled induction motor drives - Braking methods for induction motors- Rotor resistance control – slip power recovery scheme - Scherbius drive, Kramers drive– closed loop rotor controlled drives

MODULE V SPECIAL ELECTRICAL MACHINES BASED DRIVE 9

Permanent Magnet Synchronous Motor - construction, operation - PMSM fed drive – case study on real time application - Brushless DC Motor - construction, operation – BLDC fed Drive – case study on real time application, switched reluctance motor-construction, operation – SRM fed Drive

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Gopal K.Dubey, “Power semiconductor controlled drives”, Prentice Hall international, 2013

REFERENCES :

1. W. Shepherd, L. N. Halley, D. T. W. Liang, Power Electronics and Motor Control, 2nd Edition, Cambridge University Press, 1998.
2. Vedam Subramanyam, “Thyristor control of Electrical Drives”, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2015
3. Pillai.S.K., “A First Course on Electrical Drives”, New Age International (P) Ltd., 2nd Edition, 2015

COURSE OUTCOMES:

At the end of the course the student can able to

CO1: Understand the characteristics of various motors and loads and to select appropriate motor for the specified application

CO2: Ability to design, analyze and apply rectifier fed drive system for real time applications

CO3: Ability to design, analyze and apply chopper fed drive system for real time applications

CO4: Ability to design, analyze and apply induction motor fed drive system for societal applications

CO5: Ability to design, analyze and apply special machines fed drive system for societal applications

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	L	L	H	L	L	L	M	L	L	L	L	H	M	M
CO2	H	L	H	L	L	L	L	L	L	L	L	M	H	M
CO3	H	L	H	L	L	L	M	L	L	L	L	H	H	M
CO4	H	L	H	L	L	L	M	L	L	L	L	H	H	M
CO5	H	L	H	L	L	L	M	L	L	L	L	H	H	M

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

SDG 8 : Decent Work and Economic Growth

Statement: The complete understanding of industrial drives leads to have sustainable industrialization and promote economic development.

SDG 9 : Industry, Innovation and Infrastructure Understanding the fundamentals of industrial drives leads to have more innovations on its application circuits which further enhances the industry and infrastructure

EIDX 45	**MECHATRONICS**	**L**	**T**	**P**	**C**
SDG : 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

The objective of the course is

COB1: To study the basic concepts of mechatronics and various types of sensors

COB 2: To acquire knowledge on different actuators and their applications

COB 3: To learn about the working of programmable logic controllers

COB 4: To gain knowledge on different system models and controllers

COB 5: To be conversant with mechatronic design and its applications

MODULE I INTRODUCTION 9

Introduction to Mechatronics- Systems- Concepts of Mechatronics approach – Sequential controllers - Need for Mechatronics- Emerging area of Mechatronics. Introduction to Sensors & Transducers – Performance Terminology- Types: Sensors for motion and position measurement, force, torque, tactile, temperature sensors, hall-effect sensors. Selection of sensors, Signal Conditioning, Analogue to Digital Converter, Digital to Analogue Converter

MODULE II ACTUATORS 9

Basics of Pneumatic and Hydraulic Systems - Control Valves, Actuators - Mechanical Actuation Systems – Electrical Actuation Systems – Mechanical Switches, Solid State Switches, Solenoids, Construction and working principle of DC and AC Motors –speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor-servo motor

MODULE III PROGRAMMABLE LOGIC CONTROLLER 9

Programmable Logic Controllers –Basic Structure, Input / Output Processing, Programming, Mnemonics, Timers, Internal relays and counters, Shift Registers, Master and Jump Controls, Data Handling, Analog Input / Output, Selection of a PLC

MODULE IV SYSTEM MODELLING AND CONTROL 9

System Models - Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Modeling spring, mass & damper systems, Rotational –Translational Systems, Electromechanical Systems. Closed-Loop Controllers, Control Modes – Two –Step mode, Proportional Mode, Derivative Mode, Integral Mode, PID Controllers–Adaptive Control.

MODULE V MECHATRONICS DESIGN & CASE STUDIES 9

Mechatronics Design process-stages -Traditional and Mechatronics design concepts - Introduction to data acquisition and control systems, virtual instrumentation, interfacing of various sensors and actuators with PC- Case studies - Robotics and automation in manufacturing and process industries. Mechatronics control in automotive, prosthetics and artificial limbs - agriculture and energy systems. - Automatic car park barrier

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Bolton. W, “Mechatronics”, Pearson Higher Education, seventh edition, 2019.
2. Sabri Cetinkunt, " Mechatronics with Experiments ", Wiley, 2015

REFERENCES :

1. Michael B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International, Fifth edition, 2018.
2. Sanjay Gupta and Joseph John, "Virtual Instrumentation and LabVIEW", Tata McGraw Hill Publications, Co., 2012
3. Clarence W. de Silva, Mechatronics: A Foundation Course, CRC press, 1st edition, 2010
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, 2nd edition, Cengage learning India Pvt. Ltd, 2012
5. Nitaigour Premchand Mahalik, Mechatronics Principles, Concepts and Applications, McGraw Hill Education, 2015

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: Explain the basic concepts of mechatronics and use of sensors

CO2: Select actuators for different applications

CO3: Program the programmable logic controllers for automation

CO4: Analyze and apply a system model and controller for a given application

CO5: Design mechatronic systems for different applications

Board of Studies (BoS) :

18th BOS meeting held on 12.7.2022

Academic Council:

19th AC held on 29.09.22

	PO 1	PO 2	PO3	PO 4	PO 5	PO6	PO7	PO 8	PO9	PO 10	PO11	PO 12	PSO 1	PS O2	PS O3
CO1	L	L	L	L	L	M	L	L	L	L	L	L	M	M	M
CO2	L	L	L	L	L	M	L	L	L	L	L	L	M	M	M
CO3	L	L	L	L	L	M	L	L	L	L	L	L	M	M	M
CO4	H	H	L	L	L	M	L	L	L	L	L	L	M	M	M
CO5	H	H	L	L	L	M	L	L	L	L	L	L	M	M	M

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

SDG 9 : Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

The design and development of Mechatronics systems and their integration with other fields of engineering help in developing technological capabilities.

EIDX 46	**DESIGN TECHNOLOGY AND INNOVATION**	**L**	**T**	**P**	**C**
SDG: 4,8,9,12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide knowledge on innovations and it's challenges

COB2: To familiarize with collaborative innovations with examples

COB3: To provide knowledge on grass root innovations

COB4: To disseminate with research to innovations with examples

MODULE I INTRODUCTION 9

Classic Innovation - Simple examples - Challenges of reaching a millions of users

MODULE II COLLABORATIVE INNOVATION 9

Technology to Solution - A Collaborative Innovation with examples - Collaborative Innovation Methods and benefits – Examples

MODULE III GRASSROOT INNOVATION 9

Examples of Grassroot Innovation - Learnings from Grassroot Innovation

MODULE IV RESEARCH TO INNOVATION 9

Systematic Approach - Research to Innovation- Examples, methods and benefits

MODULE V CASE STUDY 9

Biomedical Innovations - innovations for societal need - innovations for environmental need

L –45 ; TOTAL HOURS 45

TEXT BOOKS:

1.Tim Brown , "Change by design", Harper Bollins, 2009

2. Idris Mootee. " Design Thinking for Strategic Innovation, John Wiley & Sons, 2013

3. Chesbrough.H “The era of open innovation”, 2003

REFERENCES:

1. David Lee, "Design Thinking in the Classroom", Ulysses press.

2. Shrutin N Shetty, "Design the Future",Norton Press

3. William lidwell, kritinaholden, Jill butter, "Universal principles of design".

COURSE OUTCOMES:

At the end of the course, the students can able to

CO1: Develop products

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

SDG 4: Quality Education

The entire arrangement of the course syllabus provides quality education

SDG 8: Decent work and economic growth

The study of this course help to identify sensors and transducers and measurement systems which provides economic growth and decent work

SDG 9: Industry, Innovation & Infrastructure

New technological application to transducer and measurement systems helps to innovate, improve the industry and infrastructure of the nation

SDG 12: Responsible consumption and production

The optimal usage of raw material and production is key factor in any process industries and this course provides the responsible consumption and production

EIDX 47	**VLSI DESIGN**	**L**	**T**	**P**	**C**
SDG: 4, 9, 12		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To discuss the fundamentals of MOS and CMOS digital circuits

COB2: To examine the basic building blocks of large-scale digital integrated circuits.

COB3: To describe the design of Sequential Logic Circuits

COB4: To analyze the sub system design of digital VLSI circuits

COB5: To apply the concepts of modeling in digital system using Verilog.

PREREQUISITES:

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

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 Design of Combinational Logic Gates in 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 Design of Sequential Logic Circuits 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. .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. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005.

5. Verilog for Digital Design, Frank Vahid, Roman Lysecky, Wiely, 2007
Joseph Cavanagh, Digital Design and Verilog HDL fundamentals, CRC Press, 2007.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Describe the techniques used for VLSI fabrication, design of CMOS logic circuits

CO2: Generalize the design techniques and analyze the characteristics of VLSI circuits such as area, speed and power dissipation

CO3: Design of complex digital circuits using circuits and system.

CO4: Compare the concepts of design rules

CO5: Write Verilog programs in gate, dataflow (RTL), behavioral and switch modeling levels of abstraction.

Board of Studies (BoS) :	**Academic Council:**
23rd BOS meeting (ECE) held on 13.7.2022	19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PS O1	PS O2	PS O3
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.

		L	T	P	C
EIDX 48	**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 cancelers

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. 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 : Choose an appropriate adaptive filters for a given application

CO5 : Analyze the noise and echo cancellation systems

Board of Studies (BoS) :
23rd BOS meeting (ECE) held on 13.7.2022

Academic Council:
19th AC held on 29.09.22

	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.

EIDX 50	**DIGITAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
SDG: 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To describe the basic principles of digital image processing and its performance measures

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

COB3: To design and implement algorithms for advanced image analysis

COB4: To use appropriate image segmentation algorithm for different image processing applications

COB5: To apply image compression algorithms for different image processing applications

Prerequisites: Basics of Signal Processing, Fundamentals of transforms

MODULE I DIGITAL IMAGE FUNDAMENTALS 9

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 ENHANCEMENT 9

Image Enhancement techniques-Basic intensity transformation techniques - Histogram of an image-Histogram equalization-Spatial and frequency domain- Low pass and High pass filters. Color Image Processing – Pseudo color Image Processing.

MODULE III IMAGE TRANSFORMS 9

Significance of image transforms – Classifications- 2D DFT, DCT, Hadamard and Haar transform – Wavelet transform.

MODULE IV IMAGE SEGMENTATION AND RESTORATION 10

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 V IMAGE COMPRESSION & IMAGE PROCESSING APPLICATIONS 8

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.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.

2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4th Edition, PHI, 2007

3. Gonzalez, Woods and Eddins, "Digital Image Processing using MATLAB", Tata McGraw Hill Education,2nd edition, 2017

REFERENCES:

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Jayaraman, S.Essakirajan and T.Veerakumar "Digital Image Processing", Tata McGraw Hill Education,5th edition, 2015
3. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

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 : Recognize & apply various image enhancement techniques.

CO3 : Choose appropriate transforms for image processing

CO4 : Categorize and apply the various techniques of image segmentation and restoration.

CO5 : Identify and use appropriate image compression techniques for different applications

Board of Studies (BoS) : 23rd BOS meeting (ECE) held on 13.7.2022

Academic Council: 19th AC held on 29.09.22

	PO 1	PO 2	PO3	PO 4	P O5	P O6	P O7	PO 8	P O9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	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 apply the theoretical concepts to analyze the Images for further processing.

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.

Specialization IV-Computer Science Engineering

EIDX 61	**INDUSTRIAL DATA NETWORKS**	**L**	**T**	**P**	**C**
SDG: 4,8,9		**2**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To educate on the basic concepts of data networks

COB2: To introduce the basics of inter networking and serial communications

COB3: To provide details on HART and Field buses

COB4: To educate on MODBUS, PROFIBUS and other communication protocol

COB5: To introduce industrial Ethernet and wireless communication

MODULE I DATA NETWORK FUNDAMENTALS 9

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP.

MODULE II INTERNET WORKING and RS 232, RS485

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Devicenet.

MODULE III HART AND FIELD BUS

Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).

MODULE IV MODBUS AND PROFIBUS PA/DP/FMS AND FF

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - review of foundation fieldbus - Data Highway.

MODULE V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum.

L – 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004.
2. A.Behrouz Forouzan ,Data Communications & Networking ,3RD edition, Tata Mc Graw hill,2006.
3. William Buchanan, Computer Buses, CRC Press, 2000.

REFERENCES:

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2ndEdition, 2001.
3. William Stallings, Wireless Communication and Networks, Prentice Hall of India, 2nd Edition, 2005.

COURSE OUTCOMES:

After completion of this course the students will be able to

CO1: define basic concepts of data communication and its importance.

CO2: explain the various internetworking devices involved in industrial networks

CO3: explain the various serial communication used in process industries.

CO4: illustrate, compare and explain the working of HART and Field bus used in process digital communication.

CO5: summarize the operation of MODBUS, PROFIBUS protocol and its applications.

CO6: explain and adopt the different Industrial Ethernet protocol and usage of wireless communication in process applications.

Board of Studies (BoS):

17th BoS held on 16.12.21

Academic Council:

18th Academic Council held on 24.02.2022.

	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO1 2	PS O1	PSO 2	PS O3
CO1	M	L	L	-	M	L	L	-	-	-	L	L	H	L	-
CO2	M	M	L	-	M	L	L	-	-	-	L	L	M	L	-
CO3	M	M	M	-	M	L	L	-	-	-	L	L	M	M	-
CO4	H	M	M	-	M	L	L	-	-	-	L	L	H	M	-
CO5	L	L	L	-	L	L	M	H	H	H	H	L	-	-	-

SDG 4: Quality Education

The entire arrangement of the course syllabus provides quality education

SDG 8: Decent work and economic growth

The study of this course help to identify sensors and transducers and measurement systems which provides economic growth and decent work

SDG 9: Industry, Innovation & Infrastructure

New technological application to transducer and measurement systems helps to innovate, improve the industry and infrastructure of the nation

EIDX 62	**R PROGRAMMING**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To familiarize the students with R programming Environment

COB2: ToKnow the functions in R and important points in Comments and commands.

COB3: To understand the programming concept of R, class and objects.

COB4: To Work with basic R commands, packages and accessing R packages.

COB5: To provide practical knowledge for handling and analyzing data sets covering a variety of real-world applications.

MODULE I INTRODUCTION TO R PROGRAMMING 9

Introduction to scientific programming, R basics, code editors for R, finding help, control structures, conditional execution, loops.

MODULE II FUNCTIONS AND COMMANDS 9

Functions in R, useful utilities, debugging utility, regular expressions, interpreting character string as expression, time-date-sleep, calling external software with system commands, running R commands.

MODULE III OBJECT ORIENTED PROGRAMMING IN R 9

Object oriented programming in R, define class and objects in R, assign generics and methods.

MODULE IV PACKAGES IN R 9

Packages in R, installation process of various packages in R, data science packages in R, Building R packages.

MODULE V USE CASES OF SCIENTIFIC PROGRAMMING 9

Comparison of R with other scientific programming software, implementation of various industry use cases of scientific programming using R .

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1.Mark Gardener,“Beginning R: The Statistical Programming language ”,Wiley Publishers, 1rd edition, New Jersy 2013.ISBN: 9788126541201

REFERENCES:

1. Roger Peng , “R Programming for Data “, Lulu Publisher, 2016. (ISBN 1365056821)

2. Grolemund, Garrett, “Hands-On programming with R” O Reilly Publications,2017.(ISBN1449359019)

COURSE OUTCOMES:

After completion of this course the students will be able to

CO1: Develop R program how to use R for effective data analysis.

CO2: Apply different searching, planning algorithms to reach the goal in state-space problems.

CO3: Understand complexity of R programming algorithms and their limitations**.**

CO4: Implement common R programming algorithms and interpret the results.

CO5: Design R packages using real-world data to address social and business problems.

Board of Studies (BoS) :

17th BoS held on 16.12.21

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

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

SDG 9 : Industry, innovation and infrastructure

Statement: To enable computers to perform such intellectual tasks as decision making, problem solving, perception, and statistical analyzing.

EIDX 63 8,11	3D ANIMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the student to the basic elements of animation

COB2: To provide knowledge on basics of 3D animation

COB3: To make the students develop a 3D story board

COB4: Students will be able to give attention to detail for the 3D Model created

COB5: To analyze different 3D forces acting on animation

MODULE I INTROUCTION 9

Introduction – Layout design -working on principals of animation-Camera settings in Maya-Setting up scene for rendering and rendering concept-Basic Animation-Animation types-Key frame animation-understanding animation work flow

MODULE II BASICS OF 3D ANIMATION 9

Introduction to 3D animation-Animation industry-History of 3D animation-Concept of modelling-Texturing-Rigging-Different types of video formats-Pixels vector and Raster-File formats-Color depth-Bit Depth-Frame rate-Time code

MODULE III DEVOLOPING A 3D STORY BOARD 9

Introduction to Story-3D Script developing-Screen play-Story board-Animatic-Previsualization-Design-Character-Conflict-Goal-Story-Tellingprinciples-Basic Shot framing-Camera movement in 3D-Global Surroundings-Working principles of producer-Director-Animator

MODULE IV 3D Modeling 9

Introduction to 3D Space in Blender-Modeling Techniques-Concept of NURBS and Polygon-Working with references-Reading anatomy-Human and Living organism-Breaking human anatomy in to different parts-Face-Facial expressions-Eye movement-Lip movement-Character definition-Basic poses-Curve editor

MODULE V 3D FORCES AND ANIMATION 9

Timing movements of objects or character-Space and Scale-Law of inertia-Movement Laws-Newton's Third Law-Working with Gravity-Action and Reaction-Motion Weight and Gravity-Jump, Walk and Run-Rigging-Pivot positions-FK and IK-Parenting-Scripting-Rigging workflow

L – 45; TOTAL HOURS - 45

TEXT BOOKS:

1. Ami Chopine,"3D art essentials “Taylor & Francis"2020
2. Beane A."3D animation essentials”. John Wiley & sons; 2018.

3. Cabrera C. "An Essential Introduction to Maya Character Rigging with DVD", Routledge; 2015.

REFERENCES:

1 ."Disney Animation: The Illusion of Life", Ollie Johnson & Frank Thomas (1915).
2. King R."3D Animation for Raw Beginner using Autodesk Maya 2e", CRC Press; 2019
3. Lanier L. "Advanced Maya texturing and lighting", John Wiley & sons;2015

COURSE OUTCOMES:

At the end of this course, the students will be able to

CO1: Define the concept of animation
CO2: Demonstrate the Physics behind the 3D Animation
CO3: Develop the idea for the 3D animation movie
CO4: Construct the 3D modeling
CO5: Evaluate the Physics behind the different types of forces

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P O 7	P O8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	M	H	H	H	M	H	L	H	M	H	M			
CO2	M	M	H	H	H	M	H	L	H	M	H	M			
CO3	M	M	H	H	H	M	H	L	H	M	H	M			
CO4	M	M	H	H	H	M	H	L	H	M	H	M			
CO5	M	M	H	H	H	M	H	L	H	M	H	M			

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

SDG 8: Decent work and economic growth. Technology creates new jobs, enables resilient work and commerce, and stimulates wider social and economic development

SDG 11: Sustainable cities and communities.

3D Technology helps cities take key steps to become smart and sustainable.

EIDX 64	**APPLIED SOFT COMPUTING FOR INSTRUMENTATION ENGINEERS**	**L**	**T**	**P**	**C**
SDG : 4, 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To expose the students to the concepts of feed forward neural networks.

COB2: To provide adequate knowledge about feedback neural networks

COB3: To provide adequate knowledge about fuzzy set theory and concept of fuzziness involved in various systems

COB4: To provide knowledge about neuro fuzzy systems

COB5: To solve single-objective optimization problem using GAs

.

MODULE I INTRODUCTION TO ANN 8

Introduction – Biological neuron – Artificial neuron – Neuron modeling – Learning rules – Single layer – Multi layer feed forward network – Back propagation – Learning factors

MODULE II NEURAL NETWORK FOR CONTROL 9

Feed back networks – Discrete time hop field networks – Transient response of continuous time networks – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.

MODULE III FUZZY SYSTEMS 10

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership Functions – Defuzzification methods - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

MODULE IV FUZZY LOGIC MODEL AND CONTROL 9

Fuzzy Modeling -TS model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification –Familiarization with fuzzy logic toolbox - Case studies.

MODULE V HYBRID CONTROL SYSTEMS 9

Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to other evolutionary optimization techniques, support vector machine– Case study – Familiarization with ANFIS toolbox

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Jacek M. Zurada, ‘Introduction to Artificial Neural Systems’, Jaico Publishing home, 2002
2. Timothy J. Ross, ‘Fuzzy Logic with Engineering Applications’, Tata McGraw Hill, 1997
3. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015
4. S.N.Sivanandam ,S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011
5. S.Rajasekaran, G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

REFERENCES:

1. LauranceFausett, Englewood cliffs, N.J., ‘Fundamentals of Neural Networks’, Pearson Education, 1992.
2. H.J. Zimmermann, ‘Fuzzy Set Theory & its Applications’, Allied Publication Ltd., 1996
3. Simon Haykin, ‘Neural Networks’, Pearson Education, 2003
4. John Yen & Reza Langari, ‘Fuzzy Logic – Intelligence Control & Information’, Pearson Education, New Delhi, 2003.

COURSE OUTCOMES:

CO1: Develop model using neural network and fuzzy logic

CO2: Implement controller using neural network and fuzzy logic

CO3: Use neuro-fuzzy systems

CO4: Use evolutionary techniques for optimization problems

CO5: Apply suitable soft computing techniques for various applications

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO3
CO1	M	M	L	L	M							L			L
CO2	M	M	L	L	H							L			M
CO3	M	L	M	L	L							L			L
CO4	M	L	M	L	L							L			M
CO5	H	M	L	L	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

The intelligent control techniques like Neural network control, Fuzzy logic control, ANFISrequires lifelong learning opportunities in most of the fields and hence include quality education.

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

Neural network which is basis for artificial intelligence promotes innovation in diverse field.

EIDX 65 **INTERNET OF THINGS FOR AUTOMATION** **L T P C**

SDG :9 **3 0 0 3**

COURSE OBJECTIVES:

COB1: To understand the fundamentals of Internet of Things

COB2: To learn about the basics of IOT protocols

COB3: To build a small low cost embedded system using Raspberry Pi

COB4: To apply the concept of Internet of Things in the real world scenario.

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 System Management with NETCONF-YANG- IoT Platforms Design Methodology.

MODULE II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

MODULE III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security.

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 AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. George Stephanopoulos, “Chemical Process Control – An Introduction to Theory and Practice”, Prentice Hall of India, 2005.
2. Eckman, D.P., “Automatic process control”, Wiley Eastern Ltd.,New Delhi,1993

3. Seborg ,D.E., Mellichamp, D.P., Edgar, T.F., and Doyle,F.J., III, “Process Dynamics and Control”, John Wiley and Sons, 4th Edition,2017.
4. Bequette, “Process Control: Modeling, Design, and Simulation”, Prentice Hall of India, 2004

REFERENCES :

1. Arshdeep Bahga, Vijay Madisetti, —Internet of Things– A hands-on approach, Universities Press, 2015
2. Cuno Pfister, "Getting Started with the Internet of Things,1st Edition, Shroff, ISBN-13: 978-1449393571,O‘REILLY, 2011.
3. Donlad Norris, —The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black, McGraw-Hill Education - Europe, ISBN10 0071835202, 2015.
4. Dieter Uckelmann, Mark Harrison, Florian Michahelles, —Architecting the Internet of Things‖, Springer, 2011
5. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective‖‖, CRC Press, 2012.
6. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
7. Olivier Hersent, David Boswarthick, Omar Elloumi,—The Internet of Things – Key applications and Protocols‖, Wiley, 2012.

COURSE OUTCOMES:

Upon completion of this course, the student will be able.

CO1: Analyze various protocols for IoT.

CO2: Develop web services to access/control IoT devices

CO3: Design a portable IoT using Rasperry Pi.

CO4: Deploy an IoT application and connect to the cloud.

CO5: Analyze applications of IoT in real time scenario.

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO !3	PO 14	PO 15
CO1	L	L	M	L	M	L	-	-	-	-	L	L	-	-	M
CO2	M	H	H	L	M	L	-	-	-	-	L	L	-	L	M
CO3	M	H	H	M	M	L	-	-	-	-	L	L	-	L	M
CO4	M	H	H	M	H	M	L	-	-	-	L	L	-	-	L
CO5	L	H	M	L	M	M	L	-	-	-	L	L	-	-	M

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

SDG 9: Investing in ICT access and quality education to promote lasting peace - United Nations Sustainable Development.

These IoT technologies connect citizens around the world, monitor and track environmental impact, and optimize industrial inefficiencies

EIDX 66	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		3	0	0	3

SDG: 9, 12

COURSE OBJECTIVES:

The students will learn about

COB1: To acquire knowledge about Industry 4.0 and Industrial IOT

COB2: To get knowledge about the various sensors and actuators used in the industry. Also provide information on the communication protocols.

COB3: To get familiarized with the architecture of IOT and IIOT.

COB4: To get knowledge about the security and analytics in IIOT

COB5: To impart knowledge on the applications of IOT in various fields

MODULE I INTRODUCTION 9

Introduction to IoT, IoT Vs. IIoT, History of IIoT, Components of IIoT -Sensors, Interface, Networks, People &Process, Hype cycle, IOT Market, Trends& future Real life examples, Key terms of IoT–IoT Platform, Interfaces, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories.

MODULE II SENSORS AND ACTUATORS 9

Introduction to sensors, Transducers, Classification, Roles of sensors in IIoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIoT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACnet, Current, M2M etc.

MODULE III IOT AND IIOT ARCHITECTURE 9

Overview of IoT components: Various Architectures of IoT and IIoT, Advantages & disadvantages, Industrial Internet -Reference Architecture; IIoT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IoT.

IIoT-Introduction, Industrial IoT: Business Model and RefereceArchiterture: IIoT-Business Models

MODULE IV SECURITY AND ANALYTICS IN IIOT 9

Cyber Physical Systems – Wireless technology – IP Mobility – Network Functionality Virtualization – Cloud and Fog - Big Data and Analytics – M2M Learning and Artificial Intelligence.

MODULE V IIOT APPLICATIONS 9

Role of IIoT in Manufacturing Processes Use of IIoT in plant maintenance practices, Sustainability through Business excellence tools Challenges and Benefits in implementing IIoT.IndustrialIoT- Application Domains: Healthcare, Power Plants, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries

L- 45 ;TOTAL HOURS – 45

TEXT BOOKS:

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, by Apress Berkeley, CA, Ebook ISBN: 978-1-4842-2047-4, Published: 28 June 2016, DOI: https://doi.org/10.1007/978-1-4842-2047-4

2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, “Industrial Internet of Things: Cyber manufacturing Systems” by Springer, eBook ISBN: 978-3-319-42559-7, Published: 12 October 2016, DOI: https://doi.org/10.1007/978-3-319-42559-7

Research papers

COURSE OUTCOMES:

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

CO1: Familiarize with the concepts of IOT, smart factory and IIOT.

CO2: Handle the sensors and actuators in industry and its communications

CO3: Explore IoT technologies, architecture and standards.

CO4: Analyze huge amount of data and design efficient, secured IoT systems

CO5: Develop and implement own IoT technologies, solutions, and applications

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	PO1 1	P O 12	PSO 1	PS O2	PS O3
CO1	M	M										L	L		L
CO2	M	L			L	L						L	L	L	L
CO3	M	L			L	L						L	L	L	L
CO4	M	M	M		L	L						L	L		L
CO 5	M	L			L	L					L	L	L		L

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

SDG 9: Industry, Innovation and Infrastructure.

Statement: This course enlightens students about the latest innovation in smart Industries.

SDG 12: Sustainable cities and communities.

Statement: The holistic understanding of IIoT leads to construction of smart industry.

		L	T	P	C
EIDX 67	**DEEP LEARNING**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the basic ideas and principles of neural networks

COB2: To understand the basic concepts of deep learning

COB3: To familiarize with image processing facilities like Tensor Flow and Keras.

COB3: To appreciate the use of deep learning applications

COB4: To understand and implement deep learning architectures

MODULE I MACHINE LEARNING 9

Machine Learning–Types of Machine Learning –Machine Learning process-preliminaries, testing Machine Learning algorithms. Difference between Machine learning and Deep learning.

MODULE II INTRODUCTION TO DEEP LEARNING 9

Deep Feed-Forward Neural Networks – Gradient Descent – Back-Propagation and Other Differentiation Algorithms – Vanishing Gradient Problem – Mitigation – Rectified Linear Unit (ReLU) – Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent.

MODULE III CONVOLUTIONAL NEURAL NETWORKs 9

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning – Recurrent and Recursive Nets – Recurrent Neural Networks – Deep Recurrent Networks – Recursive Neural Networks

MODULE IV

ADDITIONAL DEEP LEARNING ARCHITECTURES 9

Long Short-Term Memory (LSTM) Networks – Sequence Prediction – Gated Recurrent – Encoder/Decoder Architectures – Auto-encoders – Standard – Sparse – Denoising – Contractive – Applications of Auto-encoders – Representation Learning – Deep generative Models

MODULE V

APPLICATIONS OF DEEP LEARNING 9

Images segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative adversarial networks – Case Studies: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Lan J. Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press, 2017
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018

REFERENCES:

1. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017
2. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018
3. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018
4. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016

COURSE OUTCOMES:

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

CO1: Understand the role of deep learning in machine learning applications.
CO2: Design and implement deep learning applications
CO3: Design and implement convolutional neural networks
CO4: Critically analyze different deep learning models in image related projects
CO5: Know about applications of deep learning in image processing

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

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

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

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

The knowledge on deep learning will enable the students to grow with technological developments in the field of Artificial Intelligence

EIDX 68	BIG DATA ANALYTICS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the different types of data used in different domains.

COB2: To extract useful knowledge (patterns) from the data collected

COB3: To explore the different classification and clustering techniques

COB4: To learn the Hadoop ecosystem

COB5: To provide knowledge on the time series analysis and text analysis

COB6: To understand how to improve security in the different layers

.

MODULE I BIG DATA & GETTING INSIGHTS FROM DATA 13

Big Data Analytics - Big Data and Data Science – Architecture – Taxonomy – KDD process –. Data Analytics Lifecycle – Types of Data. Descriptive Statistics – Multivariate Analysis – Data Quality and Preprocessing – Clustering Techniques – Frequent Pattern Mining.

MODULE II PREDICTING THE UNKNOWN - REGRESSION 9

Regression – Performance Estimation – Performance Measures – Parameters of the model – Technique and Model Selection.

MODULE III PREDICTING THE UNKNOWN - CLASSIFICATION 7

Classification – Predictive Methods: Search Based Algorithms, Optimization based algorithms – Ensemble Learning – Non- Binary classification – Data preparation Techniques.

MODULE IV ANALYTICAL THEORY AND METHODS 9

Time Series Analysis – ARIMA Model – Text Analysis Steps – Collecting Raw Text– TFIDF - Categorizing documents – Determining Sentiments – Map Reduce and Hadoop – Ecosystem, NoSQL.

MODULE V BIG DATA ANALYTICS APPLICATION 7

Working with texts – Recommender Systems – Social Network Analysis – Open Source Tools.

L – 45 ; TOTAL HOURS - 45

TEXT BOOKS:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Businesses”, Wiley, 2013.

2. Eric Sammer, “Hadoop Operations”, O’Reilley, 2012

REFERENCES:

1. Joao Moreira, Andre Carvalho, André Carlos Ponce de Leon Ferreira Carvalho, Tomás Horvath, ―A General Introduction to Data Analytics‖, Wiley Publications, 1st Edition, 2019, ISBN: 9781119296256

2. EMC Education Services,‖Data Science and Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data‖, Wiley Publications, 2015, ISBN: 9781118876053

3. Al-Sakib Khan Pathan, Mohiuddin Ahmed, ―Data Analytics Concepts, Techniques, and Applications‖, CRC Press, 2018, ISBN: 9780429820915.

COURSE OUTCOMES:

At the end of the course the students will be able

CO1: To understand the different types of data and the big data lifecycle and also to Identify the characteristics of datasets and apply appropriate preprocessing methods

CO2: Solve problems associated with big data characteristics.

CO3: Apply scaling up machine learning techniques and associated computing techniques and technologies

CO4: Choose the appropriate data analysis technique for extracting the pattern

CO5: Integrate machine learning libraries and mathematical and statistical tools with modern technologies like Hadoop and map reduce

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

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

SDG 9: Investing in ICT access and quality education to promote lasting peace - United Nations Sustainable Development.

These Big data analytics technologies connect citizens around the world, monitor and track environmental impact, and optimize industrial inefficiencies

EIDX 69	**DATA SCIENCE FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG : 3,4,8,9,11,15		**3**	**0**	**0**	**3**

COURSE OBJECTIVES

COB1:	To introduce the students to the basics of Data Science and Analytics in the context of Manufacturing and Industrial Automation
COB2:	To introduce the students to the concepts of Predictive Maintenance, MTBF, OEE in the context of IIoT, Data Analytics and AI
COB3:	To provide Basic Data Science, Statistics and Analytics and working with Python for Data Science
COB4:	To introduce the concepts of advanced analytics, deep learning and cloud in the context of the manufacturing industry and digital manufacturing
COB5	To understand time series databases in the context of digital manufacturing
COB6:	To understand data analytics platforms and integration with databases in the context of manufacturing industries

MODULE I INTRODUCTION TO DIGITAL MANUFACTURING & DATA ANALYTICS 9

What is data science AI and Machine Learning? - Data Science for the manufacturing industry - Instrumentation and Data Science - IIoT, Digital Manufacturing and Digital Twins - Predictive Maintenance and MTBF, MTBR, MTBPM – OEE

MODULE II DATA SCIENCE WITH PYTHON 9

Statistics and Probability - Data anaysis with Excel - Python for Data Science - numpy, pandas, matplotlib, seaborn - decision trees, random forests. linear regression - logistic regression - time series analytics

MODULE III INTRODUCTION TO ADVANCED ML and CLOUD 9

Introduction to Advanced Machine Learning - Neural Networks and Deep Learning - Introduction to Cloud Platforms - On-Premise and Cloud Industrial Infrastructure - Applications of Deep Learning in Industrial Analytics

MODULE IV INDUSTRIAL TIME SERIES DATABASES 9

RDBMS, SQL and NOSQL Databases, Table storage - Blob storage Cloud Storage - Time Series Databases - CrateDB - DATABASES, TABLES, JOINS and UNIONS, integration of python-based analytics with storage systems

MODULE V ANALYTICS PLATFORMS 9

Data Historian, Industrial Time Series Databases and Data Analytics - Reporting - Condition Based Monitoring and Predictive Maintenance - KNIME Analytics Platform - IIoT and Analytics - Thingsboard - Thingsboard Trendz Analytics - Introduction to proprietary industrial analytics software and tools - Yokogawa PIMS - PSI Soft Historian - Bosch IoT Insights

L – 45; TOTAL HOURS - 45

TEXT BOOKS :

1. R. Keith Mobley, “An Introduction to Predictive Maintenance (Plant Engineering)”, Butterworth-Heinemann; 2nd edition (24 October 2002)

2. Giacomo Veneri, Antonio Capasso, “Hands-On Industrial Internet of Things”, Packt Publishing, November 2018

3. Jake VanderPlas, “Python Data Science Handbook”, O'Reilly Media, Inc.,November 2016

4. Rohan Chopra, Aaron England, Mohamed Noordeen Alaudeen, “Data Science with Python”, Packt Publishing, July 2019

5. Upom Malik, Matt Goldwasser, Benjamin Johnston, “SQL for Data Analytics”, Packt Publishing, August 2019

REFERENCES:

1. 1. Al-Najjar, B., Alexopoulos, K., Hribrenik, K., Surico, M., Nikolakis, N., Keraron, Y., ... & Makris, S. (2021). Predictive maintenance technologies for production systems.: A roadmap to development and implementation
2. Jensen, S. K., Pedersen, T. B., & Thomsen, C. (2017). Time series management systems: A survey. *IEEE Transactions on Knowledge and Data Engineering*, *29*(11), 2581-2600.
3. CrateDB Documentation Online
4. https://crate.io/docs/crate/reference/en/5.0/sql/index.html
5. https://crate.io/docs/crate/tutorials/en/latest/
6. https://crate.io/docs/crate/reference/en/5.0/
7. KNIME Documentation Online
8. https://www.knime.com/getting-started-guide
9. https://docs.knime.com/

COURSE OUTCOMES:

CO1: Understand AI/ML, Analytics and Data Science in the context of the manufacturing industry

CO2: Perform Basic Analytics in Python

CO3: Knowledge on Advanced Machine Learning Techniques

CO4: Knowledge on Time Series Databases, Time Series Analytics for Industries,

CO5: Knowledge on Cloud and Local Software and Tools for Analytics in the context of Manufacturing industries

Board of Studies (BoS) :
18th BOS meeting held on 12.7.2022

Academic Council:
19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	H	M	M	H	H	H	L	L	L	L	M	M	L	L	M
CO2	M	H	M	L	M	M	L	L	L	L	M	M	L	L	M
CO3	L	M	L	M	H	M	L	L	L	L	M	M	L	L	M
CO4	L	M	L	H	M	L	L	L	L	L	M	M	L	L	M
CO5	L	L	M	H	M	H	L	L	H	M	L	L	M	L	L

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

SDG 3: Good Health and Well-Being

Predicting the spread of infectious diseases by the movement of mobile phone users.

SDG 4**: Quality Education**

Reasons for high student dropout rates can be found through citizen reporting.

SDG 8: **Work and Economic Growth**

Global postal traffic patterns can provide data on trade, GDP, remittances, and other economic indicators.

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

GPS data can be utilized to improve public transportation and traffic control.

SDG 11**: Sustainable Cities and Communities**

The invasion of public lands and spaces, such as parks and forests, can be monitored via satellite remote sensing.

SDG 15: Life on Land

Monitoring social media in real time can provide information on the location of victims, the severity of forest fires, and the smoke cloud.

EIDX 70	PRACTICAL MACHINE LEARNING WITH TENSOR FLOW	L	T	P	C
		3	0	0	3

SDG: 9

COURSE OBJECTIVES: The students will learn about

COB1: Overview of Machine Learning

COB2: Data Input and Preprocessing with Tensorflow, Machine Learning Model Building

COB3: Prediction with Tensorflow , Monitoring and evaluating models using Tensorboard

COB4: : Advance Tensorflow

COB5: TensorFlow Customization

MODULE I OVERVIEW OF TENSORFLOW 9

Overview of Tensorflow, Steps in Machine Learning Process, Loss Functions in Machine Learning, Gradient Descent Gradient Descent Variations, Model Selection and Evaluation, Machine Learning Visualization

MODULE II DEEP LEARNING 9

Introduction to Tensors, , Deep Learning ,Mathematical Foundations of Deep Learning , Building Data Pipelines for Tensorflow, Text Processing with Tensorflow

MODULE III CLASSIFICATION AND REGRESSION 9

Classify Images, Regression, Classify Structured Data, Text Classification, Underfitting and Overfitting, Save and Restore Models

MODULE IV CONVOLUTIONAL NEURAL NETWORKS 9

CNNs, Transfer learning with pretrained CNNs, Transfer learning with TF hub, Image classification and visualization Estimator API, Logistic Regression, Boosted Trees

MODULE V TENSORFLOW CUSTOMIZATION 9

Introduction to word embeddings, Recurrent Neural Networks, Time Series Forecasting with RNNs, Text Generation with RNNs TensorFlow Customization, Customizing tf.keras, TensorFlow Distributed Training

L- 45 ;TOTAL HOURS – 45

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Science/Engineering/Math; (March 1, 1997)

2.Hand, D. J. (2007). Principles of data mining. *Drug safety*, *30*, 621-622

REFERENCES:

1.www.tensorflow.org

COURSE OUTCOMES:

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

CO1: Demonstrate ML concepts with Deep Playground

CO2: Build Machine Learning Models

CO3: Monitor and evaluate the models using Tensorboard

CO4: Build custom CNN models

CO5: Do distributed training with hardware accelerators

Board of Studies (BoS) :

18th BOS meeting held on 12.7.2022

Academic Council:

19th AC held on 29.09.22

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	H	H	H	H	H	M	H				M	M			
CO2	H	H	H	H	H	M	H				M	M			
CO3	H	H	H	H	H	M	H				M	M			
CO4	H	H	H	H	H	M	H				M	M			
CO5	H	H	H	H	H	M	H				M	M			

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

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

The knowledge on machine learning will enable the students to grow with technological developments in the field of Artificial Intelligence

MATHEMATICS ELECTIVE
(SEMESTER III)

MADX 01	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
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) :
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 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														

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

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

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

		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: **e**valuate 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														
CO2	M														
CO3	M														
CO4	M														
CO5	H														

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

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

Learning of various statistical methods will lead to knowledge of applications in Engineering problems

MADX 04	**RANDOM PROCESSES**	**L**	**T**	**P**	**C**
SDG: 4		**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, 2000

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	M														
CO2	M														
CO3	M														
CO4	L														
CO5	L														

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

SDG 9 : Sustainable Industry, innovation and Infrastructure

Learning of various techniques in Random Processes will lead to knowledge required for applying in many projects.

		L	T	P	C
MADX 05	**NUMERICAL METHODS**				
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														
CO2	M														
CO3	M														
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 methods in numerical analysis will lead to use of applications in many projects in Engineering.

HUMANITIES ELECTIVE –I
(III SEMESTER)

		L	T	P	C
SSDX 01	**ENGINEERING ECONOMICS AND**	**L**	**T**	**P**	**C**
SDG: 4, 8, 9,12	**MANAGEMENT**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To present the major concepts and techniques of engineering economic analysis that is needed in the decision making process by providing insights to the basic microeconomic concepts of demand, supply and equilibrium.

COB2: To generate theoretical knowledge and understanding of macroeconomic aggregates such as national income and inflation and the major challenges associated with the measurement of these aggregates.

COB3: To develop analytical and critical thinking skills on money, banking and public finance and use them to judge the appropriateness of economic development and policy options.

COB 4: To introduce the basic concepts of management and planning and highlight the contribution of planning to the attainment of organization's objectives.

COB 5: To apprise the students about important management concepts and create awareness about the corporate social responsibilities and ethical aspects.

MODULE I DEMAND AND SUPPLY ANALYSIS 9

Introduction to Engineering Economics – Engineering efficiency – Economic efficiency - Scope of Engineering Economics, Engineers' contributions to economic growth- Problem solving and decision making - Laws of Demand and Supply - Difference between Microeconomics and Macroeconomics - Equilibrium between Demand and Supply, Elasticity of Demand - Pricing strategies.

MODULE II NATIONAL INCOME AND INFLATION 8

Concepts of National Income and measurement – GDP Growth Rate - Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – Meaning of Inflation, its types causes and preventive measures.

MODULE III MONEY, BANKING AND PUBLIC FINANCE 10

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary Policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) – Economic Reforms in India – LPG Policy.

MODULE IV PRINCIPLES OF MANAGEMENT AND PLANNING 8

Nature of management and its process - Importance of Management-Functions and Principles of Management - Nature, Purpose and Kinds of Planning.

MODULE V ENGINEERING MANAGEMENT 10

Strategic Management-Manager and Environment - Globalization and Technology Intermediation, Corporate Social Responsibility of business - meaning, importance, arguments for and against Corporate Social Responsibility - Business Ethics- Role of Ethics in Engineering Practice-meaning, importance - State intervention in business - Pros and Cons of intervention.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Krugman, P, Wells, R, and Graddy, K., "Essentials of Economics", Worth Publishers, 4th Edition, New York, 2016.
2. Hussain, Moon Moon, "Economics for Engineers", Himalaya Publishing House, 1st Edition, New Delhi, India, 2015.

REFERENCES:

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) :
5thBoS of SSSH held on 29.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

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

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

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.
SDG 12: Ensure sustainable consumption and production patterns.

Inclusive and equitable quality education can make a critical difference to production patterns, consumer understanding of more sustainably produced goods, promote inclusive and sustainable economic growth along with productive employment and decent work for all.

SSDX 02 SDG: 17	SOCIOLOGY OF SCIENCE AND TECHNOLOGY	L T P C 3 0 0 3

COURSE OBJECTIVES:

COB1: To recognize and define the basic concepts of society and the ways in which sociologists use these concepts in constructing explanations for individual and group problems.
COB2: To illustrate the convergence and divergence of sociology with engineering subjects in terms of the subject matter, nature and scope of the discipline and its approach.
COB3: To demonstrate the relationship between science, technology and society.
COB4: To understand the issues relating to science, technology and change in India both in the historical and globalization contexts.
COB5: To appraise the impact of science and technology on different socio-cultural institutions and processes.

MODULE I INTRODUCTION 8

Sociology - Definition, scope and importance, relationship with other social sciences - Major theoretical perspectives: Functionalism, Conflict Theorizing and Interactionism - Elements of social formation - Society, Community, Groups and Association - Institutions, family and kinship, religion, education, politics - Social process - Associative Social Process - Co-operation, Accommodation and Assimilation - Dissociative Social Process - Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 9

Culture - characteristics, functions, types, cultural lag and civilization - Socialization – process, stages, agencies and anticipatory socialization - Social Control - characteristics, importance, types and agencies - Social stratification. - Meaning, forms - caste and class.

MODULE III SCIENCE, TECHNOLOGY AND SOCIETY 9

Relationship between society and science and vice-versa - Science as a social system - Norms of science - Relationship between science and technology - History of modern science in India – colonial–independence and post-independence science - Science education in contemporary India – primary level to research level - Performance of universities in the development of technology - Interrelationship between industry and universities.

MODULE IV SCIENCE, TECHNOLOGY AND SOCIAL ISSUES 10

Technology, media, identity and global society - Conformity and deviance and role of science and technology - Technology and development issue - S&T and sustainable development - Role of science and technology in the creation of environmental crisis - Social inequality, social exclusion and digital divide - Science, technology and ethical issues -Gender and technology.

MODULE V GLOBALIZATION, SCIENCE, TECHNOLOGY AND CHANGE 9

Social Change - nature, direction, forms - Technology and rate of social change – Globalization - characteristics, historical and social context- Social consequences of science and technology on civil society - Globalization - Liberalization - Their impact on Indian science and technology - WTO and issues related to intellectual property rights - MNCs and Indian industry.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Giddens A. “Sociology” Wiley India Pvt. Ltd 2017.
2. Heald Haralambos, R.M “Sociology Themes and Perspectives”, Oxford, New Delhi-92. 2014
3. Sergio Sismondo. An Introduction to Science and Technology Studies Malden: Wiley Blackwell.2010
4. R.K. Merton, Sociology of Science, Theoretical and Empirical Investigations, University of Chicago Press, 1973.

REFERENCES:

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Bilton, T. et al “Introductory Sociology”, Palgrave, New York. 2002
3. Das Gupta, Samir and ‘‘An Introduction to Sociology”, Pearson, Delhi. 2012.
4. Francis Abraham M. “Contemporary Sociology: An Introduction to Concepts and Theories”**,** New Delhi, Oxford University Press. 2014
5. Inkless, A, “What is Sociology”, Prentice Hall, New Delhi. 1987
6. Tumin, Melvin M “Social Stratification”, Prentice Hall, New Delhi. 1969.

COURSE OUTCOMES: At the end of the course, the students will be able to
CO1: Recognize the fundamental tenets of Sociology.

CO2: Interpret the relationship between individual and society in a sociological perspective.
CO3: Categorize and constructively identify their own assumptions about the relationships among society, science and technology
CO4: Appraise the dynamics of human society with special reference to the science, technology and contemporary trends of globalization.
CO5: Able to link and reflect on current and ongoing sociological debates on development and role of technology.

Board of Studies (BOS) :
5th BoS of SSSH held on 29.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

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

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

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

To inculcate knowledge and socialize youth in building participation, institutions and partnership for inclusive development for the implementation of sustainable development goals.

		L	T	P	C
SSDX 03	**INDUSTRIAL ECONOMICS AND MANAGEMENT**	**3**	**0**	**0**	**3**
SDG: 8 and 9					

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	PO10	PO11	PO12
CO1			H	M			H		M		M	L
CO2			H		M		H		M		M	L
CO3			H				H		M		M	M
CO4			H				H		M		H	M
CO5			H				H		M		H	M

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

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

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

A comprehensive and holistic approach towards the way for sustainable development and economic growth through the inclusive economic strategy and thereby to reduce the poverty, hunger among people by familiarizing them industry and its importance as survival strategy for earning decent standard of living.

SSDX 04	DYNAMICS OF INDIAN SOCIAL STRUCTURE	L	T	P	C
		3	0	0	3

SDG: 10, 16

COURSE OBJECTIVES:

COB1: To provide knowledge on the components of the Indian social structure.

COB2: To learn the nature and contemporary structure of Indian social institutions.

COB3: To sensitize students about social stratification in Indian Society.

COB4: To create awareness about the social problems occurring in contemporary India.

COB5: To explicate the changing institutions, the processes, the agents and the interventions that brings about change in the Indian society.

MODULE I INDIAN SOCIAL STRUCTURE 9

Demographic composition - Racial, religious, ethnic and linguistic -Types of communities - rural, urban, agrarian and tribal - Social backwardness - OBC, SC, ST and EWS - Indian minorities- religious, ethnic, linguistic and LGBT.

MODULE II INDIAN SOCIAL INSTITUTIONS 9

Family - types, characteristics, functions of family - Joint Family- definition features, functions of joint family , dysfunctions of joint family, disintegration of joint family – Marriage - definition, characteristics, marriage as sacrament or contract.

MODULE III SOCIAL STRATIFICATION IN INDIA 9

Social stratification - Concept of hierarchy - inequality, meaning and characteristics - Social Stratification and Social Mobility - Functions of Social Stratification - Caste, definition, principles, contemporary changes, dominant caste, caste - Class interface - Religious minorities.

MODULE IV SOCIAL PATHOLOGY 9

Social Problem - nature, social disorganization - Population explosion- causes, effects, relationship with development - Child Labour- causes, magnitude and consequences – Unemployment - nature, types, causes and effects - Gender issues - social status of women, violence against women and women in work place - Contemporary issues - communalism, terrorism and corruption.

MODULE V SOCIAL CHANGE IN INDIA 9

Socio-cultural change - Sanskritization – Westernization - Secularization, Modernization - Processes of Social change - Industrialization – Urbanization – Globalization - Social movement - concept, characteristics, functions - New social movement-Women and Environment movement.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Sharma,K.L., "Indian Social Structure and Change", Jaipur: Rawat Publications, 2008.
2. Ahuja Ram., "Social Problems in India", Rawat Publication: New Delhi, 2014.
3. Ahuja Ram., "Society in India", Rawat Publication: New Delhi, 2014.

REFERENCES:

1. Atal Yogesh, "Changing Indian Society" Rawat Publications, Jaipur, 2006.
2. Dube S.C., "India's Changing Villages: Human Factors in Community Development", London, Routledge and Kegan Paul, 2003.
3. Hasnain N., "Indian Society: Themes and Social Issues", Mc Graw Hill, 2019.
4. Jayapalan, N., "Indian Society and Social Institutions" Atlantic Publishers, 2001.
5. Pandey Vinita., "Indian Society and Culture", Rawat Publications, New Delhi, 2016
6. Rao Sankar., "Sociology of Indian Society", S.Chand Publisher, New Delhi, 2004.

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

CO1: explain about the social structure and social institutions that constitute society in India.

CO2: differentiate the various categories of inequalities and their challenges.

CO3: describe the social stratification and its impact in society.

CO4: A

nalyze the social problems encountered in contemporary India.

CO5: Correlate the various forms and trends of the social change in Indian society and realize the relevance of their role in bringing about development.

Board of Studies (BoS) :
5thBoS of SSSH held on 29.12.2021

Academic Council:
18th Academic Council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			H			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.

HUMANITES ELECTIVES – VI SEMESTER

		L	T	P	C
SSDX 11	**ECONOMICS OF SUSTAINABLE DEVELOPMENT**				
SDG: 1-17		**2**	**0**	**0**	**2**

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.

Statement: The holistic understanding of all the 17 SDGs aims to end poverty, ensure prosperity, and protect the planet.

SSDX 12 SDG: 8, 9	SOCIOLOGY OF INDUSTRIAL RELATION	L	T	P	C
		2	0	0	2

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

Statement: 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 SDG: 8	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	C
		2	0	0	2

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

	PO 1	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

Statement: 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.

		L	T	P	C
SSDX 14	**GENDER, TECHNOLOGY AND DEVELOPMENT**	**L**	**T**	**P**	**C**
SDG: 8		**2**	**0**	**0**	**2**

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) :
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	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

Statement: 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 – VI SEMESTER

PHDX 01	**NON DESTRUCTIVE TESTING OF MATERIALS (common to Civil, Mechanical, Automobile and Aero)**	**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	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	L	M	L	M	M	M	L	L	L	M	-	-	-
CO2	M	L	M	H	L	M	H	M	L	L	L	M	-	-	-
CO3	L	M	H	H	L	H	M	M	L	H	L	M	-	-	-
CO4	M	L	H	M	L	M	M	H	L	M	L	M	-	-	-

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

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

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

PHDX 02	**MATERIALS SCIENCE FOR ENGINEERING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**
SDG: 4	(For Polymer)				

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) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

PHDX 03	**BIOMATERIALS**	**L**	**T**	**P**	**C**
SDG: 4	*(For Biotechnology)*	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To gain basic knowledge in classification of biomaterials and their properties.

COB2: To provide a basis for understanding properties of metallic implant materials.

COB3: To enable the students to correlate theoretical principles with practical applications.

COB4:To help students understand biocompatibility & toxicological screening of biomaterials

MODULE I — INTRODUCTION TO BIOMATERIALS — 8

Introduction: Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Surface properties of materials, physical properties of materials, mechanical properties-Materials for biophotonic applications.

MODULE II — IMPLANT MATERIALS — 10

Metallic implants: Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion-ceramic implants : bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics-Polymer implants: Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin.

MODULE III — BIOCOMPATIBILITY AND TOXICOLOGICAL SCREENING OF BIOMATERIALS — 6

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ-implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

MODULE IV — PRACTICAL ASPECTS OF BIOMATERIALS — 6

Preparation of biomaterials - Microscopic study & analysis of different biomaterials- alginate – material preparation and characterization - Testing of various biomaterials- case studies on industrial and clinical applications of biomaterials.

L – 30; Total Hours –30

TEXT BOOKS:

1. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill, 2003
2. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. Implant biomaterials: A comprehensive review, World Journal of Clinical Cases, 2015

REFERENCES:

1. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, Introduction to Biomedical Engineering, Elsevier, 2005.
2. Park J.B., Biomaterials Science and Engineering, Plenum Press, 2007.
3. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,Woodhead Medical Textiles and Biomaterials for Healthcare, Publishing Limited 2006.
4. D F Williams, Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume, VCH Publishers 1992.

COURSE OUTCOMES:

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

CO1: differentiate common use of biomaterials as metals, ceramics, polymers and apply them to classify its chemical structure, properties and morphology.

CO2: comprehend ideas involving general properties of implant materials and apply the same to identify the benefits of implant materials.

CO3: attain knowledge about the biocompatibility & toxicological screening of biomaterials and realize its usage in real life.

CO4: reflect upon the practical ideas of using biomaterials

Board of Studies (BoS) :

BOS of Physics was held on 21.6.21

Academic Council:

17th AC held on 15.07.2021

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

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

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

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

PHDX 04	OPTICAL FIBRE COMMUNICATION *(Common to EEE, ECE, and EIE)*	L	T	P	C
		2	0	0	2

SDG: 4

COURSE OBJECTIVES:

COB1: To facilitate the knowledge about optical fibres and its transmission characteristics.

COB2: To make the students to learn about LED and laser diodes.

COB3: To make the students understand the various types of opticalReceiversand sensors.

COB4: To enrich the knowledge on optical amplifiers and networks.

MODULE I INTRODUCTION TO OPTICAL FIBRES 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers.

MODULE II FIBER OPTICAL SOURCES 7

Light Emitting Diodes (LED) – power and efficiency - double hetero LED – LED structure - LED characteristics – Semiconductor Lasers diode, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers - applications.

MODULE III FIBER OPTICAL RECEIVERS AND SENSORS 8

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode Avalanche Photodiode (APD) characteristics - APD design of detector arrays – Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells - Fiber optic sensors: Intrinsic and Extrinsic sensors, amplitude, phase, wavelength and polarization modulation.

MODULE IV OPTICAL AMPLIFIERS AND NETWORKS 8

Optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers - Optical Networks: Basic networks, SONET/SDH, WDM Networks, Nonlinear effects on network performance, Performance of WDM + EDFA systems, Solitons, Optical CDMA, Ultrahigh capacity networks.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Gerd Keiser, Optical Fiber Communication, 3rd Edition, McGraw-Hill International, Singapore, 2013.

REFERENCES:

1 Govind P. Agrawal, Fiber-Optic Communication Systems (Wiley Series in Microwave and Optical Engineering) , Wiley 4th Edition, 2010.
2 J. Senior, Optical Communication, Principles and Practice, Prentice Hall of India, 3rd Edition, 2010.
3 D. C. Agrawal, Fiber Optic Communication, S.Chand& Co Ltd., 2005.
4 Rajiv Ramaswami, KumarSivarajan, Galen Sasaki, Optical Networks: A Practical Perspective, 3rd Edition, Morgan Kaufmann, 2009.
5 B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd, 2014.

COURSE OUTCOMES:

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

CO1: realize basics of optical fiber and differentiate various modes andconfigurations.

CO2: understand and assimilate the working principle of LED andDiode Laser.

CO3: select suitable photodetectors/sensorsfor different types of applications.

CO4: analyze the mechanism of optical amplifiers and analyze opticalnetworks.

Board of Studies (BoS) :

BOS of Physics was held on 21.6.21

Academic Council:

17th AC held on 15.07.2021

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

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

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

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

PHDX 05	**SEMICONDUCTOR PHYSICS FOR INFORMATION TECHNOLOGY**	**L**	**T**	**P**	**C**
SDG: 4	*(Common to CSE, CS, IT and AI-DS)*	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the physics of semiconductor devices

COB2: To gain knowledge on various methods involved in nano fabrication of semiconductor devices

COB2: To study the working principle of optoelectronic devices and various display devices

COB4: To get insight to different types of data storage technologies

MODULE I INTRODUCTION TO SEMICONDUCTOR DEVICES 6

Semiconductors: N and P type, PN junction diode under forward and reverse bias –– Zener diode, Schottky diode – Tunnel diode –bipolar junction transistor (BJT) - metal–oxide–semiconductor field-effect transistor (MOSFET), CMOS-concepts and fabrication.

MODULE II FABRICATION OF SEMICONDUCTOR DEVICES 6

Deposition of Semiconductor thin films – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD),magnetron sputtering,Types of lithography:Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

MODULE III OPTOELECTRONIC DEVICES 10

Light Emitting Diodes (LED) - double hetero LED structure - LED characteristics - White LED – Applications, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical detection – PIN and avalanche photodiodes, Applications: Optical mouse, traffic lights, Luminescence, Cathode Luminescence, Electro Luminescence, Transparent Conductors, Liquid crystal displays – Dynamic scattering and Twisted nematic display, Display Glasses, Organic LEDs display, Charge-coupled devices (CCD), Inorganic Semiconductor TFT Technology, Organic TFT Technology; Flexible Displays, Touch Screen Technology.

MODULE IV MEMORY STORAGE DEVICES 8

Introduction to memory storage, Resistive Random Access Memory (ReRAM), Phase Change Memory (PCM); Magnetoresistive Random Access Memory (MRAM)- Gaint Magnetoresistance (GMR), Tunnel Magnetoresistance (TMR), Ferroelectric Random Access Memory (FeRAM); Comparison and future directions, Hardware circuits, working analysis.

L – 30; Total Hours – 30

TEXT BOOKS:

1) W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2) Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3) D. S. Dhaliwal et al., Prevail : Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.

REFERENCES:

1. V.K. Mehta, Rohit Mehta, Principles of Electronics (Multicolour Edition) S. Chand Publishers, 10th Rev. Edn. 2006 Edition
2. Albert Malvino, David J. Bates Electronic Principles (SIE), McGraw Hill, 7th Edition, 2017
3. U. Mishra, J. Singh, Semiconductor Device Physics and Design, Springer, 2014
4. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, Wiley Publishers, 3ed 2008.
5. Bhattacharya Pallab, Semiconductor Optoelectronic Devices, Second Edition, By Pearson 2017
6. Joseph A. Castellano, Handbook of Display Technology, Springer, 1992
7. Yoshio Nishi, Advances in Non-volatile Memory and Storage Technology, Elsevier 2014

COURSE OUTCOMES:

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

CO1: understand the physics of semiconductor devices and identify its significance towards information technology (IT).

CO1: gain insight into various fabrication techniques towards therealization of nano-dimensional semiconductor devices.

CO2: attain knowledge on working principles of optoelectronic devices and display technologies and can recognize their importance in commercial applications.

CO4: learn the principle of data storage and its application towards futuristic memory technology.

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

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

		L	T	P	C
PHDX 06	**SENSORS AND ACTUATORS**	**L**	**T**	**P**	**C**
SDG: 4	*(For CSE-IOT)*	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the basic concept of sensors towards detection of pressure, position, velocity and temperature.

COB2: To avail knowledge on sensor which are sensitive to light, magnetic field, and acoustic waves

COB3: To study the different types of fabrication techniques towards realization of various sensors.

COB4: To get introduced towards MEMS technology and various actuators.

MODULE I INTRODUCTION TO SENSORS: PRESSURE, POSITION, VELOCITY AND TEMPERATURE 8

Introduction to sensors – working principles– classification – static and dynamic characteristics, Error Analysis, Pressure sensors – strain gauge, piezoelectric force sensor, vacuum sensors, Position sensor -Proximity sensor, Capacitive, Inductive and displacement sensor, velocity and acceleration sensors, Temperature sensor-thermocouples- thermistors-Thermo-EMF Sensors, metal Junction and metal Semiconductor junction types.

MODULE II SENSORS : LIGHT, MAGNETIC FIELD AND ACOUSTIC 8

Photocondutors- Optical Detectors - Photodiodes, Phototranistors, Optical encoder-Charge Coupled Device (CCD), Fabry Perot sensor, Hall effect, magneto resistive, magneto strictive sensors, Acoustic sensors-microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.

MODULE III SENSORS FABRICATION TECHNIQUES 7

Fabrication techniques – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD),magnetron sputtering,Types of lithography:Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

MODULE IV MICROSYSTEMS AND ACTUATORS 7

Microelectro-mechanical systems (MEMS) - RF- MEMS, Micro fabrication and Applications, Classification of transducers: electrostatic, piezoelectric, thermal, Microsystem design and fabrication.working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications Solid-state switches, relays Solenoids, D.C. Motors, A.C. Motors, Stepper motors. Shape memory alloy actuators.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jacob Fraden, Hand Book of Modern Sensors: physics, Designs and Applications, 3rd edition, Springer, New York, 2015.
2. Jon. S. Wilson, Sensor Technology Hand Book, 1st edition, Elsevier, Netherland, 2011.
3. John G Webster, Measurement, Instrumentation and sensor Handbook, 2nd edition, CRC Press, Florida, 2014.

REFERENCES:

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2. Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3. D. S. Dhaliwal et al., PREVAIL: Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.
4. Tai-Ran Hsu, MEMS & Microsystem, Design and Manufacture, 1st ed., McGraw Hill India, New Delhi, 2017.
5. MassoodTabibArar, Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures, 1st ed., Kluwer Academic publishers, New York, 2014.

COURSE OUTCOMES:

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

CO1: get exposed to various types of sensors and apply the ideas to distinguish between pressure, position, velocity and temperature based sensors

CO2: familiarize towards light, magnetic field, and acoustic based sensors and recognize their importance in commercial applications.

CO3: gain insight into various fabrication techniques towards the realization of sensors
CO4: apply the ideas to conceptualize MEMS technology and different actuators in engineering field

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

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

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

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

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

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

PHDX 07 SDG: 4	FUNDAMENTALS OF NANOTECHNOLOGY AND ITS APPLICATIONS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of Nanoscience through quantum mechanical theories and solid state physics.

COB2: To provide knowledge about the various synthesis methods applicable to different nano materials

COB3: To enrich the knowledge of students in various characterisation techniques.

COB4: To provide knowledge on applications of poymer based nano materials in various fields.

MODULE I BASICS OF NANO SCIENCE 7

Introduction to Nanoscience & Nanotechnology: Review of classical mechanics – overview Quantum Mechanics. Background to nanoscience and nanotechnology - scientific revolutions - nanosized effects – surface to volume ratio – atomic structure – molecular and atomic size - quantum effects - formation of nano sized particles – energy at the nanoscale.

MODULE II SYNTHESIS OF NANOMATERIALS 8

Nanomaterial Fabrication: Bottom-up vs. top-down - Preparations of Nanomaterials by mechanical and physical methods : – High energy ball milling – melt quenching and annealing – vapour deposition – Pulsed laser deposition – Magnetron sputtering - Microwave plasma evaporation. Chemical Methods of Preparation : Sol-gel method –Electrodeposition – Electrospinning. Arc method for carbon nanotubes – nanofibres and rods – synthesis of Graphene- Handling of nano particles - Health hazards – Precautions.

MODULE III CHARACTERIZATION OF NANOMATERIALS 8

Characterisation of Nanomaterials: XRD – particle size determination - SEM - FESEM - TEM – AFM – Nanoindentor – UV-VIS spectroscopy – FTIR, FT-Raman, Photoluminescence, NMR, ESR - Dielectric characterization – Magnetic characterization.

MODULE IV APPLICATION OF NANO MATERIALS 7

Applications of Carbon based nanomaterials (CNT, CNF, Graphene) - Biosensor (principle, component, types, applications) - agriculture (nano-fertilizers, herbicides, nano-seed science, nano-pesticides) and food Systems (encapsulation of functional foods, nano-packaging) – Nano - electronics, Nano-optics.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

REFERENCES:

1 Nanotechnology: basic science and emerging technologies by Mick Wilson, Kamali Kannangara, Geoff Smith, and Michelle Simmons, Chapman & Hall/CRC; I edition, 2002.
2 Handbook of NanoScience, Engineering and Technology by Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., CRC Press, 2012.
3 Nanocomposite Science and Technology by P. M. Ajayan, L. S. Schadler, P. V. Braun, WILEY-VCH Verlag GmbH, 2003.
4 Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.

COURSE OUTCOMES:

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

CO1: understand basic principles of nanomaterials and apply them todifferentiate the significance of nanomaterials compared to bulk materials.

CO2: familiarize the various synthesis methods of nanomaterials andcompare them with the preparation of materials in bulk form.

CO3: get useful ideas about characterization techniques and differentiatedifferent techniques.

CO4: understand the various applications of nanomaterilas and realize the role of nanomaterials in various fields

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

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

CHEMISTRY ELECTIVE – VI SEMESTER

CHDX 01	CHEMISTRY OF CONSTRUCTION MATERIALS	L	T	P	C
		2	0	0	2

SDG: 9

COURSE OBJECTIVES:

To impart knowledge on

COB1: chemistry of cement and concrete

COB2: properties of steel and mechanism of corrosion

COB3: quality of water and its impact on concrete

COB4: analytical techniques for concrete research

MODULE I CHEMISTRY OF CEMENT AND CONCRETE 8

Cement - chemical composition - Bogue's compounds - hydration of cement - hydrated products - influence of hydrated products on properties of cement - types of cement - microstructure of aggregate phase and hydrated cement paste - Interfacial transition zone in concrete : significance and microstructure

MODULE II CHEMISTRY OF STEEL AND CORROSION 8

Steel for construction - chemical composition - types of steels - influence of chemical composition on properties. Corrosion of steel - mechanism of corrosion of steel in water and concrete medium - types of corrosion of steel associated to civil engineering. Corrosion prevention and control : coatings & inhibitors - working mechanism. Cathodic protection to steel : Concept - working mechanism - sacrificial anodes

MODULE III WATER CHEMISTRY FOR CONCRETE 7

Water quality parameters – pH, solids, hardness, alkalinity, chloride and sulphates in water and their determination- Water quality for building construction – Effect of water impurities on concrete strength and durability- Carbonate and Sulphate attack-Chloride attack –Alkali-Silica reactions in concrete-Case studies

MODULE IV ANALYTICAL TECHNIQUES FOR CONCRETE RESEARCH 7

Analytical techniques for cement concrete research - FITR spectroscopy - SEM - XRD - Cyclic voltammetry (CV) - Thermo-gravimetric analysis (TGA) and

Differential thermal analysis (DTA) - Advanced chloride and water analysis techniques.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Wieslaw Kurdowski, Cement and Concrete Chemistry, Springer Netherlands, 2014.

REFERENCES:

1. P.C Jain and Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd.,New Delhi , 2013.

2. S SUmare and S S Dara, A text Book of Engineering Chemistry, S. Chand and Company Ltd, New Delhi, 2014.

3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company,NewYork, 1984.

4. B. Sivasnakar, Engineering Chemistry, Tata McGrow - Hill Publication Limited, New Delhi,second reprint 2008.

5. P. Kumar Mehta and Paulo J.M. Moteiro, "Concrete : Microstructure, Properties and Materials", McGraw Hill Education (India) Pvt. Ltd., 4th Edition, New Delhi, 2014

6. APHA Standard Methods for the Examination of Water & Wastewater, American Public Health Association, USA, 2005.

COURSE OUTCOMES:

CO1: Explain the properties of cement and concrete

CO2: Describe the properties of steel, mechanism of corrosion and its prevention

CO3: Enumerate the impact of water quality on the concrete

CO4: Elaborate the principle, instrumentation and applications of various analytical techniques for concrete research

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

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	-	-	-	L	-	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-
CO3	-	-	-	-	-	-	M	-	-	-	-	-	L	-	-
CO4	-	-	-	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

CHDX 02	CHEMISTRY OF MATERIALS AND ELECTROCHEMICAL DEVICES	L	T	P	C
		2	0	0	2

SDG: 9

COURSE OBJECTIVES:

The students will be conversant with

COB1: concepts of corrosion, types and various methods to control corrosion.

COB2: the chemicals, chemical reactions, construction and working of different batteries and fuels cells.

COB3: the types, properties and manufacture of refractories and abrasives.

COB4: types, functions of lubricants and mechanism of lubrication.

MODULE I CORROSION AND ITS CONTROL 8

Types of corrosion - chemical corrosion – electrochemical corrosion – galvanic corrosion – differential aeration corrosion - factors influencing rate of corrosion.

Corrosion control – selection of materials - cathodic protection: sacrificial anode - corrosion inhibitors – paints: constituents & functions – treatment of metal surface for inorganic coatings - metallic coatings: hot dipping: galvanizing and tinning – electroplating — electroless plating.

MODULE II ELECTROCHEMICAL DEVICES 8

Electrochemical cell, electrolytic cell - introduction to batteries – classification – primary: dry alkaline – secondary: lead–acid, nickel–cadmium and lithium batteries, Fuel cells – classification based on temperature and electrolyte - hydrogen–oxygen fuel cell, applications – solar cells: construction and working – dye sensitised solar cells.

MODULE III REFRACTORIES AND ABRASIVES 7

Refractories: Introduction - refractory - classification – based on chemical nature - characteristic and selection of good refractory - properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability – general manufacture of refractory – components, properties and uses of: silica, magnesite, zirconia refractories - super refractories - application of refractories.

Abrasives: classification - Moh's scale – properties - natural abrasives: diamond, corundum, emery, garnet, quartz - synthetic abrasives: preparation, properties and uses: carborundum, alundum, boron carbide (norbide), tungsten carbide, zirconium silicate – grinding wheel – abrasive paper and cloth - Rockwell scale test - knoop hardness test.

MODULE IV LUBRICANTS 7

Introduction – functions of lubricant- mechanism of lubrication - classification of lubricant – selection of lubricants - lubricating oils - properties of lubricant: viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue - semisolid: grease (sodium, calcium, lithium, aluminium) - solid lubricant: graphite, graphene, molybdenum disulphide – lubricating emulsions - cutting fluids – synthetic and semi-synthetic lubricants.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jain P.C and Monika Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Co., New Delhi. 2016.

REFERENCES:

1. E. McCafferty, "*Introduction to Corrosion Science*" Springer, May 2010.
2. Tulika Sharma "*Electrochemical devices*" LAP Lambert Academic Publishing, 2011.
3. Jeffry S Gaffney, Nancy A Marley *General chemistry for engineers*, Elsevier, 2018.
4. Don M Pirro, Martin Webster, Ekkehard Daschner "*Lubrication Fundamentals*", Taylor & Francis Gp, LLC, 2016.
5. Theo Mang, Wilfred Dresel "*Lubricants and Lubrication*" Wiley-VCH, 2017

COURSE OUTCOMES:

The students will be able to

CO1: apply specific methods to control corrosion of different materials.

CO2: illustrate the construction and working of different types of cells, batteries and fuel cells.

CO3: compare the properties and devise a method of manufacture of refractories and abrasives.

CO4: analyze and choose the right type of lubrication based on the type of machines.

Board of Studies (BoS) :

11th BoS of Chemistry held on 17.06.2021

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	-	-	-	-	M	-	M	-
CO2	H	-	-	-	-	-	M	-	-	-	-	L	-	M	-
CO3	M	-	-	-	-	-	-	-	-	-	-	-	-	L	-
CO4	H	-	-	-	-	-	L	-	-	-	-	L	-	M	-

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

SDG 9: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

CHDX 03	**CHEMISTRY AND INSTRUMENTATION FOR ELECTRICAL AND ELECTRONIC APPLICATIONS**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: Synthesis, properties and applications of electrical and electronic devices.

COB2: Classification and types of fuel cells.

COB3: Types of sensors and their applications.

COB4: Principle, instrumentation and applications of analytical techniques.

MODULE I ELECTRICAL AND ELECTRONIC DEVICES 7

Solar Cell- Si solar cell, quantum dot solar cell, LCD : components, liquid crystals and their composition, electrodes – OLEDS: components, synthesis and modification of small molecules, polymers, phosphors - FRP-synthesis, properties and electrical applications - Solders : composition and uses – Capacitors : synthesis and modification of capacitor materials, fabrication.

MODULE II FUEL CELLS 7

Difference between batteries and fuel cells - classification of fuel cell (based on temperature and electrolyte) – principle, characteristic features, advantages, disadvantages and applications of polymer electrolyte membrane or proton exchange membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC), alkaline fuel cell (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC), and solid oxide fuel cells (SOFC) microbial fuel cell, - hydrogen storage materials, challenges in using hydrogen as a fuel.

MODULE III SENSORS 7

Definition, receptor, transducer, classification of chemical sensors based on operating principle of transducer, Ion-selective electrodes, Conductometric gas sensors (chemoresistors), Electrochemical sensors, Potentiometric MOSFET gas sensor, Touch sensors (oximeter, glucometer), Chemocapacitors, Biochips and microarray.

MODULE IV ANALYTICAL TECHNIQUES 9

Voltammetry: cyclic voltammetry, electrogravimetry - principle, instrumentation and applications of: UV-Vis spectrophotometry, Atomic emission spectroscopy-Photoluminescence spectrophotometry, atomic absorption spectrophotometry –-FT-IR spectroscopy, Raman spectroscopy, TGA-DTA analyzer, TEM.

L – 30; Total Hours – 30

TEXT BOOKS:

1. P.C. Jain & Monica Jain, Engineering Chemistry, Dhanpatrai Publishing Company (P) Ltd., New Delhi (2016).

REFERENCES:

1. K.M. Gupta & Nishu Gupta, Advanced electrical and electronic materials: process and applications, Wiley-Scrivener (2015).
2. S. Vairam, P. Kalyani and Suba Ramesh, Engineering Chemistry, Wiley India Ltd., New Delhi (2011).
3. B. Viswanathan & M. Aulice Scibioh, Fuel Cells: Principles and Applications, University Press (2008).

COURSE OUTCOMES:

CO1: Illustrate the construction and applications of electrical and electronic devices.

CO2: Classify the fuel cells and elaborate the different types of fuel cells.

CO3: Explain the different types of sensors and their applications.

CO4: State the principle and illustrate the instrumentation of various analytical techniques.

Board of Studies (BoS) :

11th BoS of Chemistry held on 17.06.2021

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

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

CHDX 04	**FUNCTIONAL MATERIALS AND APPLICATIONS**	**L**	**T**	**P**	**C**
SDG: 11 & 12	**(CSE – cyber security, AI, IOT, IT)**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

To make the students conversant with

OB1: specific materials for hardware components fabrication, data

orage and their related properties

OB2: selection of advanced materials for various current applications

OB3: materials for the fabrication of sensors

OB4: essential characterization techniques and software tools with

emistry background

MODULE I MATERIALS FOR HARDWARE AND DATA STORAGE 7

Specific materials for electrical and electronic gadgets-computers, instruments (Semiconductors-N, S doped Silicon, CdX QDs, metal nano and other applications). Networking of networks and connecting devices - materials used in robotic construction (metal alloys, kevlor, biodegradable smart materials). Data storage and magnetic hard disk and devices- pendrive (flash memory-ferro magnetic and super paramagnetic materials, optical dics). Nanomaterials to enhance the lifetime and storage of CD, DVD and BD (Nano incorporated Polycarbonate, Al and lacquer) - Nanomaterials and small molecules for data storage.

MODULE II ADVANCED MATERIALS AND APPLICATIONS 8

Materials for 3D printing (Nylon, ABS, PLA, Ti, Au and Ag). Solar panels function monitoring-IOT enabled (crystalline Si, organometallics) – Displays and LCD, LEDs and its types-OLEDs (Group III-V materials). RGB analysis - sensing and TV/system screen (QDs and anthocyanins). Semiconductor chemistry for VLSI processing technology (metalloid staircase, Si, Ge, GaAs)- materials for inkjet printable circuit board (nanocarbon based) - Right material for signal speed and right thermal coefficient of expansion - Remote sensing (photodectectors and radiometers). Solder:-Lead based solder - issues and alternative for lead free solder (Conductive inks).

MODULE III MATERIALS FOR FABRICATION OF SENSORS 8

Wireless Sensors – Introduction to sensors (chemo/bio/gas sensors)-Wearable/touch sensors-Components - selection of materials - Device fabrication and function monitoring - wireless, Smartphone based and IOT enabled-Properties of materials, anti-corrosive, water proof, insulation and lamination. Robotics in surgery, gene coding and molecular modelling. Biochips and DNA microarray chips(fluorescent dyes, glass/nylon).

MODULE IV ANALYTICAL TECHNIQUES AND SOFTWARE SOLUTIONS 7

Characterization tools – UV-Visible (DRS), FT-IR, SEM, TEM, AFM, TG-DTA and XRD (Principle and applications only). Introduction to softwares-ChemOffice, Image J, Origin - Molecular modelling, comparison of old drug structures with new, drug designing-drug for COVID-19 and drug delivery. Molecular docking (drug interaction in a human body).

L – 30; Total Hours – 30

TEXT BOOKS:

1. P. Roy, S.K. Srivastava, Nanomaterials for Electrochemical Energy Storage Devices (Book), John Wiley & Sons, 2019.
2. K. Brun, T. Allison, R. Dennis, Thermal, Mechanical, and Hybrid Chemical Energy Storage Systems (Book), Elsevier, 2000.

REFERENCES:

1. B.J. Cafferty, A.S. Ten, M.J. Fink, S. Morey, D.J. Preston, M. Mrksich, G.M. Whitesides, Storage of Information Using Small Organic Molecules, ACS Central Science, 2019, 5, 911−916.
2. Nabeel Ahmad P. Gopinath and Rajiv Dutta, 3D Printing Technology in Nanomedicine (Book), Elsevier, 2019.
3. Aaftaab Sethi, Khusbhoo Joshi, K. Sasikala and Mallika Alvala, Molecular Docking in Modern Drug Discovery: Principles and Recent Applications, IntechOpen, (2019), DOlI: 10.5772/intechopen.85991.
4. W-L. Xing, J. Cheng, Frontiers in Biochip Technology, Springer, 2006.

5. Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, 3rd Edition, Springer, 2015.

COURSE OUTCOMES:

CO1: Identification of suitable materials in electronic gadgets and data storage systems.

CO2: Application of specific functionalized materials for advanced applications

CO3: Choose appropriate materials for fabricating the different types of sensors

CO4: Hands on experience of software and exposure to material properties

Board of Studies (BoS) :

15th BoS of Department of Chemistry held on 15.06.2021

Academic Council:

17th AC held on 15.07.2021

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

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

SDG: 11 & 12

Statement : Identification of suitable materials towards the manufacturing of electronic gadgets and data storage systems without much affecting the natural resources and application of the fabricated devices to the sustainable cites and communities.

		L	T	P	C
CHDX 05	**CHEMISTRY OF FUELS, COMBUSTION AND LUBRICANTS**	**2**	**0**	**0**	**2**

SDG: 9

COURSE OBJECTIVES:

The students will be conversant with

COB1: types, composition and process of manufacture of solid, liquid and gaseous fuels.

COB2: determination of calorific value and calculation of GCV and NCV.

COB3: types, concepts of corrosion and different methods for control of corrosion.

COB4: types, functions of lubricants and mechanism of lubrication.

MODULE I FUELS 8

Introduction – classification of fuels – calorific value – characteristics of a good fuel – comparison of solid, liquid and gaseous fuel – solid fuels – coal – ranking of coal – proximate analysis of coal – pulverised coal – metallurgical coke – manufacture of coke (Otto Hoffman) – Liquid fuel – petroleum – refining of petroleum – cracking – fixed bed catalytic cracking - synthetic petrol – Fischer-Tropsch process – biodiesel - Gaseous fuel – CNG – LPG – Biogas – producer gas – water gas

MODULE II COMBUSTION 8

Introduction – calorific value - Calorific value: Gross and net calorific value - Bomb Calorimeter - Gas calorimeter - Definition of combustion – theoretical calculation of calorific values (Dulong's formula) - Gross and net calorific values (problems) - air-fuel ratio - minimum requirement of air for complete combustion of fuels (problems) –– Analysis of flue gas - Orsat's gas analysis method

MODULE III CHEMISTRY OF CORROSION 7

Types of corrosion - chemical corrosion – electrochemical corrosion – galvanic corrosion – differential aeration corrosion - factors influencing rate of corrosion.

Corrosion control – selection of materials - cathodic protection: sacrificial anode - corrosion inhibitors – paints: constituents & functions – treatment of metal surface for inorganic coatings - metallic coatings: hot dipping:

galvanizing and tinning – electroplating — electroless plating.

MODULE IV LUBRICANTS 7

Introduction – functions of lubricant- mechanism of lubrication - classification of lubricant – selection of lubricants - lubricating oils- properties of lubricant: viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue – semi solid: grease (sodium, calcium, lithium, aluminium) - solid lubricant: graphite, graphene, molybdenum disulphide – lubricating emulsions - cutting fluids – synthetic and semi-synthetic lubricants.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jain P.C and Monika Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Co., New Delhi. 2016.

REFERENCES:

1. Stephen R Turns, “An Introduction to Combustion: Concepts and Applications”, McGraw Hill Education, July 2017,
2. Samir Sarkar, “Fuels and Combustion”, University Press, 2009
3. Dipak K Sarkar “Thermal power plant: Design and operations – Chapter-3”, Elsevier, 2015.
4. E. McCafferty, “Introduction to Corrosion Science” Springer, May 2010.
5. Don M Pirro, Martin Webster, Ekkehard Daschner “Lubrication Fundamentals”, Taylor & Francis Gp,LLC, 2016.
6. Theo Mang, Wilfred Dresel “Lubricants and Lubrication” Wiley-VCH, 20172nd Edition, India, 2012. (ISBN 13: 9788131704370)

COURSE OUTCOMES:

The students will be able to

CO1: compare and interpret the different purpose of application, composition, and calorific value of different fuels.

CO2: calculate the minimum amount of air required, GCV and NCV for the combustion of the fuels.

CO3: apply specific methods to control corrosion of different materials.

CO4: analyze and choose the right type of lubrication based on the type of machines.

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

Academic Council:
!7th 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	M	-	-	-	-	M	-	-	-	-	-	-	M	-
CO2	H	H	-	L	-	-	M	-	-	-	-	-	-	L	-
CO3	H	L	-	-	-	-	-	-	-	-	-	-	M	M	-
CO4	H	M	-	-	-	-	L	-	-	-	-	-	M	L	-

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

SDG 9: Industry, Innovation & Infrastructure

The holistic understanding of the materials used as fuels and lubricants and devices towards sustainable solutions for the advances in mechanical systems.

		L	T	P	C
CHDX 06	**INSTRUMENTAL METHODS OF POLYMER ANALYSIS**				
SDG: 4		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: to impart knowledge on spectroscopic analysis of polymers.

COB2: to equip with the knowledge of optical methods and X-ray diffraction methods for understanding the morphology and orientation of molecules

COB3: to develop an understanding on separation of various mixtures by different chromatographic techniques.

COB4: to understand the chemical elemental structure of polymers by NMR and mass spectroscopic technique.

MODULE I ULTRAVIOLET, VISIBLE AND IR SPECTROSCOPY 9

Principle- Instrumentation-Double beam spectrophotometers – single beam spectrophotometers -sources of radiation – Detectors – I operational procedure – qualitative and quantitative analysis – applications in polymer analysis.

Fourier Transform Infrared Spectroscopy -principle- instrumentation – optical materials – sources- detectors – typical spectrophotometers –– calibration and standardization – sample preparation - analysis – interpretation of FTIR spectra- principle of identification and characterization of polymers using IR

MODULE II NMR SPECTROSCOPY 7

Fundamental concepts – chemical shift – spin –spin- coupling. Instrumentation - data acquisition and spectral interpretation. Solid state NMR (magic angle), Applications of NMR and FT NMR in the characterization of polymers

MODULE III CHROMATOGRAPHY AND THERMAL ANALYSIS 7

Thermal analysis: DSC, TG/DTA, TMA, DMA, DETA with examples. gel permeation chromatography (GPC) – High pressure liquid chromatography (HPLC) – Thin layer chromatography (TLC - Gas chromatography (GC) – sample preparation. Chromatographic process and instrumentation – compositional separation and detectors – various types – Analyses. The uses and applications of various chromatographic techniques – pyrolysis gas chromatography.

MODULE IV X-RAY DIFFRACTION & NEWTON SCATTERING 7

Principle & basic concept of absorption of X-rays- monochromatic X-ray sources – X-ray detectors - Instrumentation – Experimental technique -Analysis by X-ray absorption. Absorption apparatus – X-ray diffraction – Diffraction apparatus. Application to polymer analysis.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch “Principles of Instrumental Analysis” 7th edition, Publisher Cengage Learning, 2016
2. Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, “Introduction to Spectroscopy” 5th edition, Publisher Cengage Learning , 2015
3. Yang, Rui “Analytical methods for polymer characterization” CRC Press, 2018.
4. Joseph D. Menczel, R. Bruce Prime “Thermal analysis of polymers: fundamentals and applications” John Wiley, 2019.

REFERENCES:

1. Galen W. Euring, “Instrumental methods of chemical analysis”, McGraw Hill International editions, New York, 1985.
2. B.J. Hunt & MI Jones Blackie, “Polymer Characterisation”, Academic professional, London, 1997.
3. Hubert Lobo, Jose V.B.Bonilla, “Handbook of Plastic analysis” , Marcel Dekker inc, New York, 2003.
4. RA pethrick & JV Daukins, “Modern techniques for polymer characterization” , John Wiley & sons Chichester, UK, 1999.
5. D. Campbell and R. White, “Polymer characterization”, Chapman & Hall, London 1989.
6. Arza Seidel, “Characterization and Analysis of Polymers”, John wiley and sons, New jersey, 2008.
7. Nicholas P. Cheremisinoff, “Polymer Characterization: Laboratory Techniques and Analysis”, Noyes publications, New jersey, 1996.
8. John M Chalmers, Robert J Meier, “Molecular characterization and analysis of polymers” Elsevier, 2008

COURSE OUTCOMES

CO1: Gaining knowledge on principles of various instruments

CO2: Understand about various characterization techniques

CO3: Interpretation the polymer by different techniques

Board of Studies (BoS) :	**Academic Council:**
11th BoS of Chemistry held on 17.06.2021	!7th AC held on 15.07.2021

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

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

SDG 4 : Aims at ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all

This course will provide deep knowledge on analysis of polymers using different instrumental methods.

CHDX 07	MEDICINAL CHEMISTRY	L	T	P	C
		2	0	0	2

SDG: 9

COURSE OBJECTIVES:

To impart knowledge on

COB1: The basic factors governing drug design.

COB2: The software tools for molecular docking.

COB3: The synthetic pathway of antinfective, antineoplastic, cardiovascular and steroidal drugs.

COB4: The mode of action and side effects of synthetic drugs.

MODULE I INTRODUCTION TO DRUG DESIGN 7

Development of new drugs: Procedure followed in drug design – Literature survey - Search for Active Pharmaceutical Ingredient(s) - Molecular modification – Types of pharmaceutical form / mode of administration, Chemical Characterization of Medicinal Drugs - Molecular docking.

MODULE II ANTIINFECTIVE DRUGS 8

Synthesis, mode of action and side effect of Dapsone and Clofazimine (antileprotic) – Isoniazid, Rifampicin, Pyrazinamide and Ethambutol (antitubercular) – Fluconazole and griseofulvin (antifungal) – Chloroquine and Primaquine (antimalarial) - Semisytheticpencillin, Streptomycin, Ciprofloxacin (Antibiotics) - Nevirapine and Zidovudine (Antiviral)

MODULE III ANTINEOPLASTIC AND CARDIOVASCULAR DRUGS 8

Synthesis, mode of action and side effect of Mechlorethamine, Cyclophosphamide, Melphalan, Fluorouracil, 6-Mercaptopurine (Antineoplastic) – Sorbitrate, methylprednisolone, Methyldopa, quinidine (Cardiovascular).

MODULE IV STEROIDS AND RELATED DRUGS 7

Synthesis, uses and mode of action - (A) Androgens -testosterone (B) Estrogens and progestational agents – progesterone, (C) Adrenocorticoids – prednisolone, dexamethasone, Remdesivir (D) Glucocorticoids – Cortisol (E)Anabolicsteroids - nandrolone, oxandrolone (F) Neurosteroids – allopregnanolone.

L – 30; Total Hours – 30

TEXT BOOKS:

1. An Introduction to Drug Design, S. N. Pandeya and J. R.Dimmock, New Age International, 1997.
2. Burgers's Medicinal Chemistry and Drug Discovery, Fifth Edition; M. E. Wolff, John Wiley and Sons, 1996.
3. The organic chemistry of drug design and drug action, R. B. Silverman and M. W. Holladay, Academic Press, 3rd Edition, 2014.
4. Introduction to medicinal chemistry**:** How Drugs Act and Why, A. Gringuage, Wiley-VCH, 1996.
5. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry; Eleventh Edition; Lippincott Williams & Wilkins, 2004.

REFERENCES:

1. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley, 2nd Edition 2008.

COURSE OUTCOMES:

CO1: Carry out searches to retrieve information relevant to the development of a new drug.

CO2: Describe and justify the role and importance of the various disciplines involved in the different phases of drug discovery and development.

CO3: Explain how synthetic methods are used to make early decisions in the drug discovery and development.

CO4: Elaborate the mode of action and side effect of the drugs.

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

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	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-
CO3	-	-	-	-	-	L	-	-	-	-	-	-	L	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-

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

SDG 9 :Industry, Innovation & Infrastructure

Understanding of drugs preparation and usage in sustainable method reduces unwanted side effects and help to environments.