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 December 2023, as per 21st Academic Council)*

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# B.Tech.
# (Civil Engineering)

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# REGULATIONS 2021

# CURRICULUM AND SYLLABI

## (Updated upto December 2023, as per 21st Academic Council)

## B.TECH. CIVIL 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 CIVIL ENGINEERING

## VISION AND MISSION

### Vision

- To be a leading department for Education, Training and Research in Civil Engineering for a better future and over-all Socio-Economic progress of the Country in a sustainable manner.

### Mission

- To offer world class undergraduate, postgraduate and research programs of industrial and societal relevance in civil engineering.
- To nurture ethically strong civil engineers to address global challenges through quality education and application oriented research.
- To educate our students on design, construction, maintenance and advancements in civil engineering for providing solutions to the betterment of the society.
- To prepare competitive and responsible citizens with good communication, leadership and managerial skills.
- To enrich and enhance the knowledge base for the best practices in various areas of Civil & allied Engineering through collaborations with Global Institutions of Excellence, Industries and Research Organizations.
- To provide a healthy ambience for teaching, research, consultancy and extension activities.

## PROGRAMME EDUCATIONAL OBJECTIVES

- Exhibit expertise in Planning, Design, Execution and Maintenance of Civil Engineering works as per relevant codal provisions with care for Environment in the global context.
- Design and construct Civil Engineering Infrastructure with emphasis on Durability and Sustainability.
- Develop and execute Civil Engineering projects with social relevance aiming for rural and urban development.
- Pursue Research in complex Civil Engineering problems involving multidisciplinary aspects, and provide sustainable solutions.
- Exercise leadership with an ethical approach, perform in a team work with good communications skills, and excel in cost and time management.

## PROGRAMME OUTCOMES

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

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyses 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 modeling 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

**PROGRAMME SPECIFIC OUTCOMES**

- Identify suitable construction materials, techniques and practices for Civil Engineering construction.
- Plan, analyze, design and estimate civil engineering structures using relevant software and appropriate codal provisions.
- Characterize water & wastewater and design sustainable water supply & sanitation schemes.

# REGULATIONS - 2021
# B.TECH. DEGREE PROGRAMMES
## *(Under Choice Based Credit System)*

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

## 1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

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

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

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

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

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

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

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

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

ix) **"Dean of the School"** means the Dean of the School of the department concerned.

x) **"Head of the Department"** means the Head of the Department concerned.

## 2.0 ADMISSION

**2.1a)** Candidates for admission to the first semester of the eight semester B. Tech. degree programme shall be required to have passed the Higher Secondary Examination of the 10+2 curriculum

(Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

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

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

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

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

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

## 3.0 BRANCHES OF STUDY

**3.1** Regulations are applicable to the following B.Tech. Degree programmes in various branches of Engineering and Technology,

each distributed over eight semesters, with two semesters per academic year.

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

## 4.0 STRUCTURE OF THE PROGRAMME

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

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

### 4.1.1 Mandatory Induction Programme for First year Students

The first year students upon admission shall undergo a mandatory three week induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local

areas, familiarization with departments / schools and centres, etc.,

### 4.1.2 Personality and Character Development

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

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

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

### 4.1.3 Online Courses for Credit Transfer

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

### 4.1.4 Value Added Courses

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

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

These value added courses shall be specified in the consolidated

mark sheet as additional courses pursued by the student over and above the curriculum during the period of study.

**4.1.5 Industry Internship**

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

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

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

**4.1.6 Industrial Visit**

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

**4.2** Each course is normally assigned certain number of credits:

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

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

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

**5.0 DURATION OF THE PROGRAMME**

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

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

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

## 6.0 REGISTRATION AND ENROLLMENT

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

### 6.2 Change of a Course

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

### 6.3 Withdrawal from a Course

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

## 7.0 BREAK OF STUDY FROM PROGRAMME

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

7.1.1 Medical or other valid grounds

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

7.1.3 Debarred due to any act of indiscipline

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

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

**7.4** During the break of study, the student shall not be allowed to attend

any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

## 8.0 CLASS ADVISOR AND FACULTY ADVISOR

### 8.1 Class Advisor

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

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

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

### 8.2 Faculty Advisor

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

## 9.0 COURSE COMMITTEE

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

## 10.0 CLASS COMMITTEE

A class committee is constituted branch wise and semester wise by the Head of the Department / Dean of the School shall normally comprise of faculty members handling the classes, student

representatives and a senior faculty member not handling the courses as chairman.

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

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

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

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

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

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

**10.5** The third meeting of the class committee, excluding the student members, shall meet after the semester end examinations to analyse the performance of the students in all the components of

assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the course faculty concerned.

**11.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER**

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

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

**12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS**

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

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

**12.2 Theory Course**

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

**12.3 Laboratory Course**

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

**12.4 Laboratory Integrated Theory Courses**

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and

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

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

**12.6 Industry Internship**

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

**12.7 Project Work**

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

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

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

end examination and the internal assessment marks secured during the course of study shall become invalid.

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

**13.0 SUBSTITUTE EXAMINATIONS**

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

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

**14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION**

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

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

course.

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

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

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

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

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

## 15.0 REDO COURSES

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

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

## 16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

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

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

**"W" -** denotes withdrawal from the course

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

**“U” -** denotes unsuccessful performance in the course.

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

of grade.

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

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

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

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

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

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

Where n = number of courses

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

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

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

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

Percentage equivalent of marks = CGPA X 10

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

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

**16.6.1 Eligibility for First Class with Distinction**

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

**16.6.2 Eligibility for First Class**

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

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

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

**17.0 SUPPLEMENTARY EXAMINATION**

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

**18.0 DISCIPLINE**

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

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

**19.0 ELIGIBILITY FOR THE AWARD OF DEGREE**

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

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

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

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

iv) No disciplinary action pending against him/her.

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

**20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS**

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

| | |
|---|---|
| • Civil Engineering | • Mechanical Engineering |

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

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

| **Sl. No.** | **Minor Degree** | **Eligible Major Degree Programmes (from other Departments)** |
|---|---|---|
| 1. | Artificial Intelligence and Machine Learning | Mechanical Engineering<br>Aeronautical Engineering<br>Polymer Engineering<br>Automobile Engineering<br>Civil Engineering<br>Biotechnology<br>Electrical and Electronics Engineering<br>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<br>Aeronautical Engineering<br>Polymer Engineering<br>Automobile Engineering<br>Civil Engineering<br>Biotechnology<br>Electrical and Electronics Engineering<br>Electronics and Instrumentation Engineering<br>Electronics and Communication Engineering |
| 7. | Sensor Technology | Mechanical Engineering<br>Aeronautical Engineering |

| | | |
|---|---|---|
| | | Polymer Engineering<br>Automobile Engineering<br>Civil Engineering<br>Biotechnology<br>Electrical and Electronics Engineering |
| 8. | Robotics | Artificial Intelligence and Data Science<br>Computer Science and Engineering (Cyber Security)<br>Computer Science and Engineering (IoT)<br>Computer Science and Engineering Information and Technology<br>Civil Engineering<br>Biotechnology<br>Electrical and Electronics Engineering<br>Electronics and Instrumentation Engineering |
| 9. | 3D Printing | Artificial Intelligence and Data Science<br>Computer Science and Engineering (Cyber Security)<br>Computer Science and Engineering (IoT)<br>Computer Science and Engineering Information and Technology<br>Biotechnology<br>Electrical and Electronics Engineering<br>Electronics and Instrumentation Engineering<br>Electronics and Communication Engineering |
| 10. | Electric Vehicles | Artificial Intelligence and Data Science<br>Computer Science and Engineering (Cyber Security)<br>Computer Science and Engineering (IoT)<br>Computer Science and Engineering Information and Technology<br>Civil Engineering<br>Biotechnology |

| | | |
|---|---|---|
| | | Electronics and Communication Engineering |
| 11. | Industrial Automation | Artificial Intelligence and Data Science<br>Computer Science and Engineering (Cyber Security)<br>Computer Science and Engineering (IoT)<br>Computer Science and Engineering Information and Technology<br>Mechanical Engineering<br>Aeronautical Engineering<br>Polymer Engineering<br>Automobile Engineering<br>Civil Engineering<br>Biotechnology<br>Electronics and Communication Engineering |
| 12. | GIS and Remote Sensing | Artificial Intelligence and Data Science<br>Computer Science and Engineering (Cyber Security)<br>Computer Science and Engineering (IoT)<br>Computer Science and Engineering Information and Technology<br>Mechanical Engineering<br>Aeronautical Engineering<br>Polymer Engineering<br>Automobile Engineering<br>Biotechnology<br>Electrical and Electronics Engineering<br>Electronics and Instrumentation Engineering<br>Electronics and Communication Engineering |
| 13. | Computational Biology | Artificial Intelligence and Data Science<br>Computer Science and Engineering (Cyber Security)<br>Computer Science and Engineering (IoT) |

| | | |
|---|---|---|
| | | Computer Science and Engineering<br>Information and Technology<br>Mechanical Engineering<br>Aeronautical Engineering<br>Polymer Engineering<br>Automobile Engineering<br>Civil Engineering<br>Electrical and Electronics Engineering<br>Electronics and Instrumentation Engineering<br>Electronics and Communication Engineering |

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

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

**21.0 POWER TO MODIFY**

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

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**B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY**

**B.TECH. CIVIL ENGINEERING**

**CURRICULUM FRAMEWORK, REGULATIONS 2021**

*(Choice Based Credit System)*

**SEMESTER I**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | BSC | PHD 1183 | Mechanics of Solids * | 3 | 0 | 2 | 4 |
| 2. | BSC | CHD 1181 | Engineering Materials and Applications * | 3 | 0 | 2 | 4 |
| 3. | BSC | MAD 1181 | Algebra and Differential Calculus | 3 | 1 | 0 | 4 |
| 4. | ESC | GED 1101 | Engineering Graphics | 2 | 0 | 2 | 3 |
| 5. | ESC | GED 1102 | Engineering Design | 2 | 0 | 0 | 2 |
| 6. | ESC | GED 1103 | Manufacturing Practices Laboratory | 0 | 0 | 2 | 1 |
| 7. | ESC | GED 1104 | Programming for Problem Solving ** | 1 | 0 | 2 | 2 |
| | | | **Credits** | | | | **20** # |

**SEMESTER II**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | HSC | END 1181 | English for Engineers | 3 | 0 | 0 | 3 |
| 2. | BSC | MAD 1281 | Advanced Calculus | 3 | 1 | 0 | 4 |
| 3. | ESC | GED1202 | Basic Electrical and Electronics Engineering * | 3 | 0 | 2 | 4 |
| 4. | ESC | GED 1201 | Engineering Mechanics | 3 | 1 | 0 | 4 |
| 5. | PCC | CED 1201 | Building Constructionand Practices * | 2 | 0 | 2 | 3 |
| 6. | PCC | CED 1202 | Surveying * | 3 | 0 | 2 | 4 |
| 7. | PCC | CED 1203 | Civil Engineering Drawing ** | 0 | 0 | 2 | 1 |
| 8. | MC | GED 1206 | Environmental Sciences | 2 | 0 | 0 | 2 |
| | | | **Credits** | | | | **25** |

**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 | MAD 2183 | Numerical Methods for Integral and Differential Equations | 2 | 0 | 0 | 2 |
| 3. | PCC | CED 2101 | Mechanics of Structures | 3 | 0 | 0 | 3 |
| 4. | PCC | CED 2102 | Mechanics of Fluids | 3 | 0 | 0 | 3 |
| 5. | PCC | CED 2103 | Concrete Technology | 3 | 0 | 0 | 3 |
| 6. | PCC | CED 2104 | Water and Waste Water Engineering * | 3 | 0 | 2 | 4 |
| 7. | PCC | CED 2105 | Transportation Engineering | 3 | 0 | 0 | 3 |
| 8 | PCC | CED 2106 | Concrete and Highway Laboratory | 0 | 0 | 2 | 1 |
| 9. | HSC | GED 2101 | Essential Skills and Aptitude for Engineers | 0 | 0 | 2 | 1 |
| | | | **Credits** | | | | **23** |

**SEMESTER IV**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PCC | CED 2201 | Mechanics of Soils * | 3 | 0 | 2 | 4 |
| 2. | PCC | CED 2202 | Structural Analysis I | 3 | 0 | 0 | 3 |
| 3. | PCC | CED 2203 | Structural Concrete Design * | 3 | 0 | 2 | 4 |
| 4. | PCC | CED 2204 | Estimation and Costing of Infrastructure Projects | 2 | 0 | 2 | 3 |
| 5. | PCC | CED 2205 | Water Resources Engineering | 3 | 0 | 0 | 3 |
| 6. | PCC | CED 2206 | Survey and Soil Investigation Camp | 0 | 0 | 2 | 1 |
| 7. | PEC | | Professional Elective Courses | 3 | 0 | 0 | 3 |
| 8. | HSC | GED 2201 | Workplace Skills and Aptitude for Engineers | 0 | 0 | 2 | 1 |
| 9. | 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. | HSC | MSD 3281 | Entrepreneurship | 3 | 0 | 0 | 3 |
| 2. | PCC | CED 3101 | Structural Analysis II | 3 | 0 | 0 | 3 |
| 3. | PCC | CED 3102 | Design of Substructures | 3 | 0 | 0 | 3 |
| 4. | PCC | CED 3103 | Hydraulic and Hydraulic Machinery * | 3 | 0 | 2 | 4 |
| 5. | PCC | CED 3104 | Repair and Rehabilitation of RC Elements | 3 | 0 | 0 | 3 |
| 6. | PCC | CED 3105 | GIS and its Applications * | 2 | 0 | 2 | 3 |
| 7. | PEC | | Professional Elective Courses | | | | 3 |
| 8. | HSC | GED 3101 | Communication Skills for Career Success | 0 | 0 | 2 | 1 |
| 9. | PROJ | CED 3106 | Internship I ## | 0 | 0 | 0 | 1 |
| | | | **Credits** | | | | **24** |

**SEMESTER VI**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | BSC | | Physics Elective | 2 | 0 | 0 | 2 |
| 2. | BSC | | Chemistry Elective | 2 | 0 | 0 | 2 |
| 3. | HSC | | Humanities Elective II | 2 | 0 | 0 | 2 |
| 4. | OEC | | Open Elective I | 3 | 0 | 0 | 3 |
| 5. | PCC | CED 3201 | Design of Structural Steel Elements | 3 | 0 | 0 | 3 |
| 6. | PCC | CED 3202 | Construction Management | 3 | 0 | 0 | 3 |
| 7. | PEC | | Professional Elective Courses | | | | 6 |
| 8. | HSC | GED 3201 | Reasoning and Aptitude for Engineers | 0 | 0 | 2 | 1 |
| 09 | PCC | | Value added course (mandatory non credit course) | 2 | 0 | 0 | 0 |
| | | | **Credits** | | | | **22** |

**SEMESTER VII**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | OEC | | Open Elective II | | | | 3 |
| 2. | OEC | | Open Elective III | | | | 3 |
| 3. | PCC | CED 4101 | Smart Infrastructure | | | | 3 |
| 4. | PEC | | Professional Elective Courses | | | | 12 |
| 5. | PROJ | CED 4102 | Internship II ### | | | | 1 |
| 6. | HSC | GED 4101 | Employability Skills $ | 0 | 0 | 2 | 1 |
| 7. | PCC | | Value added course (mandatory non credit course) | 2 | 0 | 0 | 0 |
| | | | **Credits** | | | | **22** |

**SEMESTER VIII**

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

**Overall Total Credits – 167**

* 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: STRUCTURAL ENGINEERING

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PE | CEDX 01 | Advanced Design of RC and Masonry Structures | 3 | 0 | 0 | 3 |
| 2. | PE | CEDX 02 | Advanced Design of Steel Structures | 3 | 0 | 0 | 3 |
| 3. | PE | CEDX 03 | Design of Bridge Structures | 3 | 0 | 0 | 3 |
| 4. | PE | CEDX 04 | Earthquake Resistant Design of Structures | 3 | 0 | 0 | 3 |
| 5. | PE | CEDX 05 | Introduction to Finite Element Analysis of Structures | 3 | 0 | 0 | 3 |
| 6. | PE | CEDX 06 | Structural Dynamics | 3 | 0 | 0 | 3 |
| 7. | PE | CEDX 07 | Prestressed Concrete Structures | 3 | 0 | 0 | 3 |
| 8. | PE | CEDX 08 | Prefabricated Structures | 3 | 0 | 0 | 3 |
| 9. | PE | CEDX 09 | Introduction to Steel-Concrete Composite Structures | 3 | 0 | 0 | 3 |

### SPECIALIZATION II: CONSTRUCTION TECHNOLOGY & MANAGEMENT

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PE | CEDX 16 | Advanced Concrete Technology | 3 | 0 | 0 | 3 |
| 2. | PE | CEDX 17 | Waterproofing of Concrete and Masonry Structures | 3 | 0 | 0 | 3 |
| 3. | PE | CEDX 18 | Corrosion Prevention and Control in RC Structures | 3 | 0 | 0 | 3 |
| 4. | PE | CEDX 19 | Lean Construction | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5. | PE | CEDX 20 | Intelligent Building Management System | 3 | 0 | 0 | 3 |
| 6. | PE | CEDX 21 | Automation in Construction and Management | 3 | 0 | 0 | 3 |
| 7. | PE | CEDX 22 | Building Information Modelling | 1 | 0 | 4 | 3 |
| 8. | PE | CEDX 23 | Housing Planning and byelaws | 3 | 0 | 0 | 3 |

**SPECIALIZATION III: GEOTECHNICAL ENGINEERING**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PE | CEDX 31 | Engineering Geology | 3 | 0 | 0 | 3 |
| 2. | PE | CEDX 32 | Ground Improvement Techniques | 3 | 0 | 0 | 3 |
| 3. | PE | CEDX 33 | Subsurface Investigation and Report Writing | 3 | 0 | 0 | 3 |
| 4. | PE | CEDX 34 | Applications of software in Geotechnical Engineering | 3 | 0 | 0 | 3 |
| 5. | PE | CEDX 35 | Geo-Environmental Engineering | 3 | 0 | 0 | 3 |
| 6. | PE | CEDX 36 | Pavement Engineering | 3 | 0 | 0 | 3 |
| 7. | PE | CEDX 37 | Geo Synthetics | 3 | 0 | 0 | 3 |
| 8. | PE | CEDX 38 | Design Principles of Special foundation | 3 | 0 | 0 | 3 |

**SPECIALIZATION IV: ENVIRONMENTAL ENGINEERING**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PE | CEDX 41 | Air and Noise Pollution Control | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2. | PE | CEDX 42 | Solid Waste Management | 3 | 0 | 0 | 3 |
| 3. | PE | CEDX 43 | Industrial Waste Water Treatment | 3 | 0 | 0 | 3 |
| 4. | PE | CEDX 44 | Hazardous Waste Management | 3 | 0 | 0 | 3 |
| 5. | PE | CEDX 45 | Environmental Risk Assessment | 3 | 0 | 0 | 3 |
| 6. | PE | CEDX 46 | Environmental Impact Assessment | 3 | 0 | 0 | 3 |
| 7. | PE | CEDX 47 | Sustainable Water and Sanitation for Smart cities | 3 | 0 | 0 | 3 |

**SPECIALIZATION V: HYDROLOGY AND WATER RESOURCES ENGINEERING**

| Sl.No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PE | CEDX 51 | Hydrology | 3 | 0 | 0 | 3 |
| 2. | PE | CEDX 52 | Ground Water Engineering | 3 | 0 | 0 | 3 |
| 3. | PE | CEDX 53 | Storm Water and Flood Management | 3 | 0 | 0 | 3 |
| 4. | PE | CEDX 54 | Design of Hydraulic Structures | 2 | 0 | 2 | 3 |
| 5. | PE | CEDX 55 | Water Power Engineering | 3 | 0 | 0 | 3 |
| 6. | PE | CEDX 56 | Water Distribution Systems | 3 | 0 | 0 | 3 |

**SPECIALIZATION VI: TRANSPORTATION ENGINEERING**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PE | CEDX 61 | Traffic Engineering | 3 | 0 | 0 | 3 |
| 2. | PE | CEDX 62 | Urban Planning and Design | 3 | 0 | 0 | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3. | PE | CEDX 63 | Intelligent Transportation Systems | 3 | 0 | 0 | 3 |
| 4. | PE | CEDX 64 | Pavement Design | 3 | 0 | 0 | 3 |
| 5. | PE | CEDX 65 | Railway Engineering | 2 | 0 | 0 | 2 |
| 6. | PE | CEDX 66 | Airport planning and Engineering | 2 | 0 | 0 | 2 |
| 7. | PE | CEDX 67 | Docks and Harbour Engineering | 1 | 0 | 0 | 1 |

**SPECIALIZATION VII: SURVEYING & ARCHITECTURE**

| Sl. No. | Course Group | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | PE | CEDX 71 | GPS and Drone Surveying | 3 | 0 | 0 | 3 |
| 2. | PE | CEDX 72 | Remote Sensing | 3 | 0 | 0 | 3 |
| 3. | PE | CEDX 73 | Spatial Data Modelling and Analysis | 3 | 0 | 0 | 3 |
| 4. | PE | CEDX 74 | Principles of Architecture | 3 | 0 | 0 | 3 |
| 5. | PE | CEDX 75 | Islamic Architecture | 3 | 0 | 0 | 3 |
| 6. | PE | CEDX 76 | Vastu Sastra and Architectural Design | 3 | 0 | 0 | 3 |

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

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | GEDX 219 | Numerical Computational Tools for Engineers | 2 | 0 | 2 | 3 | EIE |
| 20 | GEDX 220 | Optimization Techniques | 3 | 0 | 0 | 3 | EEE |
| 21 | GEDX 221 | Polymers for Emerging Technologies | 3 | 0 | 0 | 3 | Polymer |
| 22 | GEDX 222 | Programming Language Principles | 3 | 0 | 0 | 3 | CSE |
| 23 | GEDX 223 | Public Speaking and Rhetoric | 2 | 1 | 0 | 3 | English |
| 24 | GEDX 224 | Python Programming | 2 | 0 | 2 | 3 | IT |
| 25 | GEDX 225 | R Programming | 3 | 0 | 0 | 3 | CA |
| 26 | GEDX 226 | Smart Sensors for Healthcare Applications | 3 | 0 | 0 | 3 | EIE |
| 27 | GEDX 227 | Total Quality Management | 3 | 0 | 0 | 3 | Mech. |
| 28 | GEDX 228 | Value Education | 3 | 0 | 0 | 3 | Commerce |
| 29 | GEDX 229 | Waste Water Management | 3 | 0 | 0 | 3 | Civil |
| 30 | GEDX 230 | Web Application Development | 3 | 0 | 0 | 3 | CA |

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

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 11 | GEDX 111 | Drone Technologies | 2 | 0 | 2 | 3 | Aero |
| 12 | GEDX 112 | Electric Vehicle | 3 | 0 | 0 | 3 | EEE |
| 13 | GEDX 113 | Emerging Technologies in Mobile Networks | 3 | 0 | 0 | 3 | ECE |
| 14 | GEDX 114 | Fundamentals of Data Science and Machine Learning | 3 | 0 | 0 | 3 | IT |
| 15 | GEDX 115 | Genetic Engineering | 3 | 0 | 0 | 3 | SLS |
| 16 | GEDX 116 | Green Design and Sustainability | 3 | 0 | 0 | 3 | Civil |
| 17 | GEDX 117 | Image Processing and its Applications | 3 | 0 | 0 | 3 | ECE |
| 18 | GEDX 118 | Industrial Automation and Control | 3 | 0 | 0 | 3 | EIE |
| 19 | GEDX 119 | Industrial Safety | 3 | 0 | 0 | 3 | Mech. |
| 20 | GEDX 120 | Industry 4.0 | 3 | 0 | 0 | 3 | Mech. |
| 21 | GEDX 121 | Introduction to Artificial Intelligence | 3 | 0 | 0 | 3 | IT |
| 22 | GEDX 122 | Introduction to Artificial Intelligence and Evolutionary Computing | 3 | 0 | 0 | 3 | EEE |
| 23 | GEDX 123 | Motor Vehicle Act and Loss Assessment | 3 | 0 | 0 | 3 | Automobile |
| 24 | GEDX 124 | National Service Scheme | 3 | 0 | 0 | 3 | SSSH |
| 25 | GEDX 125 | National Cadet Corps | 3 | 0 | 0 | 3 | SSSH |
| 26 | GEDX 126 | Personal Finance and Investment | 3 | 0 | 0 | 3 | Commerce |
| 27 | GEDX 127 | Soft Computing Techniques | 3 | 0 | 0 | 3 | CSE |
| 28 | GEDX 128 | Value Analysis and Engineering | 3 | 0 | 0 | 3 | Mech. |
| 29 | GEDX 129 | Vehicle Maintenance | 3 | 0 | 0 | 3 | Automobile |

## SEMESTER I

| | | | | | |
|---|---|---|---|---|---|
| **PHD 1183** | **MECHANICS OF SOLIDS** | **L** | **T** | **P** | **C** |
| **SDG: 4** | (For Civil Engineering) | **3** | **0** | **2** | **4** |

**COURSE OBJECTIVES:**

The objectives of the course are to impart knowledge on

**COB1:** the basic concepts of stresses, strains and deformation due to internal forces

**COB2:** the principal stresses, strains and theories of failure

**COB3:** theory of torsion and stresses and deformation in circular and hallow shafts.

**COB4:** concept of stresses in thin cylinders and spheres with its application.

**COB5:** concept of stresses and strains in thick cylinders

**MODULE I PROPERTIES OF MATERIALS 9**

Introduction – stress - Types of stress – strain – Types of strain – Poisson's ratio –Hooke's Law - Elastic constants and their relationship - Volumetric Strain - Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and ductile) - True stress – strain interpretation of tensile test; and hardness of materials;

**MODULE II SIMPLE & COMPOUND STRESSES AND STRAINS 9**

Deformation of simple and compound bars - Bar with uniform and varying section - Thermal Stresses - Principal Stresses, strain and maximum shear stresses - Mohr's Circle for Plane stress - Principal theories of failure for a member subjected to biaxial stress.

**MODULE III TORSION 9**

Theory of simple torsion – Stresses and deformation in circular and hollow shafts – Stepped shafts – Shafts fixed at both ends – Stresses and deflection of Leaf springs and helical springs.

**MODULE IV THIN CYLINDERS AND SPHERES 9**

Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

**MODULE V THICK CYLINDERS 9**

Stresses in Thick cylinders subjected to internal and external pressure and compound cylinders - Stresses and strains in thick spherical shell.

**PRACTICALS**

1. Properties of steel rebar by tension test
2. Determination of hardness of metal by Rockwell and Brinell hardness test.
3. Determination of impact strength of metal by Izod and Charpy method.
4. Investigation of Hooke's Law using timber and steel.
5. Determination of Stiffness and Modulus of rigidity of steel specimen by torsion test.
6. Determination of Stiffness and Modulus of rigidity of open coil spring

**L – 45; P – 30; Total Hours – 75**

**TEXT BOOKS:**

1. Popov, E.P and Balan, T.A., "Engineering Mechanics of Solids", Pearson India Education Services, 2nd Edition, India, 2018.
2. Stephen Timoshenko, "Strength of Materials: Elementary Theory and Problems", CBS Publishers & Distributors, 3rd Edition, New Delhi, 2004.

**REFERENCES:**

1. Jindal, U.C., "Strength of Materials", Pearson Education, India, 2012
2. Ramamrutham, S and Narayan, S., "Strength of Materials", Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2008.

**COURSE OUTCOMES:**

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

**CO1:** describe stress, strain, elastic constants and their relationship.

**CO2:** determine the principal stresses and strains based on various methods.

**CO3:** develop the torsion equation and solve the problems based on torsion.

**CO4:** determine the stress in thin cylinders and spheres

**CO5:** determine the stress in thick cylinders and spheres

**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 | - | - | - |
| **CO2** | H | M | M | L | L | M | L | L | L | L | L | M | - | - | - |
| **CO3** | H | M | M | L | L | L | L | L | L | L | L | M | - | - | - |
| **CO4** | H | M | M | L | M | M | M | L | L | L | M | M | - | - | - |
| **CO5** | H | M | M | L | M | M | M | L | L | L | M | M | - | - | - |

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

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

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

| CHD 1181 | ENGINEERING MATERIALS AND APPLICATIONS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

To make the students conversant with

**COB1:** preparation, properties and applications of various polymers and composites

**COB2:** synthesis, properties and applications of nanomaterials

**COB3:** the basic concepts and different types of catalysts involved in catalytic processes.

**COB4:** basic principles and its applications of certain spectroscopic techniques towards characterization of chemical compounds and concepts of photochemical processes involved in photochemical reactions.

**COB5:** different types of sensors and its applications.

**MODULE I POLYMER AND COMPOSITES 9**

Introduction – classification: source, heat, composition and structure- glass transition temperature – synthesis, properties and applications of polycarbonate, polyurethane, teflon, ABS, kevlar, bakelite, epoxy resin, acrylic polymers (PAN) - biopolymers : importance and applications of biodegradable polymers (PLA, PHBV).

Composites- Introduction - properties and applications: fibre-reinforced plastics (glass, carbon and aramid), ceramic matrix composites (CMC) –- bio-composites.

**MODULE II NANOCHEMISTRY 9**

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), bio-nanomaterials - biogenic method (synthesis of Ag, Au by plants extracts, bacteria, fungi)

**MODULE III CATALYSIS 9**

Types of catalysis – Criteria for catalysts - catalysis by transition metal ions and their complexes- solid catalyst - metal oxides and zeolites - shape selective

catalysts- mechanism of catalytic action- CO oxidation, NOx and SOx reduction – Enzyme catalysis-Mechanism of enzyme action- electrocatalysis -green catalyst.

**MODULE IV PHOTOCHEMISTRY AND SPECTROSCOPY 9**

Laws of photochemistry – Quantum yield -– Jablonski diagram - photophysical processes - photosensitisation – Quenching– chemiluminescence – bioluminescence

Atomic and molecular spectrum – absorption and emission spectrum - Beer Lambert's law – problems and applications – principles and applications: colorimetry, UV -vis spectroscopy (Chromophore- auxochrome, red and blue shift), atomic absorption spectroscopy, IR spectroscopy (finger print region, functional group interpretation)

**MODULE V SENSORS 9**

Sensors – types: bio and toxic chemicals sensors- principle, working and applications of Electrochemical sensors: MEMS and NEMS, - Biosensors- construction, working and classification, Advantages - Biochips - touch sensor (oxi and gluco meter) - Advanced sensors:Smoke and gas sensors, humidity sensors, temperature sensor and alcohol sensor.

**PRACTICALS**

List of Experiments

1. Preparation of polymers – phenol-HCHO, urea-HCHO, polylactic acid, epoxy resin
2. Determination of molecular weight and degree of polymerization using Oswald'sviscometer.
3. Synthesis of nano-ZnO and CuO by precipitation
4. Demonstration of Laser ablation techniques for nanomaterials.
5. Electrochemical synthesis of graphene oxide
6. One-pot synthesis using green catalyst.
7. Green synthesis: Photocatalytic reactions, solvent - free organic reaction - Aldol; green oxidation, green reduction.
8. Diels - Alder reaction in eucalyptus oil (green process).
9. Spectrophotometer iron estimation.(Beer Lambert's law) determination of $Fe^{3+}$
10. FT-IR spectral characterisation (functional group interpretation)

**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.
2. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge,2012.
3. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy (Editors), Catalysis: Principles and Applications, Narosa Publishing House, 2002.
4. Gadi Rothenberg, Catalysis: Concepts and Green Applications, WILEY-VCH
5. Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, Principles of molecular photochemistry: An introduction, University Science Books, Sausalito, CA, 2009.
6. John Vetelino, Aravind Reghu , Introduction to Sensors By · 2017.

**REFERENCES:**

1. John S. Wilson, Sensor Technology Handbook, Elsevier 2005.

**COURSE OUTCOMES:**

The students will be able to

**CO1:** enumerate and compare the preparation, properties and applications of various types of polymers and composites.

**CO2:** synthesize different type of nanomaterials on a commercial scale based on its size and applications.

**CO3:** apply the concepts of spectroscopic techniques towards spectral interpretation for identification of compounds and explain various photochemical processes in photochemical reactions.

**CO4:** Impart types, characteristics and applications of different types of catalyst.

**CO5:** categorize the sensors and its applications to real time situation.

**Board of Studies (BoS) :**
11$^{th}$BoS of Chemistry held on 17.06.2021

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

| | PO 1 | PO 2 | PO 3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | M | | | | | | | | | | | |
| CO2 | | | | M | | | | | | | | | | | |
| CO3 | | | | | | | M | | | | | | | | |
| CO4 | | | | M | | | | | | | | | | | |
| CO5 | | | | M | | | | | | | | | | | |

**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 materials and technology leads to sustainable industrialization

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

**COURSE OBJECTIVES:**

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

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

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

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

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

**MODULE I MATRICES 9+3**

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

**MODULE II THEORY OF EQUATIONS 9+3**

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

**MODULE III DIFFERENTIAL CALCULUS 9+3**

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

**MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3**

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

**MODULE V ORDINARY DIFFERENTIAL EQUATIONS 9+3**

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

**L – 45; T – 15; Total Hours– 60**

**TEXT BOOKS:**

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

**REFERENCES:**

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

**COURSE OUTCOMES:**

At the end of the course students will be able to

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

**CO2:** solve equations using the relations between roots and coefficients

**CO3:** apply differential calculus in various engineering problems

**CO4:** able to use differential calculus on several variable functions

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

**Board of Studies (BoS) :**
12th BOS of Mathematics & AS held on 23.06.2021

**Academic Council:**
17th AC held on 15.07.2021

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

**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 drawconic sections, special curves and orthographic projection of points and straight lines

**CO2:** apply the concept of orthographic projection to draw the orthographic views of plane figures and simple solids

**CO3:** draw the sections of solids and development of solid surfaces

**CO4:** apply the concept of isometric and perspective projection to draw the 3-D views of simple solids

**CO5:** draw the orthographic views of simple objects using drafting software

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

**Academic Council:**
17th AC held on 15.07.2021

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

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

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

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

| GED 1102 | ENGINEERING DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| 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):** 18th BoS of MECH held on 21.06.2021

**Academic Council:** 17th AC held on 15.07.2021

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 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** | **PROGRAMMING FOR** | **L** | **T** | **P** | **C** |
| **SDG: 8** | **PROBLEM SOLVING** | **1** | **0** | **2** | **2** |

**COURSE OBJECTIVES:**

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

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

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

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

**COB5:** To understand pointer and file operation concepts.

**MODULE I INTRODUCTION TO C PROGRAMMING 05**

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

**MODULE II DECISION MAKING AND ARRAY 05**

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

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

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

**PRACTICALS**

**LIST OF PROGRAMS IN C:**

1. Computer organization –Hardware in a typical computer Identification – Booting error messages and what it means
2. Structure of a basic program - Hello world program
3. Data types and Type conversions
4. Input / Output: Formatted functions – Unformatted functions – Library functions
5. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
6. Conditional Statements: If – if else- nested if else- goto- switch case – nested switch case
7. Iteration Statements: for loops – nested for loops – while loop – do-while loop – break and continue statement
8. I/O operations of one- and two-dimensional arrays
9. Bubble Sort and Linear Search using arrays.
10. Functions and its types, Recursion Function
11. Pointers
12. 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:**

2. Brian W. Kernighan and Dennis M. Ritchie, “ The C Programming Language”, Prentice Hall, ISBN 0-13-110362-8, 2015.
3. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012.
4. 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

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

**COURSE OBJECTIVES:**

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

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

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

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

**COB5:** To sharpen their academic writing skills

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

**MODULE I HUMAN RESOURCES 10**

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

S: Introducing one self – exchanging personal info.

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

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

Voc. development: Prefixes, Suffixes

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

**MODULE II TRANSPORT 10**

L: Listening to long scientific talks

S: Sharing personal information – greeting, leave taking.

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

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

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

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

**MODULE III ENERGY 9**

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

S: Asking about routine actions & expressing opinions.

R: Locating Specific Information

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

Voc. development: Sequence words, misspelt words.

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

**MODULE IV OUR LIVING ENVIRONMENT 8**

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

S: Speaking about one's friend.

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

W: Argumentative writing.

Voc. Development: Synonyms, antonyms, phrasal verbs.

Lang. development: If clauses, Subject - Verb Agreement

**MODULE V TECHNOLOGY 8**

L: Listening to talks (General & Scientific).

S: Short group conversations.

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

W: Short essays, Dialogue writing.

Voc. Development: Idioms & Phrases.

Lang. development: Modal verbs.

**L – 45; TOTAL HOURS– 45**

**TEXT BOOKS:**

1. Board of Editors. Using English A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015

2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

**REFERENCES:**

1. Perry, Carol Rosenblum (2011). The Fine Art of Technical Writing, Create Space Independent Publishing Platform, New Delhi.
2. Dutt, P.K. Rajeevan G. and Prakash, 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) :**
13thBoS of 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 | | | | | | | | | | M | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | | | | | | | | | | H | | |
| **CO5** | | | | | | | | | | M | | |

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

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

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

| | | | | | |
|---|---|---|---|---|---|
| **MAD 1281** | **ADVANCED** | **L** | **T** | **P** | **C** |
| **SDG: 4** | **CALCULUS** | **3** | **1** | **0** | **4** |

**COURSE OBJECTIVES:**

**COB1:** To acquaint **i**n the students in solving problems using multiple integrals

**COB2:** To acquire knowledge in vector calculus which is significantly used in engineering problems

**COB3:** To learn about the analytic functions and their mapping properties

**COB4:** To know complex integration using Cauchy's theorems.

**COB5:** To introduce techniques and engineering applications of Laplace Transforms

**MODULE I MULTIPLE INTEGRATION 9+3**

Multiple integrals– Cartesian and Polar coordinates – Change of order of integration – Beta and Gamma functions – Properties and applications- Multiple integrals to compute area and volume

**MODULE II VECTOR CALCULUS 9+3**

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields–Line, surface and volume integrals – Green's Theorem, Gauss Divergence Theorem and Stokes Theorem (statement only) – verification and evaluation of integrals

**MODULE III COMPLEX DIFFERENTIATION 9+3**

Analytic function - Necessary and Sufficient condition for analyticity – Cauchy-Riemann equations in polar coordinates - properties of analytic function – determination of analytic function – conformal mapping (w = z+a, az and 1/z) and bilinear transformation

**MODULE IV COMPLEX INTEGRATION 9+3**

Cauchy's integral theorem – Cauchy's integral formula – Taylor's series and Laurent's series expansion – singularities - classification – residues - Cauchy's residue theorem – contour integration – Unit circle and semi circular contours (excluding poles on the real axis)

**MODULE V LAPLACE TRANSFORMS 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

**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. Jain, R.K. & Iyengar, S. R. K., “Advanced Engineering Mathematics”, Narosa Publishers, 5th edition, 2016.
2. Peter V. O'Neil, “Advanced Engineering Mathematics”, 7th edition, Cengage Learning, 2011.
3. Venkataraman, M.K., “Engineering Mathematics”, Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
4. James Stewart ,“ Calculus” 7th edition, Brooks/Cole Cengagelearning, UK

**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:** compute the area and volume using multiple integrals

**CO2:** calculate vector identities and apply Gauss, Stokes and Greens theorems to simplify calculations of integrals

**CO3:** verify analyticity, conformity and bilinearity of complex functions

**CO4:** evaluate integrals using the Cauchy’s integral and formula and residue theorem

**CO5:** solve ordinary differential equations using Laplace transforms

**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 Integration and Vector Calculus will lead to knowledge of applications in Civil Engineering

| | | | | | |
|---|---|---|---|---|---|
| **GED 1202** | **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** | **L** | **T** | **P** | **C** |
| **SDG: 3, 5, 8, 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 and AC machines.

**COB4:** To impart knowledge onbasic semiconductor devices and their applications.

**COB5:** To introduce the students to fundamentals of digital electronics.

**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 17**

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

**MODULE III ELECTRICAL MACHINES 18**

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

**MODULE IV SEMICONDUCTOR DEVICES AND APPLICATIONS 14**

Introduction to semiconductors - Characteristics of PN Junction Diode – Zener Diode and its characteristics – SCR and its characteristics –– Bipolar Junction Transistorand its characteristics – JFET & MOSFET – their characteristics.
Applications: Half wave and full wave rectifiers - Voltage Regulation – Regulator ICs.

**MODULE V INTRODUCTION TO DIGITAL CIRCUITS 14**

Logic gates- Boolean algebra theorems– K Map-Introduction to combinational circuits– Flip-Flops – Registers– A/D and D/AConversion–Data acquisition systems

**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) Characteristics of DC shunt motor, single phase transformer and three phase induction motor.
4. Fabrication of a low voltage regulated power supply.
5. Implementation of half and full adders.

**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. Jacob Millman & Christos C. Halkias, Satyaprataba Jit “Electronic Devices and Circuits” McGraw Hill Education, 4th Edition, 2021.
6. Floyd, “Electronic Devices: Conventional Current Version” Pearson Education India, 7th Edition, 2008.
7. S. Salivahanan, N. Sureshkumar and A. Vallavaraj, “Electronic Devices and Circuits”, McGraw Hill Education (India) Pvt. Ltd., 2018.
8. Thomas L. Floyd, "Digital Fundamentals", 10th Edition Pearson Education Inc., New Delhi, 2008.

**COURSE OUTCOMES:**

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

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

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

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

**CO4:** fabricate a regulated power supply for low voltage applications and build static switches using BJT and SCR.

**CO5:** build simple digital circuits like half adder and full adder.

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

**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 12: Responsible consumption and production.

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

| 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.

| CED 1201 | BUILDING CONSTRUCTION AND PRACTICES | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

The main objective of this course is to impart knowledge on

**COB1:** various construction materials such as stone, brick, cement, steel etc with respect to type, mechanical properties and applications in industry.

**COB2:** allied construction materials used in construction and their properties & application areas.

**COB3:** requirements of vaiours components of buildings and types of structures

**COB4:** various basic construction practices suchs as mixing, joints in masonry and plastering and pointing

**MODULE I BASIC CONSTRUCTION MATERIALS 7**

Physical and mechanical properties of construction materials – Bricks, Stones and cement : Manufacturing process, properties and testing methods. Sand, coarse aggregate and steel – Properties and testing methods.

**MODULE II ALLIED CONSTRUCTION MATERIALS 8**

Tiles, refractory lining materials, Bitumen and asphaltic materials, Timber, Glass and Plastics, Metals for cladding, Paints and varnishes, Acoustic material, geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Fibre reinforced plastics, carbon composites and other engineering materials : Salient properties and application areas.

**MODULE III OVERVIEW OF BUILDING PROCESS AND COMPONENTS 7**

Overview of building process - elements of a building - basic requirements of a building - planning for orientation and energy efficiency.

Types of structures: Load Bearing, framed, steel and composite structures. Foundation: Safe bearing capacity of soil, Functions and requirements of good foundation, types of foundation. Walls: Types of walls - load bearing, partition walls and cavity walls.

Doors, Windows and Ventilators - Materials and types. Floors: Category, types of flooring materials and application. Roof: Types, materials and application areas. Lintels and arches, Staircase - types.

**MODULE IV BASIC CONSTRUCTION PRACTICE 8**

Masonry - Definition and terms used in masonry - Mortar – Ingredients – Mixing – Grades. Brick masonry - characteristics and requirements of good brick masonry - Types of Bonds in brick work - Stone masonry - Joints in masonry.

Plastering and Pointing - purpose, materials and methods of plastering and pointing - defects in plastering- types - Painting - Purpose, types, ingredients and defects

**PRACTICALS**

1. Tests on cement: Fineness test, initial and final setting time, standard consistency, specific gravity.
2. Tests on fine aggregate: Particle size distribution using sieves, Specific gravity, bulking and water absorption of Fine aggregate.
3. Tests on coarse aggregate: Particle size distribution using sieves, Specific gravity, water absorption of coarse aggregate.
4. Test on Glass Material
5. Test on Tile
6. Test on Bricks – Water absorption, Efflorescence, Compressive Strength
7. Demonstrate the bonds used in brick Masonary
8. Plastering Process – Demo – Site Visit
9. Making model for Building Components
10. Painting – Exercise - Demo – Site Visit

**L – 30; P – 30; Total Hours– 60**

**TEXT BOOKS:**

1. Varghese.P.C, “Building Materials”, PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Rajput. R.K., “Engineering Materials”, S. Chand and Company Ltd., 2008.
3. Shetty.M.S., “Concrete Technology (Theory and Practice)”, S. Chand and Company Ltd.,2008.
4. Gambhir.M.L., “Concrete Technology”, 3rd Edition, Tata McGraw Hill Education, 2004
5. Duggal.S.K., “Building Materials”, 4th Edition, New Age International , 2008

**REFERENCES:**

1. Jagadish.K.S, “Alternative Building Materials Technology”, New Age International, 2007.
2. Gambhir. M.L., & Neha Jamwal., “Building Materials, products, properties and systems”, Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
3. S.S. Bhavikatti., “Basic Civil Engineering’, New Age International (P) Limited, New Delhi, 2010

**COURSE OUTCOMES:**

On completion of the course the student will be able to

**CO1:** select the type of cement, and stones to be used based on the properties and application.

**CO2:** explain the properties and types of timber, bitumen, steel, aluminum, polymers and composites.

**CO3:** identify the different components in a building and its functions

**CO4:** apply the construction practices to be followed in the site

**Board of Studies (BoS) :**
15th BoS of CIVIL held on 23.06.2021

**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 | M | - | M | - | H | L | M | - | - | - | L | H | H | - | - |
| CO2 | M | - | M | - | H | L | M | - | - | - | L | H | H | - | - |
| CO3 | M | - | M | - | H | L | M | - | - | - | L | H | H | - | - |
| CO4 | M | - | M | - | H | L | M | - | - | - | L | H | H | - | - |
| CO5 | M | - | M | - | H | L | M | - | - | - | L | H | H | - | - |

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

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

The Holistic understanding of building materials and components leads to construction of resilient infrastructure and sustainable development

| CED 1202 | SURVEYING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

The objectives of the course are to impart knowledge on

**COB1:** basic concepts of surveying and to differentiate map and plan

**COB2:** the concept of linear measurement and angular measurement using compass and theodolite.

**COB3:** the concept of leveling using dumpy level and properties of contours.

**COB4:** the methods of plane tabling and solving triangulation and trilateration problems.

**COB5:** the usage of total station for the measurement of angles and distances and the concepts of engineering surveys and set out works.

**MODULE I INTRODUCTION TO SURVEYING 7**

Basic definitions, objectives, divisions and Importance of surveying to Engineers; Plane and geodetic surveys; principles of Surveying; Output of survey, Maps, Plans, Scales.

**MODULE II LINEAR AND ANGULAR MEASUREMENTS 10**

Direct and indirect methods of linear measurement; Obstacles in chaining and ranging, errors and corrections, Angular Measurements – Types of compass, basic definitions - meridians, local attraction, Theodolite - different types and their salient parts, Temporary and permanent adjustments, Methods of repetition and reiteration.

**MODULE III LEVELING AND CONTOURING 10**

Basic Definitions, Curvature & Refraction, Level, Types and salient parts, working principle, Temporary and Permanent Adjustments, Leveling Staff, Methods of leveling - Differential leveling and field book note, Reciprocal Leveling; Profile leveling; Trigonometric leveling, Errors & Mistakes in leveling, Contouring - definition, characteristics, methods and applications.

**MODULE IV TRAVERSING, TRIANGULATION AND TRILATERATION 10**

Plane Tabling - Merits and demerits, accessories; methods of plane tabling; Traversing – open traverse, closed traverse, closing error, Triangulation and Trilateration – Purpose and classification of each; Horizontal and vertical control methods, Triangulation network, fieldwork, selection of stations, measurements

and computations. Heights and distances - Tacheometry- Introduction, Basic definitions, Methods, fundamental principles; Stadia system and Tangential system, methods.

**MODULE V TOTAL STATION AND ENGINEERING SURVEYS 8**

Total Station - Working Principle, sources of errors in total station and types of total station instruments, advantages of total station, Engineering Surveys - General requirements and specifications for engineering project surveys; Reconnaissance, preliminary, location survey and surveys for highway, railway - Setting out works for buildings and simple circular curves – Applications of LIDAR.

**PRACTICALS**

**List of Experiments:**

1. Demonstration of various surveying instruments
2. Leveling - Longitudinal sectioning and Cross sectioning
3. Theodolite surveying - Measurement of horizontal angle and vertical angle by direct method.
4. Theodolite surveying - Measurement of horizontal angle by repetition and reiteration method.
5. Tacheometric surveying – Stadia method and Tangential method
6. Total station surveying - Measurement of distances - Single plane Method
7. Total station surveying - Measurement of distances - Double plane Method
8. Total station surveying - Determination of area of the field by triangulation method.
9. Setting out works - Foundation Marking
10. Setting out curves – Simple circular curve.
11. Determination of location of a point using GPS.

**L – 45; P – 30; Total Hours– 75**

**TEXT BOOKS:**

1. Arora. K.R., “Surveying”, Vol. I & II, 15th Edition, Standard Book House, New Delhi, 2018.
2. Kanetkar. T.P., “Surveying and Levelling”, Vol. I and II, Standard Publication, 2008.
3. Punmia. B.C., Ashok Kumar Jain and Arun Kumar Jain, “Surveying”, Vol. I, II and III, 15th Edition, Laxmi Publications, New Delhi, 2015.

**REFERENCES:**


1. Clark. D., “Plane and Geodetic Surveying”, Vol. I and II, 6th edition, C.B.S. Publishers and Distributors, New Delhi, 2017.
2. HeribertKahmen and Wolfgang Faig, “Surveying”, Walter de Gruyter, 2012.
3. James M. Anderson and Edward M. Mikhail, "Introduction to Surveying”, 7th Edition, McGraw Hill, 2015.
4. https://civilengineeringnotes.com/surveying/


**COURSE OUTCOMES:**

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

**CO1:** differentiate between map and plan, to know the different principles of surveying.

**CO2:** categorize the linear and angular measurements with the help of compass and theodolite.

**CO3:** determine the elevation of points and generate the surfaces of a given terrain.

**CO4:** apply the triangulation, traversing concepts in tacheometric surveying to compute heights and distances.

**CO5:** explore the total station surveying and set out curves to prepare preliminary and location survey for engineering projects.

**Board of Studies (BoS) :** 15thBoS of CIVIL held on 23.06.2021

**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 | H | L | L | H | L | L | - | L | L | - | - | L | M | - |
| CO2 | H | H | M | M | H | L | L | - | L | L | - | - | L | M | - |
| CO3 | H | H | M | M | H | L | L | - | L | L | - | - | L | M | - |
| CO4 | H | H | M | M | H | L | L | - | L | L | - | - | L | M | - |
| CO5 | H | H | M | M | H | L | L | - | L | L | - | - | L | M | - |

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

SDG 11: Make cities inclusive, safe, resilient and sustainable.

Statement:

The gained knowledge leads to create, manage and geo-enable all the city assets and to digitally map the city to plan for safety, security, equality and inclusiveness.

| CED 1203 | CIVIL ENGINEERING DRAWING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 0 | 0 | 2 | 1 |

**COURSE OBJECTIVES:**

The objectives of this course are to impart knowledge on

**COB1:** the fundamentals of building drawing.

**COB2:** the basic principles of building drawing

**COB3:** the different views of a residential building

**COB4:** various structural drawing related to RCC and steel structure.

**PRACTICALS**

List of Experiments:

1. To learn the various building component – substructure, super structure – site plan, plinth area
2. To learn the various conventional sign and symbols
3. To learn the various commands in Auto CAD drawing
4. To draw the plan of a residential building
5. To draw the elevation of a residential building
6. To draw the section of a residential building
7. To draw the beam column position
8. To draw the various types of foundation
9. To draw the various types of a inclined roof trusses
10. To draw the service plan for plumbing lines
11. To draw the service plan for electrical lines
12. To draw the 3D view of a building

**P – 30; Total Hours– 30**

**TEXT BOOKS:**

1. Venugopal, K., “Engineering Drawing And Graphics”, 5th Edition, New Age International (P) Ltd., New Delhi, 2011.
2. Gurcharan Singh, “Civil Engineering Drawing”, Standard Publishers and Distributors, 2009.
3. Kumara Swamy, N. and Kameswara Rao, A., “Building Planning and Drawing”, 6th Edition, Charotar Publishing House (P) Ltd, Gujarat, India, 2012.

**REFERENCES:**

1. IS 962: 1989 (R 2001), Code of Practice For Architectural and Building Drawings, Bureau of Indian Standards, New Delhi.

2. Gurcharan S i n g h , " Building Planning and Scheduling", Standard Publishers and Distributors, 2012.
3. Shah, M.G., Kale, C.M., Patki, S.Y., "Building Drawing: With an Integrated Approach to Built Environment", Tata McGraw-Hill Publishing Company (P) Ltd., New Delhi, 2002.

**COURSE OUTCOMES:**

After completion of the course students will be able to

**CO1:** identify the sign and symbols as per B.I.S. and develop a simple House plan and their sectional views.

**CO2:** prepare a plan, elevation and sectional view for a residential building.

**CO3:** develop structural drawings of RCC Buildings using CADD software.

**CO4:** locate and plan various service lines for a residential building as per codal recommendations.

**Board of Studies (BoS) :** 15th BoS of CIVIL 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 | L | - | L | L | - | - | - | L | - | - | - | L | L | M | - |
| CO2 | L | - | L | L | - | - | - | L | - | - | - | L | L | M | M |
| CO3 | L | - | L | L | - | - | - | L | - | - | - | L | L | M | - |
| CO4 | L | - | L | L | - | - | - | L | - | - | - | L | L | M | M |
| CO5 | L | - | L | L | - | - | - | L | - | - | - | L | 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

Statement :

The holistic understanding of building Drawings leads to construction of resilient infrastructure and sustainable industrialization

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

**COURSE OBJECTIVES:**

To make the student conversant with the

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

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

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

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

**MODULE I NATURAL RESOURCES 8**

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

**MODULE II ECOSYSTEMS AND BIODIVERSITY 8**

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

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

**MODULE III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT** 8

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

**MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES** 6

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

**Case studies related to current situation.**

**L – 30; Total Hours– 30**

**TEXT BOOKS:**

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

**REFERENCES:**


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


**COURSE OUTCOMES:**

The student will be able to

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

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

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

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

**Board of Studies (BoS) :** 11th BoS of Chem 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 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | L | M | - | - | L | M | - | - | - | - | - | - | - | - |
| CO2 | - | - | - | M | H | - | - | - | - | - | - | - | - | - | - |
| CO3 | - | - | - | - | - | - | M | M | - | - | L | - | - | - | - |
| CO4 | - | - | - | - | - | M | M | M | - | - | - | L | - | - | - |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

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

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

**SEMESTER III**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **MAD 2183** | **NUMERICAL METHODS FOR INTEGRATION AND DIFFERENTIAL EQUATIONS** | | | | |
| **SDG: 4** | | **2** | **0** | **0** | **2** |

**COURSE OBJECTIVES:**

This course aims to solve Integrations and Differential equations numerically.

**MODULE I NUMERICAL INTEGRATION 8**

Numerical Integration by Trapezoidal and Simpson's 1/3 and 3/8 Rule – Romberg's Method – Two Point and Three point Gaussian Quadrature Formulae

**MODULE II NUMERICAL DOUBLE INTEGRATION 7**

Double Integrals using Trapezoidal and Simpson's 1/3 Rules.

**MODULE III NUMERICAL SOLUTIONS OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 8**

Single step methods: Euler method – Modified Euler method – Runge-Kutta method – Multi step methods: Milne's Predictor and Corrector Method – Adam's Predictor and Corrector Method.

**MODULE IV BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 7**

Finite Difference Solution of One Dimensional Heat Equation by Explicit and Implicit Methods – One Dimensional Wave Equation and Two Dimensional Laplace Equations.

**TOTAL HOURS – 30**

**TEXT BOOKS:**

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003.
2. Grewal, B.S., "Numerical methods in Engineering and Science" 7 th edition, Khanna Publishers, 2007.
3. Dr. P. Mariappan "Numerical Methods for Scientific Solutions", New Century Book House(P) Ltd., 2022.

**REFERENCES:**

1. C.F.Gerald, P.O.Wheatley, “Applied Numerical Analysis” Pearson Education, New Delhi 2002.
2. P.Dechaumphai, N. Wansophark, “Numerical Methods in Engineering”, Narosa Publications, 2012.

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

**CO1:** solve the single integration by numerical methods.

**CO2:** solve the double integration by numerical methods.

**CO3:** find numerical solution of first order ordinary differential equations in engineering problems.

**CO4:** find numerical solution of partial differential equations in engineering problems.

**Board of Studies (BoS):**

14th BOS of Mathematics & AS held on 30.06.2022.

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

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

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

Learning of various numerical methods will lead to knowledge of applications in Civil Engineering.

| CED 2101 | MECHANICS OF STRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 , 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To provide in-depth knowledge with the computation of shear force, bending moment and draw the stress distribution under bending and shear.

**COB2**: To understand the concepts of slope and deflection of various determinate beams.

**COB3:** To understand the concepts of slope and deflection curves for various types of indeterminate beams.

**COB4:** To be familiar with the principles of energy methods and compute the structural deflections.

**COB5:** To enable the students to understand the fundamentals of axially loaded member and their behaviour under various loading conditions.

**MODULE I TRANSVERSE LOADING ON BEAMS & STRESSES IN BEAMS** **9**

Types of beams – Types of loading acting on beams – Shear force and bending moment for cantilever beams, simply supported beams and overhanging beams – Theory of simple bending – Bending stress distribution - Shear stress distribution.

**MODULE II SLOPE AND DEFLECTION OF DETERMINATE BEAMS** **9**

Determinate and Indeterminate structure - Slope and deflection analysis of statically determinate beams - Macaulay's method – Moment area method – Conjugate Beam Method - Graphical method.

**MODULE III SLOPE AND DEFLECTION OF INDETERMINATE BEAMS** **9**

Statically indeterminate Structures - Propped cantilever, fixed and continuous beams - Theorem of three moments – Effect of the sinking of supports.

**MODULE IV STRUCTURAL DEFLECTIONS – ENERGY METHODS** **9**

Strain Energy - Strain Energy stored due to axial force, bending, shear and torsion - Virtual work method (Unit – load method) - Castigliano's Theorems – Maxwell's theorem of Reciprocal - Analysis of Plane Trusses and Plane Frames with the application of energy theorems for computing deflections.

**MODULE V COLUMNS AND STRUTS** **9**

Columns and Struts – Failure of a Column - Effective length of the column – Theory of Euler's Column – Crippling load on Columns with different end conditions – Euler's formula – Secant formula - Rankine's and Gordan's formula - I.S. Code formula – Beam- column subjected to distributed lateral load – Columns with initial curvature.

**L – 45; Total Hours – 45**

**TEXT BOOKS:**


1. Bedi, D.S., "Strength of Materials", Khanna Publishing House, New Delhi, 2013.
2. Bhavikatti S.S, Structural Analysis I", Vikas Publishing House Pvt. Ltd., 4th Edition, New Delhi, 2011.
3. Salah Khalfallah, "Structural Analysis 1: Statically Determinate Structures", John Wiley & Sons, New York, 2018.
4. Srivastava, A.K and Gope P.C., "Strength of Materials", PHI Learning Pvt. Ltd., New Delhi, 2013.


**REFERENCES:**


1. Gambhir, M.L., "Fundamentals of Structural Mechanics and Analysis", PHI Learning Pvt. Ltd., New Delhi, 2011.
2. Jindal, U.C., "Strength of Materials", Pearson Education, New Delhi, 2012.
3. Popov, E.P and Balan, T.A., "Engineering Mechanics of Solids", Pearson India Education Services, 2nd Edition, New Delhi, 2018.
4. Ramamrutham, S and Narayan, S., "Strength of Materials", Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2008.
5. Stephen Timoshenko, "Strength of Materials: Elementary Theory and Problems", CBS Publishers & Distributors, 3rd Edition, New Delhi, 2004.


**COURSE OUTCOMES:**

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

**CO1:** draw the shear force, bending moment and stress distribution for statically determinate beams.

**CO2**: sketch the slope and deflection curves for various types of indeterminate beams.

**CO3**: determine the deflection and sketch the deflected curve for various types of indeterminate beams

**CO4**: apply the various energy principles and theorems for the computation of deflection in beams, plane trusses and rigid frames.

**CO5**: Elucidate the concepts for the behaviour of axially loaded members and solve for buckling under different boundary conditions.

**Board of Studies (BoS) :**
16th BoS of CE held on 5.01.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

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

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable
Statement: Analysis of structures is more essential to ensure safe and sustainable building.

| CED 2102 | MECHANICS OF FLUIDS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 6 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart understanding of key concepts and fundamental principles pertaining to fluid behavior.

**COB2:** To provide sufficient knowledge to understand the basic concepts of fluid flow.

**COB3:** To impart the basic knowledge on the dynamics of fluids and flow through pipes.

**COB4:** To expose to the significance of boundary layer theory and its applications.

**COB5:** To develop the basic knowledge on the dimensional analysis and model study.

**MODULE I FLUID PROPERTIES AND PRESSURE MEASUREMENTS 10**

Dimensions and units - Properties of Fluids - Ideal and Real fluid - Definition of pressure - Pressure at a point- Pascal's law- Absolute and Gauge pressure - Measurement of pressure - Simple and Differential Manometer theory and problems - Pressure gauges.

**MODULE II FLUID STATICS AND FLUID KINEMATICS 10**

Fluid Statics - Hydrostatic law - Definition of total pressure, Center of pressure, Metacentric height, Buoyant force –Problems on hydrostatic force and depth of center of pressure on plane surfaces and submerged surfaces (Vertical, Inclined and curved).

Fluid Kinematics – Velocity and Acceleration- Stream, Streak and Path lines – Classification of flows – Continuity equation (one-, two- and three-dimensional forms) – Stream and Potential functions – Flow nets.

**MODULE III FLUID DYNAMICS 9**

Euler and Bernoulli's equations – Application of Bernoulli's equation – Venturimeter–Orifice meter- Laminar flow through pipes– Hagen Poiseuille equation – Turbulent flow – Darcy-Weisbach formula – Major and minor losses of flow in pipes – Pipes in series and in parallel – Moody diagram.

**MODULE IV BOUNDARY LAYER 8**

Definition of boundary layer – Thickness and classification –Displacement and momentum thickness – Separation of boundary layer – Development of laminar and turbulent flows in circular pipes.

**MODULE V SIMILITUDE AND MODEL STUDY 8**

Dimensional Analysis – Rayleigh's method, Buckingham's Pi- theorem – Similitude and Models- Dimensionless numbers – Scale effect and Distorted models

**L –45; Total Hours– 45**

**TEXT BOOKS:**

1. Bansal R.K., "A textbook of Fluid mechanics and hydraulic machines", Laxmi Publications (P) Ltd., New Delhi, 10th Edition, 2019.
2. Modi, P.N. and Seth, S.M.," Hydraulics and Fluid Mechanics including Hydraulics Machines", 21st Edition, Standard Book House, New Delhi, 2018.
3. Som. S.K., Gautam Biswas and Chakraborty. S., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill Education Pvt. Ltd., 2012.

**REFERENCES:**

1. Jagadish Lal., "Fluid Mechanics & Hydraulic with Computer Applications", Metropolitan Publication, 9th Reprint edition, 2008.
2. Molykutty, M.V., "Fluid Mechanics and Machinery", D1 Publications, Chennai, 2008.
3. Munson, Okiishi , Huebsch , and Rothmayer., "Fluid Mechanics-SI Version", 7th Edition Paperback, Wiley publication, 2015.
4. Ramamrutham.S. "Hydraulics Fluid Mechanics and Fluid Machines," 9th Edition, Dhanpat Rai Publication, 2014.

**COURSE OUTCOMES:**

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

**CO1:** describe fluid properties, forces causing flow and will be able to solve problems involving fluid properties and fluid pressure measurements.

**CO2:** assess the knowledge related to hydrostatic forces acting on the floating bodies and analyze the flow using principles of fluid kinematics.

**CO3:** solve fluid problems using principle of fluid dynamics, estimate losses in pipelines and analysis of pipes connected in series and parallel.

**CO4:** demonstrate the concept of boundary layer and its application to find the drag force excreted by the fluid on the flat solid surface.

**CO5:** formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.

**Board of Studies (BoS) :**
16th BOS of Civil held on 5.1.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | L | L | L | L | M | L | L | L | L | M | L | L | L |
| **CO2** | H | M | L | L | L | L | M | L | L | L | L | M | L | L | L |
| **CO3** | H | M | H | L | L | M | H | L | L | L | L | H | L | L | M |
| **CO4** | H | M | M | M | L | L | M | L | L | L | L | H | L | L | L |
| **CO5** | H | M | M | M | L | L | H | L | L | L | L | H | L | L | L |

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

SDG 6: Clean, accessible water for all is an essential part of the world we want to live in.

Understanding the development of sustainable water supplies by means of design and construction of efficient water supply and distribution system.

| CED 2103 | CONCRETE TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:** The main objective of this course is to impart adequate knowledge on

**COB1:**significance of concrete constituent materials

**COB2:**workability of concrete and concrete mix design

**COB3:**hardened concrete properties and its significance

**COB4:** durability properties of concrete

**COB5:** different types of concrete currently used in the construction projects

**MODULE I CONCRETE CONSTITUENT MATERIALS AND WORKABILITY** **9**

Overview and significance of concrete constituent materials – Cement : chemical composition and compounds, hydration process, microstructure of concrete–Workability : water-cement ratio, influencing factors, site and laboratory methods to determine workability – Mineral and chemical admixtures : overview

**MODULE II CONCRETE MIX DESIGN** **9**

Manufacture of concrete: Construction practices to be followed in site – Concrete Mix Design: significance, salient parameters, mix design as per Indian Standards and American Concrete Institute method, validation of mix design, fresh concrete properties.

**MODULE III HARDENED CONCRETE PROPERTIES** **9**

Hardened concrete properties: overview and significance - compressive strength, flexural strength, splitting tensile strength, modulus of elasticity, bond strength, creep and shrinkage: test methods as per Indian standards, estimation of strength properties – NDT techniques for hardened concrete strength assessment : overview.

**MODULE IV DURABILITY PROPERTIES OF CONCRETE** **9**

Sustainable construction – Durable concrete – life cycle cost benefits – Mechanisms affecting durability of concrete: physical mechanisms and chemical mechanisms : overview – Significance of proper selection of construction materials, mix design and good construction practices – Tests to assess durability of concrete : water absorption, water permeability,

water sorptivity, rapid chloride penetration test, accelerated corrosion test – test procedures and estimation methods.

**MODULE V CONCRETE FOR SPECIAL APPLICATIONS 9**

High performance concrete – fibre reinforced concrete – polymer modified concrete – shotcrete – self compacting concrete

**L – 45 ; TOTAL HOURS – 60**

**TEXT BOOKS:**

1. Shetty.M.S., and A.K. Jain "Concrete Technology (Theory and Practice)", S. Chand and Company Ltd.,2010.
2. Gambhir.M.L., "Concrete Technology", 5th Edition, Tata McGraw Hill Education, 2017

**REFERENCES:**

1. Kumar Mehta. P. and Paulo J.M. Monteiro., "Concrete: Microstructure, Properties, and Materials"4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.
2. Brooks, J.J. and Neville, A.M., "Concrete Technology", Pearson, 2019.
3. Santhakumar, A.R., "Concrete Technology" Oxford, 2006.
4. IS 456 (2000) R 2005, "Plain and Reinforced Concrete – Code of Practice", Bureau of Indian Standards, New Delhi.
5. IS 10262 (2009), "Guidelines for Concrete Mix Design Proportioning", Bureau of Indian Standards, New Delhi.
6. ACI 211.1-19 (R 2002), "Standard Practice for Selecting Proportions for Normal, Heavy weight, and Mass Concrete" American Concrete Institute, Detroit, USA.
7. IS 516 (1959) R 2004, "Method of Tests for Strength of Concrete", Bureau of Indian Standards, New Delhi.
8. IS 2770 – 1 (1967) R 2007, "Methods of Testing Bond in Reinforced Concrete, Part I : Pull-out test" Bureau of Indian Standards, New Delhi.
9. IS 5816(1999) R 2004, "Method of Test Splitting Tensile Strength of Concrete", Bureau of Indian Standards, New Delhi.
10. ASTM C1585-20, "Standard Test Method for Measurement of Rate of Absorption of Water by Hydraulic-cement Composites", American Society for Testing and Materials, Pennsylvania, USA.
11. IS 3085 (1965) R 2002, "Method of Test for Permeability of Cement Mortar and Concrete", Bureau of Indian Standards, New Delhi.

12. ASTM C 1202-12, “Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration”, American Society for Testing and Materials, Pennsylvania, USA.

**COURSE OUTCOMES:** On completion of the course the student will be able to

**CO1:** describe the composition and compounds of cement, hydration process and workability of concrete.

**CO2:** perform mix design of concrete as per Indian Standards and ACI method

**CO3:** describe the hardened concrete properties including its test method as per Indian Standard

**CO4:** describe the durability properties of concrete including its test method as per Indian Standard / ASTM

**CO5:** specify and describe the type of concrete for special applications.

**Board of Studies (BoS) :** 16$^{th}$BoS of Civil held on 05.01.2022

**Academic Council:** 18$^{th}$ AC held on 24.02.2022

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

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

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Designing of durable concrete by properly understanding the properties of concrete constituent materials, expected strength, exposure conditions and application; make the human settlements safe and resilient and leads to sustainable development.

| CED 2104 | WATER AND WASTEWATER ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 6 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

The objectives of the course are to impart knowledge on

**COB1:** The population forecasting, water sources, intake structures, water quality and its treatment

**COB2:** The advanced water treatment methods, water storage facilities and distribution network

**COB3:** The sewerage systems, estimation of wastewater flows & storm runoff, wastewater characterization and its primary treatment

**COB4:** The secondary treatment of wastewater

**COB5:** The methods for wastewater disposal & sludge handling.

**MODULE I WATER TREATMENT 9**

Design Period - Population forecasting - Types of water demand -Sources of water - Intakes - Characteristics of water - Standards for drinking water - Principle, function and design of water treatment units - sedimentation, coagulation & flocculation, Filtration – theory & principle of disinfection methods.

**MODULE II ADVANCED WATER TREATMENT, STORAGE & DISTRIBUTION 9**

Water softening – Iron, Manganese and Phosphorus removal, Defluoridation – Desalination - Membrane filtration - Water storage facilities – Distribution networks & analysis.

**MODULE III PRIMARY TREATMENT OF WASTEWATER 9**

Sewerage systems - Sewage flow estimation - Storm runoff estimation - Sewer materials - Hydraulics of flow in sewer - Sewer appurtenances – Characteristics of sewage - Unit operations and processes - Primary treatment – Principles, functions and design of sewage treatment units – Screens – Grit chamber.

**MODULE IV SECONDARY TREATMENT OF WASTEWATER 9**

Introduction to Aerobic and Anaerobic treatment process - Functions and design of Activated sludge process and trickling filter – Principles and functions of Membrane Bioreactor, Sequential batch reactor, Waste stabilisation pond, UASB reactor - Onsite sanitation - septic tanks

**MODULE V WASTEWATER DISPOSAL & SLUDGE TREATMENT** **9**

Standards for disposal into water bodies – Self-purification of river - Oxygen sag curve – Sewage farming and methods - Sludge thickening & Digestion – Biogas recovery – Sludge conditioning and Dewatering – Sludge drying bed.

**PRACTICALS**

List of experiments

1. Determination of pH and Turbidity
2. Determination of Dissolved oxygen
3. Determination of Solids (Total, Suspended and Dissolved solids)
4. Determination of Conductivity
5. Determination of Sodium, Potassium and Calcium
6. Determination of Biochemical Oxygen Demand (BOD)
7. Determination of Chemical Oxygen Demand (COD)
8. Determination of Hardness
9. Determination of Chlorides and Residual Chlorine
10. Determination of Optimum Coagulant Dosage by Jar Test
11. Determination of Alkalinity
12. Determination of Nitrate
13. Determination of Phosphate
14. Heavy metals determination using AAS (Demo)

**L – 45; P – 30; Total Hours – 75**

**TEXT BOOKS:**

1. GargSK, “Water Supply Engineering”, Khanna Publications, 27th Edition, 2015
2. Mackenzie L. Davis, Ph.D., P.E., BCEE. Water and Wastewater Engineering: Design Principles and Practice, Second Edition (McGraw-Hill Education: New York, 2020.
3. Metcalf and Eddy, “Wastewater Engineering Treatment, Disposal and Reuse”, Tata McGraw Hill, 2007.
4. Modi.P.N., “Sewage Treatment and Disposal and Wastewater Engineering”, Standard Book House, New Delhi, 2008

**REFERENCES:**

1. APHA., "Standard methods for the examination of Water and Waste Water", American Public Health Association, United States, 2013.
2. Bureau of Indian Standards, "Indian Standard Drinking water — Specification- IS10500: 2012, New Delhi.
3. Water and Wastewater analysis – Manual, Central Pollution Control Board, New Delhi, 2011.

**COURSE OUTCOMES:**

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

**CO1:** forecast population, estimate quantity of water demand, characterize water quality and design treatment units

**CO2:** describe advanced treatments for water, water storage facilities and analyze distribution network

**CO3:** explain the sewerage systems, estimate wastewater flows & storm runoff, characterize quality of wastewater and design the primary wastewater treatment units

**CO4:**describe the secondary treatment of wastewater

**CO5:** describe the methods for wastewater disposal & sludge handling.

**Board of Studies (BoS) :**

16th BoS of Civil held on 05.01.2022.

**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 | - | - | L | H | L | M | M | - | M | L | - | H |
| CO2 | - | - | L | - | - | - | H | L | M | M | - | M | L | - | H |
| CO3 | - | - | M | - | - | L | H | L | M | M | - | M | L | - | H |
| CO4 | - | - | M | - | - | - | H | L | M | M | - | M | L | - | H |
| CO5 | - | - | L | - | - | M | H | L | M | M | - | M | L | - | H |

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

SDG No.6 : Clean Water and Sanitation

The understanding of water and wastewater treatment leads to the development of sustainable technologies for treatment and management of water and wastewater.

| CED 2105 | TRANSPORTATION ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The Objectives of the course are

**COB1:**To impart knowledge on urban transportation planning

**COB2:**To understand the highway engineering principles

**COB3:**To impart knowledge on the concepts of geometric design of highways

**COB4:**To gain knowledge on various types of intersections and its geometric design

**COB5:** To explain the modern techniques used in urban transportation planning

**MODULE I INTRODUCTION 8**

Role of Transportation Engineering; Modes of transportation- Their importance and limitations- Urban Transportation Planning Process, Urban Travel and Transportation Systems Characteristics, Function and form of urban structures, services, classification of urban centers, growth patterns, urban transport problems, Transport Behavior of Individuals and Households, Land use/ Transportation systems, land value and congestion, access and business migration.

**MODULE II HIGHWAY ENGINEERING 8**

Importance of Highway Transportation; Highway Planning- Principle of Highway Planning - Highway Alignment Requirements, Engineering Surveys for Highway locations. Road developments -Jayakar Committee and Recommendations, Twenty year Road Development Plan, IRC, Institutions - HRB, NHAI, MORTH and CRRI) - Financing, Privatization of Highways, Highway Alignment Requirements, Engineering Surveys for Highway locations.

**MODULE III GEOMETRIC DESIGN OF HIGHWAYS ENGINEERING 12**

Classification and Cross section of Urban and Rural Roads (IRC),Highway Cross sectional Elements – Right of way, Carriage way, Road Width, Camber, Kerbs, Shoulders and Footpaths ( IRC Standards), Sight distances – Factors affecting sight distances – PIEV theory, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate

Sight Distance and Illumination Sight Distance (Derivations and Problems in SSD
and OSD), Design of Horizontal Alignments – Super elevation, Widening of pavements – Gradient – Horizontal Curves and Transition Curves ( Derivation of Formulae and Problems) - Design of Vertical Alignments, Geometry design of hill roads – hairpin bends

**MODULE IV INTERSECTIONS 8**

Intersections – Type of intersections- Basic considerations – simplicity – uniformity – Maneouvre Elements – Separation of conflict points – Design Elements – Design Speed – Intersection Curves – Super elevation for curves at Intersection – Intersection Sight Distance. Rotary and Signalized Intersections grade separated interchanges such as flyovers, underpasses, overpasses, concept of Integrated Inter Model transit system.

**MODULE V MODERN URBAN TRANSPORTATION 9**

Introduction to Urban Freight Transportation and Urban Mass Transportation Systems. Characteristics of buses, bicycles, Para transit, rapid transit, Traffic Restraint Techniques and methods. Classification, mass and rapid transit system, Introduction to Intelligent Transportation System (ITS), Public Transport policy, intermediate.

**L- 45; Total Hours – 45**

**TEXT BOOKS:**

1. Johnson victor, S.Ponnuswamy, Urban Transportation, Planning, Operation and Management, McGraw-Hill Pvt. Ltd, 2012.
2. Kadiyali.L.R., Principles and practice of highway engineering Khanna Technical Publications, Delhi, 2005.
3. Khanna.K and Justo CEG., Highway engineering, 10th edition Khanna Publishers, 2010.

**REFERENCES:**

1. Johnson Victor and S. Ponnuswamy., “Urban Transportation: Planning, Operation and Management” McGraw-Hill Education Private Limited2012.
2. Sigurd Grava, “Urban Transportation Systems”, McGraw Hill Professional,2013.

**COURSE OUTCOMES:**

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

**CO1:** describe the urban transport planning process and various Characteristics of urban forms

**CO2:** ascertain knowledge on highway alignment requirements and engineering surveys for highway locations

**CO3:** explain geometric design of various cross sectional elements and factors affecting the sight distances

**CO4:** demonstrate the constructions of intersection design and to know the concept of integrated inter modal transit system.

**CO5:** compile the modern urban transportation such as Para transit, rapid transit and intelligent transportation system.

**Board of Studies (BoS) :**
16thBoS of Civil held on 05.01.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

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

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

SDG 8 : Decent Work and Economic Growth

The transportation engineering Promote sustained, inclusive and sustainable economic growth.

| CED 2106 | CONCRETE AND HIGHWAY LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 0 | 0 | 2 | 1 |

**COURSE OBJECTIVES:**

The objective of the course is to impart hands on training on

**COB1:** methods of measuring workability of fresh concrete

**COB2:** concrete mix design as per Indian and ACI method

**COB3:** testing hardened concrete samples

**COB4:** testing of aggregates used for Highway Engineering

**COB5:** testing and quality assurance of bitumen used for Highway Engineering

**MODULE I FRESH CONCRETE PROPERTIES** **6**

Concrete constituent materials and performance tests as per Indian Standards: Overview – Workability of concrete : Slump test, compaction factor test, flow table test and Vee Bee consistometer test – Influence of water-cement ratio on workability.

**MODULE II CONCRETE MIX DESIGN** **6**

Concrete mix design as per Indian Standards and ACI committee method for the given materials and set variables – validation of mix design.

**MODULE III HARDENED CONCRETE PROPERTIES** **6**

Compressive strength test on cubes and cylinder specimen, flexural strength test on concrete prism, splitting tensile strength test on concrete cylinder, Young's modulus of concrete : Testing as per relevant Indian Standards and interpretation of results.

**MODULE IV AGGREGATES FOR HIGHWAY APPLICATION** **6**

Materials used in Highway Engineering and performance tests as per Indian Standards : Overview – Testing on aggregates : Impact strength - crushing strength - abrasion resistance - water absorption

**MODULE V PROPERTIES OF BITUMEN** **6**

Grades of Bitumen: Overview. Tests on Bitumen - Penetration, Softening point, Ductility, Specific gravity, Binder content in bituminous mixture and Marshal stability test.

**P – 30 ; TOTAL HOURS – 30**

**TEXT BOOKS:**

1. SanthaKumar,A.R.,“ConcreteTechnology”,Oxford University Press,Chennai 2007.
2. Shetty, M.S., “Concrete Technology – Theory and Practice”, S. Chand & Company Limited, New Delhi,2008

**REFERENCES:**

1. IS 1199 (1959) R 2004, “Methods of Sampling and Analysis of Concrete”, Bureau of Indian Standards, New Delhi.
2. IS 10262 (2009), “Guidelines for Concrete Mix Design Proportioning”, Bureau of Indian Standards, New Delhi.
3. ACI 211.1-19 (R 2002), “Standard Practice for Selecting Proportions for Normal, Heavy weight, and Mass Concrete” American Concrete Institute, Detroit, USA.
4. IS 516 (1959) R 2004, “Method of Tests for Strength of Concrete”, Bureau of Indian Standards, New Delhi.
5. IS 5816(1999) R 2004, “Method of Test Splitting Tensile Strength of Concrete”, Bureau of Indian Standards, New Delhi.
6. IS 383 (1970), “Specification for coarse and fine aggregate from natural sources for concrete”, Bureau of Indian Standards, New Delhi.
7. IS 2386 - PartI (1963), “Methods of test for aggregates for concrete-Particle size and shape”, Bureau of Indian Standards, New Delhi.
8. IS 1203 (1978), “Determination of penetration of bitumen”, Bureau of Indian Standards, New Delhi.
9. IS 1205 (1978), “Determining softening point of bitumen”, Bureau of Indian Standards, New Delhi.
10. IS 1208 (1978), “Determination of ductility of bitumen”, Bureau of Indian Standards, New Delhi.

**COURSE OUTCOMES:**

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

**CO1:** Find workability of concrete for the give set of materials and conditions

**CO2:** Perform concrete mix design as per Indian Standards and ACI method for the given materials and validation

**CO3:** Assess hardened concrete properties by conducting tests as per Indian standards.

**CO4:** Determine the properties of materials used in highway engineering as per Indian Standards

**CO5:** Perform the tests to determine the properties of Bitumen as per Indian Standards

**Board of Studies (BoS) :**
16th BoS of Civil held on 05.01.2022

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

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

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Making of durable concrete by properly understanding the properties of concrete constituent materials, expected strength, exposure conditions and application; and Building Highway Infrastructure by proper understanding of materials and its properties make the human settlements safe and resilient and leads to sustainable development.

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

**COURSE OBJECTIVES:**

**COB1**:To enable them to make effective business presentations

**COB2**:To train them to participate in group discussions

**COB3:**To enhance the problem-solving skills

**COB4:**To train students in solving analytical problems

**MODULE I ORAL DISCOURSE 07**

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

**MODULE II VERBAL COMMUNICATION 08**

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

**MODULE III BASIC NUMERACY 08**

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

**MODULE IV ANALYTICAL COMPETENCY 07**

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

**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. 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) :**
13thBoS of the Department of English held on 17.6.2021

**Academic Council:**
17th AC held on 15.07.2021

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

| CED 2201 | MECHANICS OF SOILS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:** To familiarize the students with geotechnical terminology and impart knowledge on index properties and hydraulic properties of soil.

**COB2:** To provide knowledge on the effective stress behavior and stress distribution for different loading condition.

**COB3:** To understand the concepts in compaction and consolidation of soil.

**COB4:** To enable the students to determine the shear strength of the soil.

**COB5:** To provide an understanding on slope stability in soil.

**MODULE I INDEX PROPERTIES AND HYDRAULIC PROPERTIES OF SOILS** **12**

Introduction: Nature of Soil - Problems with soil - Index properties: Phase relation - Sieve analysis - Sedimentation analysis- Atterberg limits – Field Density – Classification of soils for engineering purpose - Hydraulic properties: Soil water - Various forms- Influence of clay minerals - Capillary rise - Permeability - Darcy's Law- Permeability measurement in the laboratory – Introduction to Flow nets – Simple problems.

**MODULE II EFFECTIVE STRESS AND STRESS DISTRIBUTION IN SOIL** **8**

Effective stress concepts in soil – Total, neutral and effective stress distribution in soil - Stress distribution in soil media - Boussinesque formula- stress due to line load, circular and rectangular loaded area - approximate methods - Use of influence charts - Westergaard equation for point load.

**MODULE III COMPACTION AND CONSOLIDATION** **8**

Soil compaction - factors affecting compaction - field compaction methods and monitoring – Consolidation - Terzaghi's one dimensional consolidation theory – Consolidation Settlement - Problems - Laboratory consolidation test - Field consolidation curve.

**MODULE IV SHEAR STRENGTH 8**

Shear strength of cohesive and cohesion less soils - Mohr - Coulomb failure theory - Saturated soil and unsaturated soil (basics only)-Strength parameters - Measurement of shear strength, direct shear, triaxial compression, UCC and Vane shear tests-types of shear tests based on drainage and their applicability.

**MODULE V SLOPE STABILITY 9**

Slope failure mechanisms - Modes of failure- Infinite slopes - Finite slopes - Total and effective stress analysis - Stability analysis for purely cohesive and c-φ soils - Friction circle method - Stability number - Slope protection measures.

**PRACTICALS**

**List of Experiments**

1. Specific gravity of soil grains
2. Grain size distribution by Sieve analysis and Hydrometer analysis,
3. Relative density of sands
4. Atterberg limits test.
5. Field density test (Core cutter and sand replacement methods).
6. Permeability determination (constant head and falling head methods)
7. Determination of moisture - density relationship using Standard Proctor Compaction test.
8. One dimensional consolidation test (Determination of co-efficient of consolidation only).
9. Determination of shear strength parameters - Direct shear test on cohesion less soil, Unconfined Compression test on cohesive soil, Triaxial compression test and Vane shear test.

**L – 45 ; P – 30 ; Total Hours– 75**

**TEXT BOOKS:**

1. Gopal Ranjan and Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age International Publishers, New Delhi, 3rd edition, 2016.
2. Iqbal H Khan., “A text book of Geotechnical Engineering”, Prentice Hall of India, New Delhi, 3rd edition, 2012.
3. Punmia, B.C, Ashok Kumar Jain and Arun Kumar Jain., “Soil Mechanics and Foundations”, Laxmi Publications Pvt. Ltd., New Delhi, 17th edition, 2017.
4. Venkatramaiah, C., “Geotechnical Engineering”, New Age International Publishers, New Delhi, 6th edition, 2018.

**REFERENCES:**

1. Coduto, D.P, Man-chu Ronald Yeung and William A Kitch., "Geotechnical Engineering Principles and Practices", Prentice Hall of India Private Limited, New Delhi, 2010.
2. Das, B.M. and Khaled Shoban., "Principles of Geotechnical Engineering", 9th Edition, Thomas Brooks/ Cole Publishing Company, 2016.
3. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations – Basic Geotechniques", 7th Edition, Prentice-Hall, New Jersey, 2014.
4. Muni Budhu., Soil Mechanics and Foundations., 3rd edition, John Willey & Sons, Inc., New York, 2010.

**COURSE OUTCOMES:**

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

**CO1:** determine the index properties and hydraulic properties of soil and classify soil for engineering purpose.

**CO2:** analyze effective stress and stress behaviour of soil under various loading condition in soil.

**CO3:** assess consolidation settlement and incorporate various compaction methods.

**CO4:** ascertain the behaviour of soil based on shear strength parameters.

**CO5:** analyze the stability of soil and suggest suitable protection measures

**Board of Studies (BoS) :**
16th BoS of CIVIL held on 05.01.2022

**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 | | | M | M | | | L | L | M | H | | |
| CO2 | H | L | L | | | L | M | | | L | L | L | M | | |
| CO3 | H | L | L | | | L | M | | | L | L | L | H | | |
| CO4 | H | L | L | | | L | L | | | L | L | L | H | | |
| CO5 | M | L | M | | | M | M | | | | L | L | M | L | |

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement : The impart of knowledge on basic soil properties and their behavior under different stress conditions helps in designing an economical and safe foundation leading to construction of resilient infrastructure.

| CED 2202 | STRUCTURAL ANALYSIS – I | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 & 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To provide in-depth knowledge of the analysis of structures by the slope - deflection method.

**COB2**: To impart knowledge on the analysis of beams and frames by moment distribution method.

**COB3**: To understand the fundamental concepts of beams curved in plan.

**COB4:** To provide knowledge on the analysis of beams using moving loads and influence lines.

**COB5**: To enable the students to understand the influence lines for indeterminate structures.

**MODULE I SLOPE DEFLECTION METHOD 9**

Continuous beams and rigid frames (with and without sway) – Symmetry and ant symmetry - Simplification for hinged end - Support displacements.

**MODULE II MOMENT DISTRIBUTION METHOD 9**

Stiffness and carry-over factors - Distribution and carryover of moments - Analysis of continuous Beams - Plane rigid frames with and without sway - Naylor's simplification.

**MODULE III BEAMS CURVED IN PLAN 9**

Introduction to curved beams - Analysis of beams curved in plan- Circular arc cantilever – Semi-circular beams fixed at two ends and subjected to central concentrated load - Circular ring beams.

**MODULE IV MOVING LOADS AND INFLUENCE LINES FOR DETERMINATE STRUCTURES 9**

Influence lines for reactions in statically determinate structures – Influence lines for member forces in pin-jointed frames – Influence lines for shear force and bending moment in beam sections – Calculation of critical stress resultants due to concentrated and distributed moving loads.

**MODULE V INFLUENCE LINES FOR INDETERMINATE STRUCTURES 9**

Muller Breslau's principle – Application of Muller Breslau's principle to determinate beams and continuous beams.

**L – 45; Total Hours – 45**

**TEXT BOOKS:**

1. Bhavikatti, S. S., "Structural Analysis - I, Vikas Publishing House Pvt. Ltd., 4th Edition, New Delhi, 2011.
2. Devdas Menon, "Structural Analysis", Alpha Science International Ltd., 2nd Edition, New Delhi, 2017,
3. Muthu, K. U., Azmi Ibrahim, Vijayanand, M., and Maganti Janardhana, "Basic Structural Analysis", I.K. International Publishing House Pvt. Limited, 3rd Edition, New Delhi, 2017.
4. Salah Khalfallah, "Structural Analysis 2: Statically Indeterminate Structures", John Wiley & Sons, New York, 2018.

**REFERENCES:**

1. Bhavikatti, S. S., "Structural Analysis - II, Vikas Publishing House Pvt. Ltd., 4th Edition, New Delhi, 2013.
2. Gambhir, M.L., "Fundamentals of Structural Mechanics and Analysis", Publisher, PHI Learning Pvt. Ltd., New Delhi, 2011
3. Das Madan Mohan, Das Bhargab Mohan and Saikia Mimi Das, "Structural Analysis", PHI Learning Pvt. Ltd., New Delhi, 2011.
4. Vaidyanathan, R., and Perumal, P, "Structural Analysis, Volume 2", Laxmi Publications, 2nd Edition, New Delhi, 2006.

**COURSE OUTCOMES:**

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

**CO1:** plot the bending moment diagram and shear force diagram of indeterminate structures by using the slope deflection method.

**CO2**: construct the bending moment diagram and shear force diagram of indeterminate structures by using the moment distribution method.

**CO3**: analyse the curved beams subjected to loads in the plane of curvature.

**CO4**: valuate and construct statically determinate structures from the influence lines.

**CO5:** generate the influence line diagram for continuous beam using Muller Breslau's principle.

**Board of Studies (BoS):**
16th BoS of CE held on 5.1.2022

**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 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | | L | | | | | | | | M | H | |
| **CO2** | H | H | M | | L | | | | | | | | M | H | |
| **CO3** | H | H | M | | L | | | | | | | | M | H | |
| **CO4** | H | H | M | | L | | | | | | | | M | H | |
| **CO5** | H | H | M | | L | | | | | | | | M | H | |

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : Analysis of structures is more essential to ensure safe and sustainable building.

| CED 2203 | STRUCTURAL CONCRETE DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 & 11 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

**COB1:** To introduce the fundamental concepts of reinforced concrete materials with an emphasis on the various methods of design and also design the beam under flexure & shear

**COB2**:To impart knowledge to students about the design of concrete one-way & two-way slabs as per Indian Standards.

**COB3**: To design the short and slender columns subjected to axial load as well as combined axial load and bending moment.

**COB4:** To be familiar with various types of footings and design the foundation for RC structures.

**COB5**: To understand the concepts of structural behaviour of staircases and design the staircase for buildings.

**MODULE I STRUCTURAL RC DESIGN CONCEPTS & DESIGN OF BEAMS** **9**

Objectives of structural design – Concept of the elastic method, ultimate load method and limit state method – Advantages of Limit State method over other methods – Limit State Design philosophy as per IS Code recommendations - Fundamental assumption –Linear elastic analysis of composite sections – Flexural and shear behaviour of reinforced concrete – Analysis and Design of singly and doubly reinforced rectangular and flanged sections – Behaviour and design of torsion – Mechanisms of bond resistance – Flexural bond – Anchorage bond.

**MODULE II DESIGN OF SLABS** **9**

Behaviour of slabs spanning in one and two directions - Design of one way simply supported and continuous slabs - Design of two-way slabs for various edge conditions.

**MODULE III DESIGN OF COLUMNS** **9**

Classification of columns – Behaviour of RC columns - Design of short columns under axial compression, combined axial compression with uniaxial and biaxial bending.

**MODULE IV DESIGN OF FOOTINGS** **9**

Types of footings – Pressure distribution under footings - Design of Isolated rectangular footings with concentric column loads – Design of Isolated rectangular footings with eccentric column loads - Design of circular footings with concentric column loads - Design of combined rectangular footings.

**MODULE V DESIGN OF STAIRCASES 9**

Dimensioning and Types of staircases – Structural behaviour of staircases – Loads on staircases - Design of stair slabs spanning transversely and longitudinally.

**PRACTICALS**

**List of Exercises**

1. Introduction to STAAD.Pro, Model generations, Assigning Loads, Creating Load Combinations, Analysis and Design
2. Analysis and Design of a simply supported beam
3. Analysis and Design of a continuous beam
4. Analysis and Design of plane frames with two bay five-storey (G+4)
5. Analysis and Design of space frames with single-bay two-storey (G+1)
6. Design of foundation for the space frames with single-bay two-storey (G+1)
7. Design of staircase with single-bay two-storey (G+1)

**L – 45; P – 30 ; Total Hours – 75**

**TEXT BOOKS:**

1. Krishna Raju, N., “Design of RC Structures”, CBS Publishers and Distributors, New Delhi, 2008.
2. Pillai, S.U., and Wight, R.G., “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2016.
3. Subramanian, N., “Design of Reinforced Concrete Structures”, Oxford University Press, New Delhi, 2013.
4. Sarma, T.S., “Design of R.C.C. Buildings using Staad Pro V8i with Indian Examples: Static and Dynamic Methods”, Educreation Publishing, New Delhi, 2017.
5. Sham Tickoo, “Exploring Bentley STAAD.Pro V8i (SELECT series 6)”, CADCIM Technologies, USA, 2017.
6. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi, 2008.

**Codes /Standards**

1. IS 456 :2000, Indian Standard for Plain and Reinforced Concrete- Code of Practice,BIS, New Delhi

2. SP:16 : Design Aids for Reinforced Concrete to IS : 456-1978, BIS, New Delhi
3. SP:34 : Handbook Concrete Reinforcement and Detailing, BIS, New Delhi

**REFERENCES:**


1. Bandyopadhyay. J.N., "Design of Concrete Structures", Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
2. Ghosh Karuna Moy, "Practical Design of Reinforced Concrete Structures", PHI Learning Pvt. Ltd., New Delhi, 2010.
3. M. N. Hassoun, M.N and Akthem Al-Manaseer, "Structural Concrete: Theory and Design", Sixth Edition, John Wiley & Sons, New York, 2015.Syed Mehdi Ashraf, "Practical Design of Reinforced Concrete Buildings", CRC Press, Florida, 2017.
4. Wight, J.K., "Reinforced Concrete: Mechanics and Design", Pearson, 7thEdition, London, 2016.


**COURSE OUTCOMES:**

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

**CO1:** demonstrate various design philosophies in concrete structures and design the beams under flexure and shear.

**CO2:** apply the codal provisions for the design of slabs.

**CO3**: employ the codal provisions for the design of reinforced concrete columns.

**CO4:** iIdentify the suitable type of footing for RC structures and design as per standards.

**CO5:** design and construct an appropriate staircase for buildings.

**Board of Studies (BoS) :**
16th BoS of CE held on 5.1.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

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

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: Efficient reinforced concrete design is a prerequisite of safe, resilient and sustainable building construction.

| CED 2204 | ESTIMATION AND COSTING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | OF INFRASTRUCTURE PROJECTS | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

**COB1:**To understand the basic concepts of planning and estimation of buildings.

**COB2:** To impart knowledge on various methods of detailed estimation of buildings.

**COB3:** To introduce the concepts of specification writing and rate analysis and tendering process.

**COB4:** To enable knowledge on quoting tenders and contracts.

**COB5:** To provide understanding on valuation engineering and report preparation.

**MODULE I INTRODUCTION 4 + 4**

Estimation- Necessity of Estimation - Duties and requirements of a good Quantity Surveyor- Types of Estimates- Approximate and Detailed Estimates - Taking off Quantities - Units of measurements – Measurement Books – Consideration for Deductions of openings – Painting co-efficients - Task/Out-turn work – Standard Data Book - Schedule of rates - Revision of rates - Market Rates- Lead and Lift - Cost of conveyance and handling charges – Lump sum and Contingencies - Planning and layout of residential building – size of rooms, floor area, height and thickness of walls.

**MODULE II DETAILED ESTIMATE 7 + 8**

Load Bearing and Framed Structures - Calculation of quantities of earthwork, brick work, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing – Long Wall and Short Wall method – Centre line method– Problems – Tutorial in Excel work sheet.

**MODULE III SPECIFICATIONS AND ANALYSIS OF RATES 7 + 6**

Specifications - Detailed and General specifications - Standard specification – Advantages of Standard specifications - Writing standard specifications with reference to Tamilnadu Building Practice / Indian Standards / NBC - Examples - Analysis of rates – Earthwork -Brickwork – P.C.C and R.C.C – Plastering – Painting - Flooring.

**MODULE IV TENDERS AND CONTRACTS 5 + 6**

Tenders – Tender procedures and drafting - Tamilnadu Tender Transparency Act – e-tendering – Encryption and Decryption – Contracts – Types of contracts – Construction contract documents.

**MODULE V VALUATION AND TECHNICAL REPORT WRITING 7 + 6**

Value and Cost- Purpose of valuation – Basic terms in valuation - Factors affecting the value of a property –Mortgage and Lease -Problems on determination of Sinking Fund - Problems on calculation of Depreciation - Methods of valuation of Buildings –Technical report writing – Necessity - Points to be considered – Documents to be enclosed – Report writing for construction of residential building, roadwork's and water treatment plants.

**L – 30 ; P- 30 ; Total Hours – 60**

**TEXT BOOKS:**

1. Chakraborti.M., "Estimating, Costing, Specification & Valuation in Civil Engineering", Chakraborti Publishers, 24th Edition, 2010.
2. Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt Ltd; 28th Revised Edition, New Delhi, 2020.

**REFERENCES:**

1. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S Chand Publishers, 13th edition, New Delhi, 2013.
2. Rangwala, "Estimating, Costing and Valuation", Rangwala Publishers, 17th edition, 2017.

**COURSE OUTCOMES:**

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

**CO1:** plan and estimate different items of work for buildings.

**CO2:**estimate the quantities of items of works involved in construction of residential and commercial building in detail

**CO3:**prepare specification report and analyse the rate involved for each item of works to be done.

**CO4:**quote tenders and contract agreements in construction field.

**CO5:**determine the value of a building and also excel in technical report writing

**Board of Studies (BoS) :**
16th BoS of CIVIL held on 05.01.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

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

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

SDG 8 : Promote sustained, inclusive and sustainable economic growth.

Statement : The holistic approach of estimating a building with in-depth description of the expenditures needed paves the way to prevent project cost overruns and promotes economic growth of the nation.

| CED 2205 | WATER RESOURCES ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To provide the basic knowledge on crop water requirements and soil moisture irrigation relationship.

**COB2:**To develop idea on various irrigation methods and minimizing water losses.

**COB3:**To expose the students on various canals and tank irrigation systems.

**COB4:** To equip knowledge related to the impounding structures.

**COB5:**To familiarize with the concept of diversion structures and irrigation management

.

**MODULE I INTRODUCTION 9**

Irrigation - Need, merits and demerits of irrigation – Crop and crop seasons in India - Duty – Duty Delta relationship – Factors affecting duty - Irrigation efficiencies - Consumptive use of water –Soil moisture irrigation relationship – Field capacity -Determination of depth and frequency of irrigation - Irrigation schemes - Planning and Development of irrigation projects.

**MODULE II IRRIGATION METHODS 8**

Types of irrigation – Surface and Sub surface irrigation – Techniques for water distribution - Flooding Methods - Canal irrigation – Lift irrigation – Tank irrigation – Sprinkler irrigation – Drip irrigation – Need for optimization of water use - Minimizing irrigation water losses.

**MODULE III WATER CONVEYANCE AND STORAGE STRUCTURES 9**

Canal - Classification of canals - Alignment of canals – Canal lining – Types of lining - Unlined canal - Kennedy's and Lacey's Regime theory - Canal drops – Types and functions - Tank - Isolated tanks – Tanks in series – Embankments - Tank Outlets/Tank Sluices - Surplus weir.

**MODULE IV IMPOUNDING STRUCTURES 10**

Weirs –Types and functions - Elementary profile of a weir – Weirs on pervious foundations – Seepage analysis -Bligh's and Khosla Theories – Dams – Site selection - Factors affecting location and type of dams -

Gravity dams – Earth dams – Arch dams – Forces on gravity dams - Spillways – Types and functions.

**MODULE V DIVERSION STRUCTURES AND WATER RESOURCE MANAGEMENT** 9

Cross drainage works –Types and functions – Diversion head works – Canal regulators – Cross and Head Regulators – River Training works - On farm development works - Percolation Pond - Check dams - Participatory irrigation management – Water users associations – Changing paradigms in water management – Performance evaluation.

**L – 45; Total Hours – 45**

**TEXT BOOKS:**

1. Asawa, G.L., “Irrigation and Water Resources Engineering,” New age International publishers, 2005.
2. Raghunath H.M., “Irrigation Engineering”, Wiley India Pvt Ltd Publication, 2012.
3. Santosh Kumar Garg., “Irrigation Engineering and Hydraulic Structures” Khanna Publishers, New Delhi, 2013.

**REFERENCES:**

1. Darde P.N., “Irrigation Engineering”, Vayu Education of India, 2nd Edition, 2020.
2. Dilip Kumar Majumdar, “Irrigation Water Management (Principles & Practices)”, Prentice Hall of India (P) Ltd., New Delhi, 2004.
3. Novak, P, Moffat, A.I.B, Nalluri, C and Narayanan, R, “Hydraulic Structures”, CRC press, 4th Edition, 2006.

**COURSE OUTCOMES:**

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

**CO1:** estimate crop water requirements, irrigation efficiency and the consumptive use of water for irrigation.

**CO2:** assess knowledge on different methods of irrigation and optimum method of irrigation for judicious use of water resources.

**CO3:**develop a wide knowledge on the canal and tank irrigation system

**CO4:** identify the major concept of structures like dams, spillways, weirs and barrage structures.

**CO5:** determine the knowledge about the functions of diversion structures and water management.

**Board of Studies (BoS) :**
16th BOS of Civil held on 5.1.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

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

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

SDG 9: Investments in infrastructure are crucial to achieving sustainable development.

The structures like diversion head works, canal regulators etc are constructed for the sustainable use of water.

| CED 2206 | SURVEY AND SOIL | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | INVESTIGATION CAMP | 0 | 0 | 2 | 1 |

**COURSE OBJECTIVES:**

The objectives of the course are to impart knowledge on

**COB1:** the methods of preparing contour maps from the elevation data.

**COB2:** longitudinal sectioning profiles &cross-sectional profiles for a new road, drainage route to compute the volumes of embankment and excavation.

**COB3:** the concept of triangulation surveying using a total station.

**COB4:** the characteristics of a highway curve and also sketch & set out the excavation markings of a residential building.

**COB5:** the execution of real-time soil investigations.

**PRACTICALS**

List of Experiments:

1. Preparation of elevation & contour map.
2. Preparation of longitudinal sectioning profiles &cross-sectional profiles for a new road, drainage route.
3. Computation of reduced level (RL) of points using profile leveling.
4. Determination of area of survey tract using triangulation surveying.
5. Determination of the location of a point using GPS.
6. Determination of the shortest distance between two points and its gradient by tachometric traversing.
7. Setting out of a Curve for a new road or rail alignment.
8. Marking of foundation for a multi-storey building.
9. Soil Investigation - Conduction of Standard Penetration Test.
10. Soil Investigation - Preparation of bore log & soil profile.

**P – 30; Total Hours – 30**

**TEXTBOOKS:**

1. Arora.K.R., “Surveying”, Vol. I & II, 15th Edition, Standard Book House, New Delhi, 2018.
2. Kanetkar.T.P., “Surveying and Levelling”, Vol. I and II, Standard Publication, 2008.
3. Punmia. B.C., Ashok Kumar Jain and Arun Kumar Jain, “Surveying”, Vol. I, II and III, 15th Edition, Laxmi Publications, New Delhi, 2015.

**REFERENCES:**


1. Clark. D., “Plane and Geodetic Surveying”, Vol. I and II, 6th edition, C.B.S. Publishers and Distributors, New Delhi, 2017.
2. Heribert Kahmen and Wolfgang Faig, “Surveying”, Walter de Gruyter, 2012.
3. James M. Anderson and Edward M. Mikhail, "Introduction to Surveying”, 7th Edition, McGraw Hill, 2015.
4. https://civilengineeringnotes.com/surveying/


**COURSE OUTCOMES:**

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

**CO1:** plan and execute a survey for topography modeling of terrain and create a contour map.

**CO2:** plan and execute the survey for the formation of a new road alignment by longitudinal sectioning and cross-sectioning profiles and compute the volumes of embankment and excavation.

**CO3:** determine the area of a tract of land using triangulation surveying and determine the location of points using GPS.

**CO4:** compute the characteristics of a highway curve and set out the same by an appropriate method and also sketch out the excavation markings of a residential building and set out the same.

**CO5:** execute a soil investigation programmed, sketch the soil profile and compute the safe bearing capacity of the soil.

**Board of Studies (BoS) :**
16th BoS of CIVIL held on 05.01.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

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

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

SDG 11: Make cities inclusive, safe, resilient and sustainable.

The gained knowledge results in measuring and mapping the city to create a digital simulation that allows for forecast any event and helps in better decision making for resilient structures.

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

**COURSE OBJECTIVES:**

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

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

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

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

**MODULE I EXTENSIVE READING & WRITING 07**

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

**MODULE II INTENSIVE READING & WRITING 08**

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

**MODULE III QUANTITATIVE APTITUDE 08**

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

**MODULE IV LOGICAL COMPETENCY 07**

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

**P – 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) :**
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 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | L | | H | | | | | | H | | | | | |
| CO2 | | | L | | | | | | | H | | | | | |
| CO3 | | | L | | | | M | | | | | | | | |
| CO4 | | H | | M | | | | | | | | | | | |
| CO5 | | | | | | | | | | | | | | | |

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

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

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

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

**COURSE OBJECTIVES:**

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

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

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

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

**MODULE I INTRODUCTION AND BASIC INFORMATION ABOUT INDIAN CONSTITUTION** **8**

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

**MODULE II FUNDAMENTAL RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES** **7**

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

**MODULE III GOVERNANCE IN INDIA** **8**

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

**MODULE IV HUMAN RIGHTS AND INDIAN CONSTITUTION** 7

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

**L – 30; Total Hours– 30**

**TEXT BOOKS:**

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

**REFERENCES:**

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

**COURSE OUTCOMES:**

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

**CO1:** describe the emergence and evolution of Indian Constitution.

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

**CO3:** compare the various structure of Indian government.

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

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

**Academic Council:** 17th AC held on 15.07.2021

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | 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

| 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

| CED 3101 | STRUCTURAL ANALYSIS – II | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 & 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:** The objectives of the course are

**COB1:** To provide in-depth knowledge on the analysis of structures by the flexibility matrix method.

**COB2:**To impart knowledge on the analysis of beams and frames by the matrix stiffness method.

**COB3:** To understand the concepts and analyse the various types of arches.

**COB4:** To provide knowledge on the analysis of cables and suspension bridges.

**COB5:** To provide knowledge on the concepts of plastic theory and to analyse the beams & rigid frames.

**MODULE I FLEXIBILITY MATRIX METHOD 9**

Degree of static indeterminacy - Primary structure - Compatibility conditions – Characteristics of structure – Flexibility and Stiffness – Relation between stiffness and flexibility co-efficient - Analysis of indeterminate beams, pin-jointed frames, rigid jointed frames.

**MODULE II MATRIX STIFFNESS METHOD 9**

Degree of kinematic indeterminacy - Element and global stiffness matrices– Co-ordinate transformations – Rotation matrix- Compatibility matrix – transformations of stiffness matrices, load vectors and displacement vectors – Analysis of Continuous Beams – Analysis of pin-jointed frames and rigid jointed frames.

**MODULE III ARCHES 9**

Arches structural forms – Examples of arch structures – Types of arches – Analysis of three-hinged and two-hinged arches – fixed, parabolic and circular arches – Settlement and temperature effects.

**MODULE IV CABLES & SUSPENSION BRIDGES 9**

Introduction – Equilibrium of cable – Cable subjected to different kinds of loads – Forces on anchor cables & towers - Analysis of suspension bridges with cables with three and two-hinged stiffening girders.

**MODULE V PLASTIC ANALYSIS OF STRUCTURES** **9**

Introduction to plastic theory – assumptions in plastic analysis - Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Basic theorems – Methods of plastic analysis – Plastic analysis of beams and rigid frames.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Praveen Nagarajan , “Matrix Methods of Structural Analysis”, CRC Press, New York, 2018.
2. Singh, P.K, “ Matrix Structural Analysis”, Dorrance Publishing, Pittsburgh, 2020.
3. Bhavikatti, S. S., “Structural Analysis - II, Vikas Publishing House Pvt. Ltd., 4th Edition, New Delhi, 2013.

**REFERENCES:**

1. Bhavikatti, S. S., “Structural Analysis - I, Vikas Publishing House Pvt. Ltd., 4th Edition, New Delhi, 2011.
2. Natarajan, N., and P. Revathi, P., “Matrix Methods of Structural Analysis: Theory and Problems”, PHI Learning Pvt. Ltd., New Delhi, 2014.
3. T. S. Thandavamoorthy, T.S., “Structural Analysis”, Oxford University Press, New Delhi, 2011.

**COURSE OUTCOMES:**

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

**CO1:** Determine the statically degree of indeterminacy and analyze the beams & frames by flexibility matrix method.

**CO2:** Compute the degrees of freedom and apply the stiffness matrix method to analyse indeterminate beams & frames.

**CO3:** Categorize and analyse the various structural forms of arches.

**CO4:** Analyse the cables for various types of loads and evaluate the three and two-hinged stiffening girder suspension bridges.

**CO5:** Use appropriate assumptions to establish the plastic hinge on beams & rigid frames.

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 18th BoS of CE held on 05.04.2023 | 20th Academic council held on 13.4.2023 |

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : Analysis of structures is more essential to ensure safe and sustainable building.

| CED 3102 | DESIGN OF SUBSTRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To give exposure on soil exploration and site investigation.

**COB2:** To provide knowledge on determine bearing capacity of soil and introduce concepts on settlement of foundation under load.

**COB3:** To impart knowledge on contact pressure distribution and design and proportioning of shallow foundation.

**COB4:** To enable the students to analyze and design various types of pile foundation.

**COB5:** To provide an understanding on earth pressure theories of retaining structures.

**MODULE I SITE INVESTIGATION AND SELECTION OF FOUNDATION 8**

Scope and objectives- Methods of exploration-auguring and boring- Wash boring and rotary drilling-Depth of boring-Spacing of bore hole- Sampling-Disturbed and undisturbed sampling - Sampling techniques- Split spoon sampler, Thin tube sampler, Stationary piston sampler-Bore log report - Penetration tests (SPT and SCPT)- Data interpretation (Strength parameters)

**MODULE II BEARING CAPACITY AND SETTLEMENT OF FOUNDATION 8**

Introduction-Location and depth of foundation- Codal provisions - bearing capacity of shallow foundation on homogeneous deposits- Terzaghi's formula and IS formula -problems - Bearing Capacity from in situ tests (SPT, SCPT and plate load) - Allowable bearing pressure - Settlement - Components of settlement - Immediate settlement and Consolidation settlement - Determination of settlement of foundations on granular and clay deposits - Allowable settlements - Codal provision - Methods of minimizing settlement, differential settlement.

**MODULE III SHALLOW FOUNDATION 12**

Types of foundation - Contact pressure distribution below footings – Design of Isolated footing – Rectangular footing - Combined footings – types - proportioning - Mat foundation - types - use - proportioning – Strap footing - Floating foundation principle.

**MODULE IV PILES** **9**

Types of piles and their function - Factors influencing the selection of pile-Load carrying capacity of single pile in granular and cohesive soil. Static formula - dynamic formulae (Engineering news and Hiley's) - Capacity from insitu tests (SPT and SCPT) - Negative skin friction- Group capacity by different methods (Feld.s rule, Converse Labarra formula and block failure criterion)- Settlement of pile groups – Pile load test - Interpretation of pile load test results.

**MODULE V RETAINING WALLS** **8**

Plastic equilibrium in soils - Active and Passive states. Rankine's theory - cohesion less and cohesive soil – Coulomb's wedge theory - condition for critical failure plane - Earth pressure on retaining walls of simple configurations – Culmann's Graphical methods - pressure on the wall due to line load.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**


1. Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers, New Delhi, 3rd edition, 2016.
2. Iqbal H Khan., "A text book of Geotechnical Engineering", Prentice Hall of India, New Delhi, 3rd edition, 2012.
3. Punmia, B.C, Ashok Kumar Jain and Arun Kumar Jain., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 17th edition, 2017.
4. Venkatramaiah, C., "Geotechnical Engineering", New Age International Publishers, New Delhi, 6th edition, 2018.


**REFERENCES:**


1. Coduto, D.P, Man-chu Ronald Yeung and William A Kitch., "Geotechnical Engineering Principles and Practices", Prentice Hall of India Private Limited, New Delhi, 2010.
2. Das, B.M. and Khaled Shoban., "Principles of Geotechnical Engineering", 9th Edition, Thomas Brooks/ Cole Publishing Company, 2016.
3. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations – Basic Geotechniques", 7th Edition, Prentice-Hall, New Jersey, 2014.
4. Muni Budhu., Soil Mechanics and Foundations., 3rd edition, John Willey & Sons, Inc., New York, 2010.

**COURSE OUTCOMES:**

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

**CO1:** Recommend an appropriate site investigation programme for any construction.

**CO2:** Explore the bearing capacity of the soil for different types of shallow foundation and analyze the settlement based on soil condition.

**CO3:** Propose the size and depth of shallow foundation according to the bearing capacity and contact pressure distribution.

**CO4:** Determine the load carrying capacity and settlement of piles.

**CO5:** Determine the various types of earth pressure and stability of retaining structures

**Board of Studies (BoS) :**

18th BoS of CE held on 05.04.2023

**Academic Council:**

20th Academic council held on 13.4.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The integrated understanding of design of substructures results in the development of durable and resilient infrastructure throughout the life span.

| CED 3103 | HYDRAULIC AND HYDRAULIC | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 12 | MACHINERY | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:** To expose the concepts of flow measurements

**COB2:** To familiarize the students with the flow through open channels and most economical sections.

**COB3:** To acquire knowledge on the rapidly and gradually varied flows

**COB4:** To study about the working principles and characteristics of various pumps

**COB5:** To impart knowledge on the working principles and characteristics of various turbines

**MODULE I FLOW MEASUREMENTS 10**

Flow through orifices, mouthpieces - Classification - Hydraulic coefficients - problems, Flow over notches and weirs - Classification - Equation for discharge over rectangular, trapezoidal notches, V-notch- - Cippoletti notch - Ventilation of weirs - Discharge over broad crested weirs, narrow crested, submerged weirs – Problems – Velocity measurement using floats and current meter.

**MODULE II FLOW IN OPEN CHANNELS 10**

Definition of open channels – Classification - Types of flow -Geometric properties of open channels - Uniform flow- Velocity measurements - Chezy's and Manning's formulae- Most economical sections - Derivation of conditions for rectangular, triangular, trapezoidal and circular sections - Specific energy – Definitions - specific energy curve - Conditions for minimum specific energy and maximum discharge - Critical flow and its computation.

**MODULE III VARIED FLOWS 9**

Dynamic equations of gradually varied flow – Assumptions – Characteristics of flow profiles – Draw down and backwater curves – Profile determination – Graphical integration, Direct step method - Hydraulic jump – Types and problems – Applications -Energy dissipation- Positive and Negative surges.

**MODULE IV PUMPS 8**

Centrifugal pump –Work done and Efficiency- Minimum speed to start the pump – Multistage Pumps – Jet and Submersible pumps - Positive displacement pumps - Reciprocating pump – Work done and Efficiency - Negative slip - Flow separation conditions - Air vessels - Indicator diagram and its variation - Characteristic curves - Introduction to rotary pumps.

**MODULE V TURBINES 8**

Turbines - Classification - Radial flow turbines - Axial flow turbines – Impulse and Reaction turbines – Work done and Efficiency - Draft tube theory - Performance of turbines - Similarity laws.

**PRACTICALS**

## List of Experiments

**1.FLOW MEASUREMENTS:**

i) Determination of discharge for Orifice and Mouth piece fitted in a tank by constant and variable head method.

ii) Determination of co-efficient of discharge for venturimeter and orificemeter.

iii) Determination of coefficient of discharge for notches.

**2.MEASUREMENT OF LOSSES IN PIPES:**

i)Study on friction in pipes

ii) Study on minor losses in pipes.

**3)PERFORMANCE CHARACTERISTICS OF PUMPS AND TURBINES:**

i) Performance characteristics of Centrifugal Pump

ii) Performance characteristics of Reciprocating Pump

iii) Performance characteristics of Submersible Pump

iv)Performance characteristics of Pelton turbine

**L – 45; P – 30; TOTAL HOURS –75**

**TEXT BOOKS:**

1. Bansal R.K.,“A textbook of Fluid mechanics and hydraulic machines”, Laxmi Publications (P) Ltd., New Delhi, 10th Edition, 2019.
2. Modi, P.N. and Seth, S.M.,” Hydraulics and Fluid Mechanics including Hydraulics Machines”, 21st Edition, Standard Book House, New Delhi, 2018.
3. Molykutty, M.V., “Fluid Mechanics and Machinery”, D1 Publications, Chennai, 2008.
4. Subramanya, K., "Flow in Open channels", 3rd Edition, Tata McGraw-

Hill Publishing Company, New Delhi, 2009.

**REFERENCES:**

1. Arora, K.R., "Fluid Mechanics, Hydraulics and Hydraulics Machines", 9th Edition, Standard Publishers and Distributers, New Delhi. 2005.
2. Ven Te Chow, "Open Channel Hydraulics", The Blackburn Press, 2009.
3. Ramamurtham, S., "Hydraulics Fluid Mechanics and Fluid Machines", 9th Edition,Dhanpat Rai & Sons, New Delhi, 2014.
4. Kumar, K.L., "Engineering Fluid Mechanics", Reprint Edition, S.Chand Publication, 2006.

**COURSE OUTCOMES:**

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

**CO1:** describe the concepts of flow measurements and the use of flow measurement devices.

**CO2:** demonstrate various theories dealing with the flow phenomenon of fluid in an open channel.

**CO3:** analyze the various gradually varied flow profiles in an open channel flow and solve problems related to it.

**CO4:** discuss the working principle and compute the work done, efficiency and performance characteristics

**CO5:** classify turbines in various categories, and compute the work done, efficiency and performance characteristics.

**Board of Studies (BoS):**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

**SDG 12:** Securing a responsible production and consumption

Acquiring knowledge on the hydraulic machineries help the students to utilize it efficiently. This may lead to minimize the energy consumption.

| CED 3104 | REPAIR AND REHABILITATION | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | OF RC ELEMENTS | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objective of the course is to impart adequate knowledge on

**COB1:** physical and chemical deterioration mechanisms acting on reinforced concrete (RC) structures in the real time conditions.

**COB2:** condition assessment of distressed RC structures using NDT techniques

**COB3:** materials used in RC repair works

**COB4:** techniques used for rehabilitation of RC structures

**COB5:** seismic retrofitting cum rehabilitation of RC structures

**MODULE I REPAIR, REHABILITATION AND DETERIORATING MECHANISMS** **9**

Definition: Repair, rehabilitation and retrofitting – various facets of maintenance - Physical deteriorating mechanisms: shrinkage & creep - abrasion – erosion – cavitation - freeze and thaw. Chemical deteriorating mechanisms: alkali silica reaction – sulphate attack – corrosion of steel rebar in RC (chloride penetration and carbonation) – microbial induced corrosion.

**MODULE II CONDITION ASSESSMENT OF RC STRUCTURES** **9**

Condition assessment: significance and objectives – various stages – preliminary inspection – planning – visual inspection – laboratory and field testing. Non-Destructive testing techniques for condition assessment: overview – Rebound hammer test, ultrasonic pulse velocity test, concrete resistivity, cover meter, concrete core test and half-cell potential test. Condition assessment of distressed building: case study – report preparation.

**MODULE III MATERIALS FOR REPAIR** **9**

Repair materials – Factors influencing selection of repair materials – various stages of concrete repair – importance of surface preparation – bond coat – rust convertors – rust removers - protective coating to steel rebars - superplasticizers – corrosion inhibitor admixed concrete – micro concrete - polymer modified mortar / concrete – grouting agents – FRP sheets - concrete coatings - sacrificial anodes.

**MODULE IV TECHNIQUES FOR REHABILITATION OF RC ELEMENTS** 9

Rehabilitation techniques – overview, significance and selection methods – dry pack method – overlays – pressure grouting – RC jacketing technique – Plate bonding technique – FRP jacketing technique - ferrocement – guniting and shotcrete – techniques for repairing cracks – sacrificial anode cathodic protection.

**MODULE V CASE STUDIES ON REHABILITATION OF RC ELEMENTS** 9

Case study on rehabilitation of : dampness in buildings, leaky sunken slab, distressed roof slab, distressed overhead RC water tank, corrosion damaged RC bridge, fire damaged building, damaged industrial floors etc.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Perkins, P.H., “Repair, Protection and Waterproofing of Concrete Structures”, Third edition, E & FN Spon, 1997.
2. Emmons, P.H., “Concrete Repair and Maintenance Illustrated: Problem Analysis; Repair Strategy; Techniques”, RSMeans Publishers, 2002.

**REFERENCES:**

1. Santha Kumar, A.R., “Concrete Technology”, Oxford University Press, New Delhi, 2007.
2. Shetty.M.S., and A.K. Jain “Concrete Technology (Theory and Practice)”, S. Chand and Company Ltd., 2010.
3. Brooks, J.J. and Neville, A.M., “Concrete Technology”, Pearson, 2019.
4. Kumar Mehta. P. and Paulo J.M. Monteiro., “Concrete: Microstructure, Properties, and Materials” 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.Hand Book on “Repair and Rehabilitation of RCC Buildings”, Central Public Works Department, Government of India, 2002.
5. Malhotra, V.M. and Carino, N.J., “Handbook on Non-destructive Testing of Concrete”, CRC Press, 2004.
6. John Broomfield, “Corrosion of Steel in Concrete – Understanding, Investigation and Repair”, CRC Press, London, 2003.
7. Yoshihiko Ohama, “Hand Book of Polymer Modified Concrete and Mortars”, Noyes Publications, U.K., 3rd Edition, 2013.

**COURSE OUTCOMES:**

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

**CO1:** under the physical and chemical mechanisms detrimental to the RC structures, and need for proper maintenance and timely rehabilitation.

**CO2:** perform condition assessment of distressed building using NDT.

**CO3:** suggest materials for different repair works.

**CO4:** identify the suitable repair techniques for rehabilitation of RC elements.

**CO5:** suggest procedure for rehabilitation of distressed RC structures.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

1. Development of sustainable infrastructure by understanding the physical and chemical deteriorating mechanisms responsible for repair during its life time.
2. Make the existing human settlements safe and resilient by performing condition assessment of RC structures using NDT and, by adopting suitable repair materials and techniques for its rehabilitation.

| CED 3105 | GIS AND ITS APPLICATIONS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge on the components of GIS, coordinate system and mapping process.

**COB2:** To understand the different raster and vector data storage procedures and database structures to store the GIS data in a database management system.

**COB3:** To classify the real-world data into raster & vector representations and to analyze the GIS data.

**COB4:** To identify the real-world problems in precision agriculture, natural resources management and mobile GIS through spatial analysis.

**MODULE I FUNDAMENTALS OF GIS 7**

Introduction – definition of GIS – components of GIS – maps – mapping process – coordinate systems – geographic coordinate system & projected coordinate system – map projection – geo referencing.\

**MODULE II GIS DATA MODELS & DATA QUALITY 8**

Raster data representation – vector data representation – Raster data models – Vector data models – data quality – components of data quality – assessment of data quality – managing data errors – geographic data standards.

**MODULE III SPATIAL ANALYSIS 8**

GIS analysis and modeling: Raster Data Analysis – Overlay Operations, Slope & Aspects – Statistical Analysis – Feature-Based Topological functions: Buffering Overlay Analysis, Distance Measurements – Layer Based Topological Functions – Geographic Visualization, Data Classification – network analysis – DEM – Spatial Data Query.

**MODULE IV APPLICATIONS OF GIS 7**

Applications of GIS: Natural Resources Management, Natural hazard management, Vehicle Tracking, Water Resources Management, Precision Agriculture, Surveying and mapping using Unmanned Aerial Vehicle (UAV), Environmental Engineering & Monitoring, Web GIS and Mobile GIS.

**PRACTICALS**

**List of Experiments:**

1. Georeferencing and rectifying maps.
2. Creation of GIS Data/Feature-based digitization.
3. Adding attributes, using joins and relates.
4. GIS Querying.
5. Convert data from one format to other format.
   a. Raster to Vector b. Vector to Raster
6. Generation of contour from Digital Elevation Model (DEM)
7. Shortest path analysis using road network.
8. Conversion of KML file from Google Earth into shapefile

**L – 30; P – 30; TOTAL HOURS – 60**

**TEXTBOOKS:**

1. Anji Reddy, “Remote sensing and Geographical systems”, 4th Edition, B.S Publications, Hyderabad, 2014.
2. Chor Pang Lo and Albert K.W. Yeung, "Concepts and Techniques of Geographic Information Systems," Pearson Educations Inc., 2019.
3. Clarke, K., “Getting Started with Geographic Information Systems”, 5th Edition, Pearson Prentice Hall, New Jersey, 2010.

**REFERENCES:**

1. Burrough. P.A, “Principles of Geographical Information Systems”, 3rd Edition, Oxford University Press, 2015.
2. De Mers and Michael, N., “Fundamentals of geographic information system”, 4th Edition, John Wiley and sons, 2012.
3. https://www.gislounge.com/gis-essentials
4. https://www.esri.com/training/catalog/5b73407f8659c25ea7014330/gis-fundamentals

**COURSE OUTCOMES:**

After completion of the course, the students will be able

**CO1:** To classify the different components of GIS, coordinate systems and the mapping process.

**CO2:** To create raster, vector layers & generate and create error-free spatial data with its attributes.

**CO3:** To generate spatial queries & spatial analysis and identify the outputs achieved.

**CO4:** To solve real-world problems in precision agriculture, natural resources management and mobile GIS through spatial analysis.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | M | L | - | M | H | M | M | - | M | M | M | L | - | M | - |
| CO 2 | M | H | - | M | H | M | M | - | M | M | M | L | - | M | - |
| CO 3 | M | H | - | M | H | M | M | - | M | M | M | L | - | M | L |
| CO 4 | M | H | H | M | H | H | H | - | M | M | M | 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.

Statement :
The integrated understanding of the GIS concepts enables all the industrial assets and helps in fostering & managing each of them better by saving cost and maximizing productivity.

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

**COURSE OBJECTIVES:**

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

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

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

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

**MODULE I BRIEF EXCHANGES OF COMMUNICATION 08**

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

**MODULE II WORKPLACE COMMUNICATION 07**

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

**MODULE III INTERPERSONAL COMMUNICATION 08**

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

**MODULE IV NEGOTIATING AND PERSUADING 07**

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

**P-30: TOTAL HOURS - 30**

**REFERENCES:**

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

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

**COURSE OUTCOMES:**

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

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

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

**CO4:** Use appropriate grammar and vocabulary in any context.

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

**Academic Council:** 17th AC held on 15.07.2021

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO1 1 | 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.

| CED 3106 | INTERNSHIP - I | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 &11 | | 0 | 0 | 2 | 1 |

**GENERAL GUIDELINES:**

1. The course carries one credit for two weeks of Internship with a minimum duration of 80 hrs.
2. The students shall pursue Internship in Industry (Government departments / Private Constructions Companies / Private consulting firms etc.,) / Research organizations (SERC, PMI, CBRI etc.,) / Eminent Academic Institutions (IIT/ NIT/ Government or Private Universities) based on their field of interest.
3. The students shall obtain permission from Head of the Department / Dean of School by submitting an 'induction to internship certificate' provided by the firm (as per the given template) before commencement of Internship.
4. The students shall submit a report at the end of internship elaborating knowledge acquired during the internship period.
5. The student shall also submit the internship completion certificate issued by the Industry/ Research Organization / Academic Institution along with confidential feedback provided by them (in a specified format) in a sealed cover to the Class Advisor.
6. A committee comprising of faculty members constituted by the Head of the Department / Dean of School shall evaluate the Internship report, and also conduct an oral examination.
7. The weightage of marks for internship report and viva-voce examination are 60 % and 40% respectively.
8. Based on the assessment of internship report, and performance of the students in viva-voce examination, relative grade is awarded.

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 18th BoS of CE held on 05.04.2023 | 20th Academic council held on 13.4.2023 |

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : The industry internship shall impart the students the need for sustainable and resilient infrastructure, in the real time context, with respect to all aspects of civil engineering

## SEMESTER VI

| | | | | | |
|---|---|---|---|---|---|
| **CED 3201** | **DESIGN OF STRUCTURAL** | **L** | **T** | **P** | **C** |
| **SDG: 9** | **STEEL ELEMENTS** | **3** | **0** | **0** | **3** |

**COURSE OBJECTIVES:**

The **COB1:** To impart knowledge to students on the significance of steel structures, structural steel sections and its connection design.

**COB2:** To enable the students to design the tension members and splices.

**COB3:** To provide knowledge to design the compression members and column bases.

**COB4:** To impart knowledge on the design of simple beams and plate girders.

**COB5:** To enable the students to understand and design the roof trusses.

**MODULE I CONNECTIONS 9**

Indian standard structural steel sections - Review of IS 800 - 2007: General design requirements - Metal joining methods - types of connections - Bolted connection - failure modes - IS 800 codal provisions - Shear, bearing and tension capacity of bolts - Design of lap joint, butt joint -types of eccentric connection - Design of bracket connection - bolts subjected to combined shear and tension. Welded connection - Design of welded lap joint - bracket connection.

**MODULE II TENSION MEMBERS 9**

Types of sections - behaviour of tension members - Design strength due to yielding, rupture of critical section and block shear - IS 800 :2007 codal provisions for design - importance of lug angle - concept of shear lag - Design tensile strength of plates and angles - Design of tension members - Design of tension splice.

**MODULE III COMPRESSION MEMBERS 9**

Types of members and forms - short column, long column and buckling phenomenon - slenderness ratio - effective length – buckling class - IS 800 : 2007 codal provisions for design - Design of simple column - Design of laced and battened columns - Column bases - Design of slab base and gusseted base - connection details.

**MODULE IV BEAMS 9**

Importance and functions - behaviour of steel beams - web crippling and web buckling - IS 800 codal provisions for design - design of simply supported beams - design of laterally unsupported beams - built up beams - beams subjected to biaxial bending - Design of plate girder, intermediate and bearing stiffeners .

**MODULE V ROOF TRUSSES 9**

Types of roof trusses - components - load combinations - IS 875 codal provisions - Design wind speed, wind pressure and wind loads - Wind pressure calculation on buildings in hilly terrain - Design of purlin for load combinations - design load on roof truss.

**L – 45:TOTAL HOURS – 45**

**TEXTBOOKS:**

1. Bhavikatti,S.S., "Design of Steel Structures", I.K International Publishing House Pvt. Ltd., New Delhi, 2010.
2. Shah, V.L. and Veena Gore, "Limit State Design of Steel Structures", Structures Publications, Pune, 2010.
3. Duggal, S.K., “Design of Steel Structures", Tata McGraw-Hill Publishers, New Delhi, 2009.

**REFERENCES:**

1. Subramanian,N., "Steel Structures - Design and Practice", Oxford University Press, Chennai, 2011.
2. Haji Sheik Mohammed, M.S.,”Lecture Notes on Design of Steel Structures", B.S. Abdur Rahman University, Chennai, 2011.
3. IS 800 - Indian Standard general construction in steel - Code of Practice, Bureau of Indian Standards, New Delhi.

**COURSE OUTCOMES:**

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

**CO1:** determine the composition, properties and sections used for steel structures and design appropriate connections between structural members as per IS codal provisions.

**CO2:** identify the different failure modes in tension members and select the most suitable section shape and size for the design of tension members.

**CO3:** determine the lateral buckling length of compression members and design the column & column bases with suitable connection details.

**CO4:** analyse and design the beams, built-up sections and plate girders in accordance to the Indian standards.

**CO5:** estimate the wind pressure as per Indian standards, analyze and design the members of a steel roof truss under gravity and wind loads.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
19th AC held on 15.07.2023

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

Statement : The sustainable design of steel structures results in the development of durable and resilient infrastructure.

| CED 3202 | CONSTRUCTION MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9&11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objective of the course is to impart knowledge on

**COB1:** planning of construction projects.

**COB2:** scheduling of activities using network diagrams.

**COB3:** resource planning for a project.

**COB4:** cost control and cash flow for a project.

**COB5:** quality control and safety during construction.

**MODUE I CONSTRUCTION PLANNING 9**

Basic concepts in the development of construction plans - Choice of technology and construction method- plan development process - Activities - estimating resource requirements for work activities - estimating activity durations - work breakdown structure - Coding systems - defining precedence relationships among activities - Tools for scheduling - Gant chart Development of project network AOA and AON diagrams - Infrastructure projects.

**MODULE II SCHEDULING PROCEDURES AND TECHNIQUES 9**

scheduling techniques- CPM - Earliest and Latest times - different types of floats - significance- calculation of critical path method-PERT - terms and definitions - network and solving problems using PERT - standard deviation and probability calculation in PERT.

**MODULE III RESOURCE PLANNING 9**

Materials: Inventory control - terms and definitions - types of inventory -EOQ – ABC Analysis - reasons for maintain inventory - different tools for inventory.

Equipment: Classification of major construction equipment- planning and selecting of equipment- Equipment productivity – Fleet management.

Labor: labor schedule - leveling resources - resource leveling strategies-scheduling with resource constraints.

**MODULE IV COST CONTROL MONITORING 9**

Cost – Types of Cost - crashing and time/cost tradeoffs - Control of project - Cost control problem-Project budget- Earned Value Analysis – Terms & Definitions - Schedule and budget updates- Calculating Contract Cash flow – Minimizing Contractor negative cash flow

**MODULE V QUALITY AND SAFETY MANAGEMENT 9**

Quality – Total quality management – Quality policy – Quality circle manual – standard operating procedures - quality checklists – statistical quality control – codal provisions – IS 456 - Accidents; their causes and effects, costs of accidents, Safety concerns in construction – safety policy – manual –standard – Safety Meetings – Personal Protection Equipment

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Baldwin. A & D. Bordoli, “A Handbook for Construction planning and scheduling”, Wiley publications, 2014
2. Chitkara, K.K. “Construction Project Management: Planning, Scheduling and Control”, New Delhi, Tata McGraw-Hill Publishing Company, 2019.
3. Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pittsburgh, 2000
4. Mubarak.S, “Construction Project Scheduling and Control”, John Wiley publications, 2019.

**REFERENCES:**

1. IS456, “Code of Practice – plain & reinforced concrete, Bureau of Indian standards, New Delhi.
2. Eppinger. S.D & T.R. Browning, “Design Structure Matrix Methods and Applications”, MIT Press, 2012.
3. James P. Lewis, “Project Planning, Scheduling, and Control: The Ultimate Hands-On Guide to Bringing Projects in On Time and On Budget”, Mc Grew Hill, New York, 2010.

**COURSE OUTCOMES:**

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

**CO1:** Create WBS and precedence relationships among activities

**CO2:** perform the CPM and PERT analysis method of scheduling

**CO3:** select the material and equipment resources for optimization

**CO4:** solve the cash flow problem and financial accounting systems on site

**CO5:** apply statistical quality control techniques and list the safety and quality control checklist on site

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

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

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

The holistic understanding of planning and scheduling of time cost and resources to avoid unnecessary wastage of resources and sustainable development.

| GED 3201 | REASONING AND APTITUDE FOR ENGINEERS | L | T | P | C |
|---|---|---|---|---|---|
| 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

**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. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009

4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017

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

**COURSE OUTCOMES:**

**CO1:**Demonstrate their reading ability

**CO2:**Exhibit their vocabulary and writing skills

**CO3:**Apply the problem-solving techniques

**CO4:**Gain confidence mentally and be successful in their career

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

**Academic Council:**
17th AC held on 15.07.2021

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

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

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

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

**SEMESTER VII**

| **CED 4101** | **SMART INFRASTRUCTURE** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**SDG: 11**

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:** to gain knowledge about smart urban development

**COB2:** to understand the smart infrastructure enablers

**COB3:**to apply smart technologies across the spectrum of infrastructure.

**COB4: t**o understand IOT for smart infrastructure

**COB5:** to understand the governance of smart infrastructure

**MODULE I SMART INFRASTRUCTURE - STANDARDS 8**

Understanding – Dimensions – Global experience, Global standards and performance bench marks, Practice codes. India 100 smart cities policy and mission, Smart infrastructure planning and development.

**MODULE II SMART INFRASTRUCTURE ENABLERS 9**

Instrumentation and control – connectivity- interoperability- security and privacy - data management - computing resources and analytics - Process of building a smart infrastructure roadmap.

**MODULE III SMART INFRASTRUCTURE 11**

Built environment – Energy – Telecommunications – Transportation - Health and human services - Water and wastewater - Public safety and Payments. – case study in India and world wide.

**MODULE IV IOT FOR SMART INFRASTRUCTURE 9**

ICT initiatives in Indian Cities - economic development - smart city technologies: inventory and standardization- potential of commercialization and emerging trends - e-democracy and e-governance - Case studies in India .

**MODULE V GOVERNANCE OF SMART INFRASTRUCTURE 8**

Role of law and technology, administration and organization, industry and corporate, Communities and people in building smart infrastructure and smart communities

**L – ; TOTAL HOURS – 45**

**TEXT BOOKS:**


1. Chan.D., Defining smart cities seminar : A Guiding Frame work. 2016
2. Townsend, A.M., “Smart Cities: Big data, Civic Hackers, and the quest for new ww norton & company, 2013.
3. Goldsmith.S & Crawford.S “the responsive city: engaging communities through data – smart governance” John Wiley & sons, 2014


**REFERENCES:**

Sample :


1. Brkovic, M. B., ‘Planning in the Information Age: Opportunities and Challenges of e- Planning, CORP, 2004
2. Intelligent Community forum, ‘Innovation and Employment in the Intelligent Community”, Intelligent Community forum, 2012
3. Komakech, D., ‘Achieving More Intelligent Cities”, Municipal Engineer, 2005. 4. Nohrstedt, ‘Digital Planning : Integrating New Information and Communication Technologies in Urban Planning”, www.oruse.com, 2002.
4. Peng, L., Tao, Z., ‘Establish the Intelligent City System and Realize its Level Analysis”, Telematics and Informatics, 2010.


**COURSE OUTCOMES:**

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

**CO1:** explore and understand the fundamental concepts of smart infrastructure

**CO2:** explain the components of smart cities and dwell into their technological advancement

**CO3:** enumerate the design and implementation of responsive smart infrastructure.

**CO4:** initiate the ICT in smart infrastructure for economic development.

**CO5:** explain the importance of different linkages and their roles including government, urban planners, city developers and communities.

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO1 1 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | M | L | L | - | - | - | M | M | M | - | - | - | M |
| CO2 | H | H | L | - | M | M | M | M | - | M | M | H | - | H | |
| CO3 | L | H | H | H | H | - | H | M | - | M | M | H | M | M | H |
| CO4 | M | - | L | M | L | - | - | - | - | M | M | | M | M | |
| CO5 | M | - | L | - | H | H | - | H | - H | H | L | L | M | M | H |

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

SDG No. & Short Description

SDG 11 : Sustainable Cities and Communities Statement : The holistic understanding of smart Infrastructure and its components leads to construction of Sustainable cities and communities.

| CED 4102 | INTERNSHIP - II | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 &11 | | 0 | 0 | 2 | 1 |

**GENERAL GUIDELINES:**

1. The course carries one credit for two weeks of Internship with a minimum duration of 80 hrs.
2. The students shall pursue Internship in Industry (Government departments / Private Constructions Companies / Private consulting firms etc.,) / Research organizations (SERC, PMI, CBRI etc.,) / Eminent Academic Institutions (IIT/ NIT/ Government or Private Universities) based on their field of interest.
3. The students shall obtain permission from Head of the Department / Dean of School by submitting an 'induction to internship certificate' provided by the firm (as per the given template) before commencement of Internship.
4. The students shall submit a report at the end of internship elaborating knowledge acquired during the internship period.
5. The student shall also submit the internship completion certificate issued by the Industry/ Research Organization / Academic Institution along with confidential feedback provided by them (in a specified format) in a sealed cover to the Class Advisor.
6. A committee comprising of faculty members constituted by the Head of the Department / Dean of School shall evaluate the Internship report, and also conduct an oral examination.
7. The weightage of marks for internship report and viva-voce examination are 60 % and 40% respectively.
8. Based on the assessment of internship report, and performance of the students in viva-voce examination, relative grade is awarded.

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 18th BoS of CE held on 05.04.2023 | 20th Academic council held on 13.4.2023 |

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : The industry internship shall impart the students the need for sustainable and resilient infrastructure, in the real time context, with respect to all aspects of civil engineering

## SEMESTER VIII

| CED 4201 | Project Work | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 18 | 9 |

**OBJECTIVE:** The Project aims to provide opportunity for the students to exhibit their capacity in executing a project work as a team which deals with analysis / design /experimental works related to civil engineering

**GENERAL GUIDELINES:**

- The students will be given opportunity to select a project topic of his/her interest and advised to approach the faculty member with expertise in that field to appraise the project and get his/her willingness to guide the project.
- The information related to proposed topic and the faculty member willing to act as guide shall be informed to the course co-ordinator within the stipulated time.
- The project co-ordinator in consultation with Professor in-charge and Head of the Department shall give initial approval.
- In the project, students are expected to identify a suitable topic, draw the need for present study and scope of the investigation, review at least 10 journal papers in the related field, formulate the experimental / analytical methodology and conduct preliminary studies.
- Detailed experimental investigation / in-depth analytical study / fabrication of equipment have to be performed in line with the scope of investigation.
- The students are expected to analyse the obtained results and discuss the same in an elaborate manner by preparing necessary charts / tables / curves to get an inference.
- The important conclusions need to be drawn and scope for further research also to be highlighted.
- The project co-ordinator shall arrange to conduct three reviews to ascertain the progress of the work and award the marks based on the performance
- At the end, students should submit a report covering the various aspects of Project work. The typical components of the project report are Introduction, Need for present study, Scope of the Investigation, Literature review, Methodology / Experimental investigation / development of software

packages, Results & discussion of experimental and analytical work, Conclusions, References etc.

- The project co-ordinator shall arrange for final viva-voce examination to ascertain the overall performance in Project work.

**OUTCOME**: At the end of the course, the students will be able to

- apply their knowledge base in civil engineering
- utilize the creative ability and inference capability to solve real world problems.
- apply the practical knowledge while solving real time problems
- prepare an appropriate documentation

**PROFESSIONAL ELECTIVES**
**SPECILAIZATION I: STRUCTURAL ENGINEERING**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **CEDX 01** | **ADVANCED DESIGN OF RC AND MASONRY STRUCTURES** | **3** | **0** | **0** | **3** |
| **SDG: 9 & 11** | | | | | |

**COURSE OBJECTIVES:**

The objectives of the course are :

**COB1:** to gain knowledge on the behaviour of flat slab and design the flat slab as per IS codal provisions.

**COB2:** to impart knowledge to students about the concepts of the yield line analysis for the design of the slabs of different profiles.

**COB3**: to design the RC water tanks square, rectangular and circular shape.

**COB4:** to inculcate the behaviour and design of cantilever & counterfort retaining walls.

**COB5:** to understand the concepts of structural behaviour and design the masonry structures.

**MODULE I DESIGN OF FLAT SLAB 9**

Types of flat slabs – Direct design method - Equivalent frame method – Shear in flat slab – Design of flat slab

**MODULE II YIELD LINE THEORY OF SLABS 9**

Introduction to yield line theory – Yield line patterns – Characteristic features of yield lines – Load on slabs – Yield line analysis by virtual work method to square, rectangular, circular and triangular slabs.

**MODULE III DESIGN OF RC WATER TANKS 9**

Design of square, rectangular and circular shape RC water tanks resting on ground – Design of Underground Water Tanks – Design of Overhead water tank and Intze type Tanks – Design of Staging and Foundations.

**MODULE IV DESIGN OF RETAINING WALLS 9**

Types of Retaining walls and their behaviour – Theories of Earth Pressure and Stability Requirements - Proportioning and Design of Cantilever and Counterfort Retaining Walls.

**MODULE V DESIGN OF MASONRY STRUCTURES 9**

Masonry Materials and Properties - Strength and Behaviour of Masonry structures - Basics of reinforced masonry design – Resistance to axial load, bending, shear – Design of reinforced masonry walls, masonry beams, masonry columns

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Raju, N. K., “Advanced Reinforced Concrete Design”, CBS Publishers and Distributors, 3rd Edition, New Delhi, 2016.
2. Bhavikatti, S.S., “Advance R.C.C. Design (R.C.C. Volume-II)”, New Age International, New Delhi, 2008.
3. Subramanian, N., “Design of Reinforced Concrete Structures”, Oxford University Press, New Delhi, 2013.
4. Pillai, S.U., and Wight, R.G., “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2016.
5. Hendry, A.W., Sinha, B.P., and Davies, S.R., “Design of Masonry Structures”, CRC Press, New York, 2017.

**REFERENCES:**

1. Krishna Raju, N., “Design of RC Structures”, CBS Publishers and Distributors, New Delhi, 2008..
2. Ghosh Karuna Moy, “Practical Design of Reinforced Concrete Structures”, PHI Learning Pvt. Ltd., New Delhi, 2010.
3. Bandyopadhyay. J.N., "Design of Concrete Structures”, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.

**COURSE OUTCOMES:**

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

**CO1:** employ the Indian code of practice for the design of flat slab.

**CO2:** establish the appropriate approaches to design the slabs by yield line theory.

**CO3:** categorise the various types of water tanks and design the RC water tanks as per standards.

**CO4:** classify and design the various types of retaining walls.

**CO5:** elucidate the behaviour of masonry structures and design the masonry walls, beams & columns.

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | L | H | | | | | | | | | | M | H | |
| **CO2** | H | L | H | | | | | | | | | | M | H | |
| **CO3** | H | L | H | | | | | | | | | | M | H | |
| **CO4** | H | L | H | | | | | | | | | | M | H | |
| **CO5** | H | L | H | | | | | | | | | | M | H | |

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : High-performance design of concrete structures is imperative for safe and sustainable construction.

| CEDX 02 | ADVANCED DESIGN OF STEEL STRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**SDG: 9 & 11**

**COURSE OBJECTIVES:**

**The objectives of the course are :**

**COB1:** To introduce the concepts of plastic analysis of structures and design the beams & frames

**COB2:** To impart knowledge to students about the various types of roof trusses, the load acting on the trusses and design the roof trusses.

**COB3:** To understand the different components used in industrial buildings and provide knowledge on the design of tubular trusses and hoarding structures.

**COB4:** To provide in-depth knowledge in the design of gantry girder as per IS codal recommendations.

**COB5:** To give exposure to the basic concepts and design of cold formed structures.

**MODULE I PLASTIC ANALYSIS AND DESIGN 9**

Plastic analysis and design – Advantages and disadvantages – Plastic neutral axis – Shape factor - Plastic modulus – Plastic moment of resistance – Shape factor – Load factor – Plastic hinge – Collapse mechanisms – Theorems of plastic analysis – Analysis and Design of beams and Simple frames – Limitations – Plastic design Versus Elastic design. Design of castellated beam for bending and shear.

**MODULE II DESIGN OF ROOF TRUSSES 9**

Types of roof trusses - components - load combinations - IS 875:1987 codal provisions - Design wind speed, wind pressure and wind loads - Wind pressure calculation on buildings in hilly terrain - Design of purlin for load combinations - design load on roof truss.

**MODULE III DESIGN OF INDUSTRIAL STRUCTURES 9**

Industrial structures – Types – Elements of an industrial building – Loads on industrial structures - Braced industrial buildings – Un-braced industrial frames - Pre- Engineered Buildings– Advantages of PEB over conventional roof trusses - Tubular Trusses, joint details and tubular scaffoldings. Analysis and design of hoarding structures under dead live and wind loads condition as per IS 875 (Part3) & SP 64: 2001.

**MODULE IV DESIGN OF GANTRY GIRDERS 9**

Introduction - Loads acting on gantry girder – Effects of maximum load – Selection of gantry girder - Design of gantry girder.

**MODULE V DESIGN OF COLD-FORMED SECTIONS 9**

Cold form light gauge sections - Type of cross-section, stiffened, multiple stiffened and un-stiffened elements, Design of light gauge compression, tension and flexural members as per IS 802 (Part 1 to 3):1995.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Subramanian, N., “Steel Structures: Design and Practice”, Oxford University Press, New Delhi, 2011.
2. Bhavikatti, S.S, “Design of Steel Structures”, I.K. International Publishing House Pvt. Ltd., New Delhi, 2012.
3. Duggal, S.K, “Limit State Design of Steel Structures”, Tata McGraw Hill Education Private Ltd, New Delhi, 2014.
4. Ram Chandra, and Gehlot, V., “Limit State Design of Steel Structures”, Vol. I & II, Scientific Publishers, New Delhi, 2017.

**REFERENCES:**

1. Shiyekar, M.R., “Limit State Design in Structural Steel”, PHI Learning Pvt. Ltd., 2nd Edition, 2nd Edition 2013.
2. Teaching Resource for Structural Steel Design, INSDAG, Kolkatta, 2010.
3. Sairam, K.S., “Design of Steel Structures”, Pearson Education India, 2nd Edition, New Delhi, 2013.

**COURSE OUTCOMES:**

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

**CO1:** Describe the fundamental concepts of plastic analysis and design the structural steel beams and frames under the collapse load conditions.

**CO2:** Design the various components of roof trusses as per codal provisions.

**CO3:** Explain the various components adopted in industrial buildings and design the tubular trusses and hoarding structures for different load combinations.

**CO4:** Design the gantry girder for industrial buildings.

**CO5:** Discuss the different types of cross-sections of cold formed sections and design the compression, tension and flexural members as per the Indian standards.

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

The statement: Steel structures offers green and highly sustainable construction practices for society.

| CEDX 03 | DESIGN OF BRIDGE STRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**SDG: 9 & 11**

**COURSE OBJECTIVES:**

**The objectives of the course are :**

**COB1**: To introduce the various components of bridge structures, site investigations for a bridge and different types of load acting on the bridge structure as per the standards.

**COB2:** To impart knowledge to students about the analysis and design of slab, pipe and box culverts.

**COB3**: To provide in-depth knowledge in the design of different types of RC bridge structures.

**COB4:** To inculcate the principles involved in the design of steel and prestressed concrete bridges.

**COB5:** To impart knowledge and understand the various functions of bearings, substructure and foundation of a bridge.

**MODULE I** **FUNDAMENTALS OF BRIDGE ENGINEERING & IRC LOADS** **9**

Components of a bridge structure - Inspection and site investigations for a bridge - Determination of linear waterway, design discharge and scour depth - Economical span - Types and choice of bridges - IRC loading for road bridges - General design considerations.

**MODULE II** **DESIGN OF CULVERTS** **9**

Slab Culvert - General Features, Analysis and Design - Pipe culverts - General features - Classification - Analysis and design of Pipe Culvert - Box culverts – General features - Analysis and design of Box culverts

**MODULE III** **DESIGN OF RC BRIDGES** **9**

Design of Tee beam bridge – Design of the main girder and cross girders, Single span rigid frame bridge (barrel or slab type only), Continuous girder bridges and Balanced cantilever RC bridges – Design of articulations - Concrete Segmental Bridges – Design and Construction.

**MODULE IV** **DESIGN OF STEEL & PSC BRIDGES** **9**

Design principles of plate girder bridges, IRC specifications - Types of prestressed concrete bridges - Types of prestressing – Pre-tensioning and Post-tensioning - Design principles of post-tensioned concrete bridges.

**MODULE V BEARING, SUBSTRUCTURE & FOUNDATIONS** 9

Bearings – types, functions – simple problems – Substructures – Pier and Abutment – Materials, Design - Stability requirements – Foundations – types, pile foundation, well foundation, Caissons – pneumatic and box types.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Raju, N.K., “Design of Bridges”, Oxford & IBH Publishing, 5th Edition, New Delhi, 2018.
2. Jayaram Jagadeesh, T.R., “Design of Bridge Structures”, PHI Learning, New Delhi, 2020.
3. Ponnuswamy, “Bridge Engineering”, Tata McGraw-Hill Education, New Delhi, 2008.
4. Victor, D.J., “Essentials of Bridge Engineering”, Oxford and IBH Publishing, New Delhi, 2017.

**REFERENCES:**

1. Raina, V.K., “Concrete Bridge Practice - Analysis, Design and Economics", Shroff Publishers, 3rd Edition, New Delhi, 2004.
2. Chen, W.F., and Duan, L., “Bridge Engineering Handbook: Volume 1”, CRC Press, Florida, 2019.
3. Bindra, S.P., “Principles and Practice of Bridge Engineering”, Dhanpat Rai Publications (P) Ltd., 7th Edition, New Delhi, 2005.
4. Huang, D., and Hu, B., “Concrete Segmental Bridges: Theory, Design, and Construction to AASHTO LRFD Specifications”, CRC Press, New York, 2020.

**COURSE OUTCOMES:**

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

**CO1:** Identify a suitable site, classify different types of bridges and calculate loadings as per the standards.

**CO2:** Analyze and Design the various types of culverts.

**CO3:** Recognize and design the various components in different types of reinforced concrete bridges

**CO4:** Explain the principles involved in the design of plate girder bridges and prestressed concrete bridges as per IRC specifications.

**CO5:** Describe the types of bearings, piers & abutments and adopt suitable foundations for bridge structures.

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

The statement: It is important to create a safe and high-performance, sustainable design bridge structures for the future generation

| CEDX 04 | EARTHQUAKE RESISTANT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 & 11 | DESIGN OF STRUCTURES | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To provide a basic understanding of the earthquake phenomena and its measurements.

**COB2:** To impart knowledge on the conceptual design due to seismic action.

**COB3:** To provide an in-depth understanding of the seismic method of analysis and seismic performance of structures.

**COB4:** To give exposure to the various codal provisions of the seismic-resistant of structures.

**COB5:** To provide insight knowledge on the seismic retrofitting techniques of structures.

**MODULE I ELEMENTS OF ENGINEERING SEISMOLOGY 9**

Elements of engineering seismology - characteristics of earthquake-earthquake size- plate tectonics – types of seismic waves – terms associated with earthquakes -Magnitude/Intensity of an earthquake-scales-Energy released - Earthquake measuring instruments- Seismoscope – seismographs, accelerograph - effect of earthquake - earthquake history-seismicity zone of India.

**MODULE II SEISMIC DESIGN PHILOSOPHY 9**

Earthquake load on simple buildings – Simplicity and Symmetry – Plan configuration – Horizontal and Vertical Members - Pounding effects – Stiffness and Strength – Flexible Building and Rigid Building Systems-Torsion in structural system - Lateral load resisting structural systems.

**MODULE III EARTHQUAKE RESISTANT DESIGN OF STRUCTURES 9**

Requirements for Seismic Design – Framed buildings - Masonry Buildings - Structural Walls and Non-Structural Elements - Performance of structures under past earthquakes- lessons learnt from past earthquakes - Basic Load Combinations – Sesimic Method of Analysis - Design earthquake loads – equivalent static force procedure as per IS 1893 – 2016.

**MODULE IV DUCTILE DETAILING OF STRUCTURAL MEMBERS 9**

Introduction to Indian Standard Codes -IS:4326 and IS13920- detailing for seismic resistance of beam-column joints, beams, columns and footings.

**MODULE V SEISMIC RETROFITTING OF STRUCTURES 9**

Base isolation – Seismic dampers – GOI guidelines on Seismic Retrofitting of Deficient Buildings and Structures – Case study.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Duggal, S.K., "Earthquake Resistant Design of Structures", Oxford University Press, 2nd Edition, New Delhi, 2013.
2. Pankaj Agrawal, Manish Shrikhande, "Earthquake Resistant Design of Structures", PHI Learning Pvt. Ltd., New Delhi, 2006.
3. Muhammad Hadi and Mehmet Eren Uz, "Earthquake Resistant Design of Buildings", CRC Press, Florida, 2017.

**REFERENCES:**

1. Chopra, A.K., "Dynamics of Structures - Theory and Applications to Earthquake Engineering" Pearson, 5th Edition, London, 2017.
2. Paulay, T., and Priestly, M.N.J., "Seismic Design of Reinforced Concrete and Masonry Building", John Wiley and Sons, New York, 1992.
3. Mohiuddin Ali Khan, "Earthquake-Resistant Structures: Design, Build, and Retrofit", Butterworth-Heinemann, London, 2013.
4. IS:4326 "Earthquake Resistant Design And Construction Of Buildings — Code Of Practice", Bureau of Indian Standards, New Delhi
5. IS13920 "Ductile Detailing Of Reinforced Concrete Structures Subjected to Seismic Forces - Code Of Practice" Bureau of Indian Standards, New Delhi.

**COURSE OUTCOMES:**

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

**CO1:** Explain the types of seismic waves, measure the magnitude of the earthquake and recognize the characteristics of the earthquake.

**CO2:**Describe the effect of building configuration under seismic motion.

**CO3:** Perform the seismic analysis of structures using various methods and describe the performance of structures.

**CO4:** Critically use the various codal provisions for the earthquake resistant design of structures.

**CO5:** Identify the seismic damage evaluation of structures and suggest suitable retrofitting techniques.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : Promote building structures with higher seismic performance, which contribute to design a long-lasting, sustainable and resilient society

| CEDX 05 | INTRODUCTION TO FINITE ELEMENT ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**SDG: 9 & 11**

**COURSE OBJECTIVES:**

The objectives of the course are :

**COB1:** To introduce the fundamental concepts of the finite element method.

**COB2:**To impart knowledge of the matrix techniques and concepts of one and two-dimensional elements.

**COB3:** To understand the concepts of higher-order elements.

**COB4:** To provide in-depth knowledge on mesh refinement and error evaluation for various elements.

**COB5:** To provide knowledge of the concepts of non-linear structural engineering problems.

**MODULE I FUNDAMENTAL CONCEPTS** **9**

Stresses and equilibrium – Boundary conditions – strain displacement relations – stress- strain relations – potential energy and equilibrium – weighted integral and weak formulation –variational approach.

**MODULE II ONE AND TWO DIMENSIONAL FORMULATION** **9**

Concept of an element - Derivation of Elemental Equations – coordinates and shapes functions – Assembly of global stiffness matrix and global load vector – constant strain triangle – Isoparametric elements - Lagrange and serendipity elements

**MODULE III HIGHER-ORDER ELEMENTS** **9**

Triangular Elements, Rectangular Elements, Three-Dimensional Elements, AxiSymmetric Elements.

**MODULE IV MESHING AND SOLUTION PROBLEMS** **9**

Pre and post-processor interpretations - p and h methods of refinement - ill-conditioned elements - discretization errors – patch test - auto and adaptive mesh generation techniques - error evaluation.

**MODULE V NON - LINEAR PROBLEMS** **9**

Material and Geometric Non-linearity - Consistent System Matrices - Dynamic Condensation - Eigen Value Extraction - Modal methods.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Kim, N.H., Sankar, B.V., and Kumar, A.V., "Introduction to Finite Element Analysis and Design", John Wiley & Sons, 2nd Edition, New York, 2018.
2. Seshu, P., "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
3. Cook, R.D., Malkus, D.S., Plesha, M.E., and Witt, R.J., "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, 4th Edition, New York, 2007.
4. Hutton, D,V., "Fundamentals of Finite Element Analysis", Tata McGrawHill Edition, Noida, 2005.

**REFERENCES:**

1. Tirupathi R. Chandrupatla, "Introduction to Finite Elements in Engineering", Prentice Hall of India, 4th Edition, New Delhi, 2014.
2. Krishnamoorthy,C.S., "Finite Element Analysis Theory and Programming", Tata McGraw Hill Education Private Limited, 2nd Edition, New Delhi, 2011.
3. Reddy, J.N, "An Introduction to the Finite Element Method", McGraw Hill, 3rd Edition, New York, 2006.

**COURSE OUTCOMES:**

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

**CO1:** Solve the boundary value problems using the approximate method.

**CO2:** Derive the elemental equations and shape function for one and two-dimensional elements.

**CO3:** Generate the isoparametric functions for various elements.

**CO4:** Perform the mesh refinement and error evaluation for various elements.

**CO5:** Describe the various concepts adopted for non-linear problems in structural engineering.

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : Analysis of structures is more essential to ensure safe and sustainable building.

**CEDX 06** **STRUCTURAL DYNAMICS** **L T P C**

**3 0 0 3**

**SDG: 9 & 11**

**COURSE OBJECTIVES:**

The objectives of the course are :

**COB1:** To impart knowledge on the theory of vibrations and vibration parameters to analyse the dynamic forces.

**COB2:** To impart knowledge on the formulation of equations of motion for a single degree of freedom systems.

**COB3:** To provide an in-depth understanding of the establishment of a multi-degree of freedom systems.

**COB4:** To impart knowledge on the formulation of equations of motion for continuous systems

**COB5:** To provide insight knowledge on the numerical evaluation of the dynamic response of systems.

**MODULE I** **INTRODUCTION TO STRUCTURAL DYNAMICS** **9**

Equation of Motion - Mass, Stiffness, and Damping - Ground Excitation and Rotational Motion.

**MODULE II** **SINGLE DEGREE OF FREEDOM SYSTEMS** **9**

Formulation of equations of motion by different methods, Free and forced vibrations, Effect of damping.

**MODULE III** **MULTI DEGREE OF FREEDOM SYSTEMS** **9**

Formulation of structure-property matrices, Eigen value problems, Mode shapes and orthonormality of modes, Effect of damping.

**MODULE IV** **CONTINUOUS SYSTEMS** **9**

Modeling - free and forced vibration of bars and beams. Rayleigh-Ritz method - Formulation using Conservation of Energy - Formulation using Virtual Work.

**MODULE V** **NUMERICAL EVALUATION OF DYNAMIC RESPONSE** **9**

Wilson Theta method, Newmark beta method, step-by-step numerical integration techniques.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Chopra, A.K., “Dynamics of Structures - Theory and Applications to Earthquake Engineering” Pearson, 5th Edition, London, 2017.
2. Mukhopadhyay, M., “Structural Dynamics: Vibrations and Systems”, Springer Nature, London, 2021.
3. Mario Paz and Kim, Y.H., “Structural Dynamics: Theory and Computation”, Springer International Publishing, 6th Edition, New York, 2018.

**REFERENCES:**

1. Clough R.W, “Dynamics of Structures”, McGrawHill International Edition, 2nd Edition, London, 1995.
2. Kappos, A., “Dynamic Loading and Design of Structures”, CRC Press, New York, 2001.
3. Craig, R.R., and Kurdila, A.J., “Fundamentals of Structural Dynamics”, John Wiley and Sons, 2nd Edition, New York, 2011.

**COURSE OUTCOMES:**

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

**CO1:** Formulate the equation of motion with mass, spring and damper.

**CO2:** Develop the equation of motion for a single degree of freedom system.

**CO3:** Analyse the dynamic response of multi-degree of freedom systems.

**CO4:** Analyse the free and forced vibration of bars and beams.

**CO5:** Find the dynamic response of structures using a numerical integration procedure.

**Board of Studies (BoS) :** 15th BoS of CE held on 23.06.2021

**Academic Council:** 17th AC held on 15.07.2021

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

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : Integrated approach for the safe, sustainable and resilient structural design to combat various dynamic forces viz., earthquake and wind etc.,

| CEDX07 | PRESTRESSED CONCRETE STRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**SDG: 9 & 11**

**COURSE OBJECTIVES:**

**The objectives of the course are :**

**COB1:** To inculcate the basics of prestressing techniques, materials used for prestressed concrete (PSC) and analyse the sections using different concepts.

**COB2:** To impart knowledge on the significance of losses of prestress and deflection of prestressed concrete members.

**COB3:** To understand the behaviour and design of the prestressed concrete members under flexure & shear with the anchorage zone reinforcement.

**COB4:** To give exposure to prestressed concrete in composite construction.

**COB5:** To provide sufficient knowledge on the various prestressed concrete special structures viz., circular PSC pipes, water tanks, poles and piles.

**MODULE I BASIC CONCEPTS & ANALYSIS OF STRESSES OF PSC SECTIONS** **9**

Concept of Prestressing – Advantages of prestressed concrete – Materials required – Systems and methods of prestressing – Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons.

**MODULE II LOSSES OF PRESTRESS AND DEFLECTION OF PSC MEMBERS** **9**

Losses of prestress for pre-tensioned and post-tensioned members – Deflections of prestressed concrete members - Factors influencing deflections – Effect on tendon profile on deflections - Short term and long term deflections as per codal provisions.

**MODULE III DESIGN OF PSC MEMBERS** **9**

Flexural strength – Strain compatibility method - Simplified procedures as per codes – Shear and Principal Stresses – Ultimate shear resistance of PSC members - Design of shear reinforcement – Design of PSC sections for flexure - Transmission of prestress in pre-tensioned members – Bond and transmission length – Anchorage zone stresses - Stress distribution - Design of anchorage zone reinforcement.

**MODULE IV COMPOSITE CONSTRUCTION** **9**

Analysis of stresses for composite sections – Differential Shrinkage - Estimation of deflections – Flexural and shear strength of composite members.

**MODULE V DESIGN OF PSC SPECIAL STRUCTURES 9**

Concept of circular prestressing – Analysis and Design of prestressed concrete pipes, Design of PSC water tanks – Design of PSC poles and piles.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Krishna Raju, N., "Prestressed Concrete", McGraw-Hill Education, 6th Edition, New Delhi, 2018.
2. Muthu K. U., Ibrahim Azmi, Janardhana Maganti and Vijayanand M., "Prestressed Concrete", PHI Learning Pvt. Ltd., New Delhi, 2016.
3. Praveen Nagarajan, "Prestressed Concrete Structures", Pearson Education India, New Delhi, 2013.
4. Hurst, M.K., "Prestressed Concrete Design", CRC Press, 2nd Edition, New York, 2017.

**REFERENCES:**

1. Dayaratnam, P., "Prestressed Concrete Structures", CBS Publishers & Distributors, 6th Edition, New Delhi, 2018.
2. Rajagopal, N., "Prestressed Concrete", 2nd Edition, Narosa Publications, New Delhi, 2007.
3. Dolan, C.W., and (Trey) Hamilton, H. R., "Prestressed Concrete: Building, Design, and Construction", Springer, 2018.
4. Lin, T,Y., "Design of Prestressed Concrete Structures", John Wiley & Sons, 2013.

**COURSE OUTCOMES:**

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

**CO1:** Describe the properties of constituents in prestressed concrete and apply the principles & procedures for analyzing the prestressed concrete structures.

**CO2:** Evaluate the short & long term losses and deflection for PSC members

**CO3:** Establish the appropriate approaches to calculate the design strength for flexure & shear and enlighten the effects of transfer of prestress in the application of the designing of PSC members.

**CO4:** Analyse and design the PSC composite structures.

**CO5:** Apply the principles and techniques for the design of circular prestressing and demonstrate the various structures such as poles, piles and piles.

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

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

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

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : Efficient prestressed concrete design is a prerequisite of safe, resilient and sustainable building construction.

| CEDX 08 | PREFABRICATED | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 & 11 | STRUCTURES | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:** The objectives of the course are :

**COB1:** To understand the concepts of the principles of prefabricated structures.

**COB2:** To understand the design concepts of various prefabricated components.

**COB3:** To familiarize with the various manufacturing methods and erection techniques of the structures.

**COB4:** To give exposure to the applications of the precast unit for various structures.

**COB5:** To provide sufficient knowledge for the introduction of pre-engineered buildings**.**

**MODULE I PRINCIPLES OF PREFABRICATION 9**

Comparison with monolithic construction – Types of prefabrication – site and plant prefabrication - Economy of prefabrication – Modular coordination – Standardization – Planning for Components of prefabricated structures – Disuniting of structures – Design of simple rectangular beams and I beams – Handling and erection stresses – Elimination of erection stresses – Beams, columns – Symmetrical frames.

**MODULE II PREFABRICATED COMPONENTS 9**

Roof and floor panels, ribbed floor panels – wall panels – footings – Joints for different structural Connections – Effective sealing of joints for waterproofing – Provisions for nonstructural fastenings – Expansion joints in precast construction-Designing and detailing of the precast unit for factory structures – Purlins, Principal rafters, roof trusses, lattice girders, gable frames – Single span single storeyed frames – Single storeyed buildings –slabs, beams and columns

**MODULE III PRODUCTION AND HOISTING TECHNOLOGY 9**

Choice of production setup – Manufacturing methods – Stationary and mobile production – Planning of production setup – Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening. Equipments for hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns – Vacuum lifting pads.

**MODULE IV APPLICATIONS OF PREFABRICATED STRUCTURES** **9**

Designing and detailing of precast unit for factory structures– Purlins, Principal rafters, roof trusses, lattice girders, gable frames – Single span single-storeyed frames – Single storeyed buildings: slabs, beams and columns, Application of prestressed concrete in prefabrication.

**MODULE V PRE-ENGINEERED BUILDINGS** **9**

Introduction – Advantages – Pre Engineered Buildings Vs Conventional Steel Buildings – Design of Pre Engineered Buildings (PEB) – Applications.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Elliott, K.S., “Precast Concrete Structures”, CRC Press, Florida, 2nd Edition, 2019.
2. Knaack, U., Chung-Klatte, S., and Hasselbach,, “Prefabricated Systems : Principles of Construction”, De Gruyter, Berlin, 2012.
3. K.P.Jaya "Handbook on Precast Concrete Buildings",Indian Concrete Institute, 2016

**REFERENCES:**

1. Steinle, A., Bachmann, H., and Tillmann, M., “Precast Concrete Structures”, Wiley, 2019.
2. Lewicki, B., “Recent Case Studies in India : Pre-engineered Buildings, Space Frames”, Institute for Steel Development & Growth, India, 2016.
3. K.P.Jaya, “Connections in Precast Structures”, Anna University, CSIR-CBRI Roorkee, 2016

**COURSE OUTCOMES:**

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

**CO1:** Describe the design principles adopted for the construction of prefabricated structures.

**CO2:** Elucidate the various components utilized for prefabricated structures.

**CO3:** Explicate the manufacturing methods and erection techniques of prefabricated structures.

**CO4:** Apply the design principles involved in the precast construction of the factory and single-storeyed structures.

**CO5:** Elaborate on the concepts of pre-engineered buildings for construction.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

SDG – 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: It is necessary to make the building safer, efficient, affordable and sustainable structures for the future generation.

| CEDX 09 | INTRODUCTION TO STEEL-CONCRETE COMPOSITE STRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 & 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To introduce and understand the basic concepts of steel-concrete composite construction.

**COB2:** To understand the fundamentals of various composite members

**COB3:** To familiarise with the various design concepts of connections for constructing the composite structural members.

**COB4:** To understand the basic concepts and behaviour of composite box girder bridges

**COB5:** To give exposure to the various case studies of steel-concrete composite construction in buildings

**MODULE I CONCEPTS OF STEEL-CONCRETE COMPOSITE CONSTRUCTION** **9**

Introduction to steel-concrete composite construction - theory of composite structures - introduction to steel-concrete - steel sandwich construction.

**MODULE II COMPOSITE MEMBERS** **9**

Behaviour of composite beams - columns - design concepts of composite beams - steel - concrete composite columns - design of composite trusses – Codal recommendations.

**MODULE III CONNECTIONS** **9**

Types of connections - design concepts of connections in the composite structures - shear connections - design of connections in composite trusses –Codal recommendations.

**MODULE IV COMPOSITE BOX GRIDER BRIDGERS** **9**

Introduction - behaviour of box girder bridges – Requirements of various componsnets of boxgirder bridges – Design concepts

**MODULE V CASE STUDIES** **9**

Case studies on steel-concrete composite construction in buildings – Failure modes of steel concrete composite members – Seismic behaviour of composite structures.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Johnson, R., “Composite Structures of Steel and Concrete: Beams, Slabs, Columns and Frames for Buildings”, John Wiley & Sons, 4th Edition, New York, 2018.
2. Brian Uy, Tao, Z., Lin-Hai Han and Lam, D., “Behaviour and Design of Composite Steel and Concrete Building Structures”, Taylor & Francis Group, Florida, 2020.
3. Liang, Q.Q., “Analysis and Design of Steel and Composite Structures”, CRC Press, Florida, 2018.

**REFERENCES:**

1. Richard Liew, J.Y., “Advances in Steel Concrete Composite Structures”, Research Publishing Service, Singapore, 2012.
2. David Collings, “Steel-concrete Composite Buildings: Designing with Eurocodes”, Thomas Telford, London, 2010.
3. Oehlers, D.J., and Bradford, M.A., “Composite Steel and Concrete Structural Members : Fundamental Behaviour”, Elsevier, London, 2013.

**COURSE OUTCOMES**:

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

**CO1:**Describe the composite structures using various theories.

**CO2:** Elucidate the behaviour and various design concepts of composite beams and columns.

**CO3:** Identify the suitable design for the connections in composite structures.

**CO4:** Apply the design principles for the construction of composite box girder bridges.

**CO5:** Explicate the steel-concrete composite construction in buildings through case studies.

**Board of Studies (BoS) :**

18th BoS of CE held on 05.04.2023

**Academic Council:**

20th Academic council held on 13.4.2023

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | L | L | H | M | | | L | | | | | | | H | |
| CO 2 | L | L | H | M | | | L | | | | | | | H | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 3** | L | L | H | M | | | L | | | | | | | H | |
| **CO 4** | L | L | H | M | | | L | | | | | | | H | |
| **CO 5** | L | L | H | M | | | 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.

SDG - 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : Promote sustainable and high-performance design of composite structures for a resilient society.

## SPECIALIZATION II : CONSTRUCTION TECHNOLOGY & MANAGEMENT

| | | | | | |
|---|---|---|---|---|---|
| **CEDX 16** | **ADVANCED CONCRETE TECHNOLOGY** | **L** | **T** | **P** | **C** |
| **SDG: 11** | | **3** | **0** | **0** | **3** |

**COURSE OBJECTIVES:**

The objective of the course is to impart adequate knowledge on

**COB1:** usage of mineral and chemical admixtures in concrete

**COB2:** mechanism of corrosion of steel rebar in concrete and protection methods

**COB3:** ready-mix concrete and self-compacting concrete

**COB4:** Non-destructive testing techniques to assess distress in concrete

**MODULE I MINERAL ADMIXTURES IN CONCRETE 9**

Supplementary cementitious materials : source, significance and overview. Flyash (different classes), silica fume, metakaoline, blast furnace slag, rice husk, titanium-di-oxide : properties – influence on fresh concrete, hardened concrete, microstructure and durability properties of concrete.

**MODULE II CHEMICAL ADMIXTURES IN CONCRETE 9**

Chemical admixtures for concrete: overview and significance. Water reducers / plasticizers : types, working mechanism, optimum dosage, influence on workability and application areas. Viscosity modifying agents, retarders, set accelerators, air entraining agents, damp-proofers, water repelling admixtures, shrinkage reducing admixtures and corrosion inhibitors : types, brief working mechanism and application areas.

**MODULE III CORROSION OF STEEL IN CONCRETE 9**

Mechanism of corrosion of steel in concrete – causes and influencing parameters –Carbonation, chloride attack, microbial induced corrosion and acid attack: deteriorating mechanism - consequences of corrosion in reinforced concrete and pre-stressed concrete structures - Corrosion protection methods: overview - Protective coating to steel rebars: fusion bonded epoxy coating, galvanization and cement polymer anticorrosive coating – sacrificial anode cathodic protection.

**MODULE IV READY MIX CONCRETE AND SELF COMPACTING CONCRETE 9**

Ready mix concrete: ingredients, mix proportion, mix design, manufacturing process and good construction practices. Self compacting concrete: ingredients, mix design as per EFNARC guidelines, workability requirements of SCC : Abrams cone, J-ring, V-funnel, L-box and U-box, good construction practices and application areas.

**MODULE V NON-DESTRUCTIVE TESTING TECHNIQUES 9**

Non-Destructive techniques for assessing distress in concrete members: overview – Rebound hammer test, ultrasonic pulse velocity test, concrete resistivity, cover-meter, concrete core test, half-cell potential test, tests for carbonation and chloride content.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Brooks, J.J. and Neville, A.M., “Concrete Technology”, Pearson, 2019.
2. Santhakumar, A.R., “Concrete Technology” Oxford, 2006.

**REFERENCES:**

1. Kumar Mehta. P. and Paulo J.M. Monteiro., “Concrete : Microstructure, Properties, and Materials” 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.
2. Shetty.M.S., and A.K. Jain “Concrete Technology (Theory and Practice)”, S. Chand and Company Ltd., 2010.
3. Gambhir.M.L., “Concrete Technology”, 5th Edition, Tata McGraw Hill Education, 2017
4. Nayak, N.V, and Jain, A.K, Handbook on Advanced Concrete Technology, Narosa Publishing House Pvt. Ltd., New Delhi, 2012.
5. Zongjin Li, “Advanced Concrete Technology”, John Wiley & Sons, 2011.
6. EFNARC (2002), “Specification and Guidelines for Self-compacting Concrete”, Surrey, UK.
7. John Broomfield, “Corrosion of Steel in Concrete – Understanding, Investigation and Repair”, CRC Press, London, 2003.
8. Malhotra, V.M. and Carino, N.J., “Handbook on Non-destructive Testing of Concrete”, CRC Press, 2004.

**COURSE OUTCOMES:**

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

**CO1:** understand the significance of addition of mineral admixtures in concrete for varied applications.

**CO2:** suggest the chemical admixtures for real time applications

**CO3:** describe the manufacturing of ready-mix concrete

**CO4:** perform mix design of self-compacting concrete as per EFRAC standards

**CO5:** describe mechanism of corrosion in concrete and suggest protection measures

**CO6:** describe NDT techniques to assess distress in concrete structures

**Board of Studies (BoS) :**
16th BoS of Civil held on 05.01.2022

**Academic Council:**
18th AC 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 | | | | | | H | | |
| CO2 | | | | | | | M | | | | | | H | | |
| CO3 | | | | | | | M | | | | | | M | | |
| CO4 | | | | | | | M | | | | M | | M | | |
| CO5 | | | | | H | | M | | | | M | | H | | |
| CO6 | | | | | H | | | | | M | M | | H | | |

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Designing of durable and sustainable concrete by using mineral admixtures, chemical admixtures in concrete, adopting corrosion protection methods during construction and monitoring well-being of structures using NDT techniques, make the human settlements safe and resilient and leads to sustainable development.

| CEDX 17 | WATERPROOFING OF CONCRETE | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | AND MASONRY STRUCTURES | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objective of the course is to impart adequate knowledge on

**COB1:** principles of waterproofing and designing envelope for concrete structures

**COB2:** below-grade waterproofing, designing and relevant materials

**COB3:** above-grade waterproofing, designing procedures and relevant materials

**COB4:** waterproofing problems in residential buildings and protection systems

**COB5:** remedial waterproofing of distressed concrete structures

**MODULE I PRINCIPLES OF WATERPROOFING 9**

Introduction to waterproofing and envelope design – water sources – designing to prevent leakages in concrete structures. Basic envelope design – most important waterproofing principles – preventing water infiltration – beyond envelope waterproofing.

**MODULE II BELOW-GRADE WATERPROOFING 9**

Introduction – surface water control – ground water control – manufactured drainage systems – waterstops – hydrophilic bentonite / asphalts. Capillary action – positive and negative systems – cementitious system – metallic system – acrylic modified system – chemical additive system. Fluid applied systems – urethane – rubber derivatives – polymer asphalt etc.

**MODULE III ABOVE-GRADE WATERPROOFING 9**

Introduction – difference from below-grade waterproofing systems – vertical applications – horizontal applications – above-grade exposure problems. Materials – clear repellents – film forming sealers – penetrating sealers – choosing appropriate repellents – cementitious coatings – elastomeric coatings – deck coatings. Roof waterproofing – interior waterproofing on masonry elements - applications.

**MODULE IV RESIDENTIAL WATERPROOFING 9**

Introduction – Multiple residents and single family construction. Below-grade waterproofing – substrate – ground water control – positive versus negative waterproofing – basement waterproofing systems. Above-grade waterproofing

– exterior insulate finish systems – terminations and transitions – roof waterproofing systems – masonry waterproofing systems.

**MODULE V REMEDIAL WATERPROOFING 9**

Introduction – remedial applications – visual inspection – non-destructive testing – destructive testing – cause determination and methods of repair. Cleaning surfaces – types. Restoration work – pointing – grouting – epoxy injection – cementitious patching – shotcrete – overlays.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Michael T. Kubal, “Construction Waterproofing : Handbook”, Second edition, Mc Graw Hill Education, 2008.

**REFERENCES:**

1. Brooks, J.J. and Neville, A.M., “Concrete Technology”, Pearson, 2019.
2. Emmons, P.H., “Concrete Repair and Maintenance Illustrated: Problem Analysis; Repair Strategy; Techniques”, RSMeans Publishers, 2002.
3. Handbook on “Waterproofing of Concrete Structures”, Indian Concrete Institute, 2020.
4. Hand Book on “Repair and Rehabilitation of RCC Buildings”, Central Public Works Department, Government of India, 2002.
5. Kumar Mehta. P. and Paulo J.M. Monteiro., “Concrete: Microstructure, Properties, and Materials” 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.
6. Mahel Al-Jabari, “Integral Waterproofing of Concrete Structures : Advanced Protection Technologies of Concrete by Pore Blocking and Lining”, Elsevier Ltd., 2022.
7. Malhotra, V.M. and Carino, N.J., “Handbook on Non-destructive Testing of Concrete”, CRC Press, 2004.
8. Perkins, P.H., “Repair, Protection and Waterproofing of Concrete Structures”, Third edition, E & FN Spon, 1997.
9. Santha Kumar, A.R., “Concrete Technology”, Oxford University Press, New Delhi, 2007.
10. Yoshihiko Ohama, “Hand Book of Polymer Modified Concrete and Mortars”, Noyes Publications, U.K., 3rd Edition, 2013.

**COURSE OUTCOMES:**

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

**CO1:** understand scientific principles involved in design of waterproofing

envelope for concrete and masonry structures.

**CO2:** identify below-grade waterproofing system for different applications

**CO3:** identify above-grade waterproofing system for different applications

**CO4:** design waterproofing system for residential application

**CO5:** conduct condition assessment on concrete and masonry elements distressed with water leakage and suggest remedial methods.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

3. Development of sustainable infrastructure by understanding the principles of waterproofing in buildings.

4. Make the existing human settlements safe and resilient by identifying suitable waterproofing materials, and adopting feasible techniques based on application areas.

| CEDX 18 | CORROSION PREVENTION AND | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9&11 | CONTROL IN RC STRUCTURES | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objective of the course is to impart adequate knowledge on

**COB1:** durability of reinforced concrete (RC) and various factors affecting the same.

**COB2:** mechanism of corrosion of steel in concrete, its major causes,influencing parameters and consequences.

**COB3:** techniques and methods for condition assessment, corrosion prevention, and corrosion control in RC structures.

**MODULE I DURABILITY OF RC STRUCTURES** **9**

Durability – significance – influence on life cycle cost – factors affecting durability of RC : water-cement ratio, permeability, microstructure formation, resistivity and electrical resistance, concrete cover and exposure conditions.

**MODULE II MECHANISM OF CORROSION OF STEEL IN RC** **9**

Corrosion of metals - mechanism of corrosion of steel in concrete – passivation - galvanic corrosion, causes of corrosion : carbonation - chloride attack – microbial induced corrosion – influencing parameters, corrosion damage in RC structures - cost of corrosion - worldwide scenario.

**MODULE III CORROSION PREVENTION IN RC STRUCTURES** **9**

Control of carbonation - control of chlorides – corrosion prevention methods : high performance concrete, corrosion inhibitors, protective coating to steel rebars, galvanized rebars, stainless steel rebars, sealers and membranes and cathodic protection.

**MODULE IV CONDITION EVALUATION AND CORROSION RATE MEASUREMENT** **9**

Preliminary survey - visual inspection, detailed survey – delamination survey - cover – half-cell potential measurements - carbonation depth measurement - chloride determination - resistivity measurement, corrosion rate measurement : macrocell corrosion test and accelerated corrosion studies.

**MODULE V CORROSION CONTROL IN RC STRUCTURES 9**

Physical and chemical rehabilitation techniques – coatings - sealers and membranes - corrosion inhibitors, electrochemical repair techniques – basic principles –cathodic protection.

**L – 45, TOTAL HOURS – 45**

**TEXT BOOKS:**

1. John P. Broomfield, Corrosion of Steel in Concrete: Understanding, Investigation and Repair, second edition, CRC Press, 2006.

**REFERENCES:**

1. ASTM A 775/A775 M-19, "Standard specification for epoxy-coated steel reinforcing bars", American Society for Testing and Materials, 2019.
2. ASTM C 876, Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete, American Society for Testing and Materials, 2015.
3. ASTM G109-07: Standard test method for determining effects of chemical admixtures on corrosion of embedded steel reinforcement in concrete exposed to chlorides. ASTM International, West Conshohocken, PA, USA, 2013.
4. Central Public Works Department (CPWD). "Handbook on repair and rehabilitation of RCC buildings." 2002.
5. Dyer, Thomas. Concrete durability. CRC Press, 2014.
6. Haji Sheik Mohammed MS, "Performance evaluation of protective coatings on steel rebars", Ph.D. Thesis submitted to Anna University, India, 2008.
7. IS 12594, Hot-Dip Zinc Coating on Structural Steel Bars for Concrete Reinforcement - Specification, Bureau of Indian Standards, 1988.
8. IS 13620, "Fusion bonded epoxy-coated reinforcing bars-Specification", Bureau of Indian Standards, New Delhi, 2020.
9. Jacobson, Gretchen A. "NACE International's IMPACT Study Breaks New Ground in Corrosion Management Research and Practice." The Bridge 46, no. 2, 2016.
10. Luca Bertolini, Bernhard Elsener, Pietro Pedeferri, Elena Redaelli and Rob B. Polder, Corrosion of Steel in Concrete: Prevention, Diagnosis, Repair, 2nd Edition, Wiley, 2013.
11. Mattsson, Einar. "Basic Corrosion Technology for Scientists and Engineers." 1996.
12. Mehta, P. Kumar, and Paulo JM Monteiro. Concrete: microstructure, properties, and materials. McGraw-Hill Education, 2014.

**COURSE OUTCOMES:**

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

**CO1:** understand the importance of durability of RC structures and its significance on life cycle cost.

**CO2:** understand mechanism of corrosion under different contexts, its causes and consequences

**CO3:** suggest techniques and methods for corrosion prevention in RC structures

**CO4 :** perform condition evaluation of corrosion distressed elements by understanding the scientific principles.

**CO5:** recommend techniques and methods for corrosion control in distressed RC structures

**Board of Studies (BoS):**

18th BoS of CE held on 05.04.2023

**Academic Council:**

20th Academic council held on 13.4.2023

| | PO 1 | PO 2 | PO 3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | M | | | | | | | | | | | | M | | |
| CO 2 | M | H | | | | | | | | | | | M | | |
| CO 3 | H | M | M | | M | | M | | | | | | H | | |
| CO 4 | H | M | M | | M | | | | | H | M | | M | | |
| CO 5 | H | M | M | | M | | M | | | | | | H | | |

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

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

SDG - 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: The knowledge on importance of durability on life cycle cost, corrosion prevention and control methods, and corrosion auditing in RC structures shall lead to construction of safe and resilient infrastructure by giving emphasize to sustainability and innovation.

| CEDX 19 | LEAN CONSTRUCTION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**SDG: 11**

**COURSE OBJECTIVES:** The course will impart knowledge on

**COB1:** drawbacks in traditional practices and concepts of lean

**COB2:** principles and tools

**COB3:** lean methods

**COB4:** lean tools like VSP, work sampling, last planner system

**COB5:** activities for implementation in the construction industry.

**MODULE I LEAN PHILOSOPHY AND CONCEPTS 9**

Problems with current construction management techniques - Toyota's management principle - History of How Lean originated - History of Lean Construction - Origins and Essence of Lean - Eight Major Wastes (Non-value-added work) - Two Pillars of The Toyota Way - 4P Model of the Toyota Way- Five of Principles of Lean Thinking- Toyota Production System (TPS)- WIP – cycle time – little‟s law –queuing theory

**MODULE II LEAN PRINCIPLES 9**

- Concept of Variation in Construction - Concept of Value & Waste in Construction - Concept of Flow, Push vs Pull & Flow efficiency - Concept of Batch vs Single Piece flow in construction - Aspects of Continous Improvement /PDCA - Importance of Visual Management Respect for People - Culture of Collaboration - Trust & Team Work - key features of Integrated Project Delivery/IPD

**MODULE III LEAN METHODS 9**

Collaborative Planning - Define Value Stream - Lean Workstructuring - Lean Problem Solving - Just in Time - Visual Management (information Transperency) - Digitalization - Kaizen/ Kata - Root Cause Analysis - Workplace Organizing - Target Value Design

**MODULE IV LEAN CONSTRUCTION TOOLS 9**

Set Based Design - Choosing By Advantages - Value Stream Mapping - Last Planner System - Big Room - PDCA - A3 Reporting – Fish Bone Diagram - Paretto Analysis - 5S 11. Poka Yoke

**MODULE V LEAN ACTIVITIES** 9

Milestone Pull Planning - Look ahead pull planning - Weekly work Planning - Daily Huddles - Brain Storming Sessions - Gemba visits - 5S Implementation - Constraints Log - Issue Log - PPC Analysis - Reason for Non Completion Analysis - Root Cause workshop - Daily Update (Big Room) - On Job Trainings - Work observation

**L – 45 TOTAL HOURS –45**

**TEXT BOOKS:**

1. Corfe, C. and Clip, B., “Implementing lean in construction: Lean and the sustainability agenda”, CIRIA, 2013.
2. Shang Gao and Sui Pheng Low, “Lean Construction Management: The Toyota Way”, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, P., “Implementing lean in construction: Lean construction and BIM, CIRIA”, 2013.

**REFERENCES:**

1. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., “Site implementation and Assessment of Lean Construction Techniques”, Lean Construction Journal, 2005.
2. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., “Lean construction tools and techniques”, 2002.

**COURSE OUTCOMES:** On completion of the course, students will be able to

**CO1:** explain the contemporary management techniques and the issues in present scenario.

**CO2:** explain the principles of lean construction.

**CO3:** apply the lean methods to the construction industry.

**CO4:** apply the different tools in the construction industry to achieve better productivity.

**CO5:** implement various activities in construction site.

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

| CEDX 20 | INTELLIGENT BUILDING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | MANAGEMENT SYSTEM | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objective of the course is to impart knowledge on

**COB1:** the concepts of Intelligent buildings

**COB2:** HVAC systems

**COB3:** fire alarm and Surveillance system

**COB4:** access control and intruder alarm system

**COB5:** performance of smart buildings.

**MODULE I BASIC CONCEPTS 9**

Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS – Cost – Energy savings.

**MODULE II HVAC SYSTEMS 9**

Fundamentals: Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating ,Cooling etc) Basic Science: Air Properties, Psychometric Chart, Heat Transfer mechanisms, Examples. Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heat loss. Processes: Heating Process & Applications (I.e. Boiler, Heater), Cooling Process & Applications (I.e. Chiller), Ventilation Process & Applications (I.e. Central Fan System, AHU, Exhaust Fans), Unitary Systems (VAV, FCU etc).

**MODULE III FIRE ALARM AND SURVILLENCE SYSTEM 9**

Introduction To Fire Alarm System - Need For Fire Alarm System - Types Of Fire Detectors -Types of Fire Panels - Conventional And Addressable System - Input-Output Modules - Indicators & Annunciators - Fire Cables And Classes Of Wiring - Sprinkler System – Design – Components – Types.

Survillence system - Design. CCTV: Camera: Operation & types, Camera Selection Criteria, Camera Applications, Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. CCTV Applications: CCTV Applications. Introduction.

**MODULE IV ACCESS CONTROL AND INTRUDER ALARM SYSTEM 9**

Access Control System Topology – Credentials – Pin – Card – Biometric - Card Types - Biometric System – Behavioral – Physical - Reader Types- Locking

devices - Exit Switch & Status Detectors-Panel Communication Protocols-Introduction To Intruder Alarm System-Need For Intruder Alarm System-Intrusion Detector Types-Door Magnetic Contact-Vibration Detectors-Motion Detectors-Glass Break Detectors-Panic Switches-Hardware And Software Types Zone-Zone Attributes-Keypad Types-Panel Types-Zone Partitioning

**MODULE V PERFORMANCE OF BUILDINGS 9**

Intelligent buildings-Building automation- Building services in high rise buildings-Green buildings- Case studies of residence, office buildings and other buildings in each zones. BMS and energy savings Energy management systems – BMS benefits smart home - smart office

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. James Sinopoli,"Advanced Technology for Smart Buildings",Artech House, 2016.
2. Intelligent Building Systems by Albert Ting-Pat So, WaiLok Chan, Kluwer Academic publisher,3rd ed., 2012.
3. **REFERENCES:**
4. Derek Clements Croome, Intelligernt Building Design, Management and Operations, 2nd edition, ICEP Publishers, London, 2012.
5. Shengwei Wang, Intelligent Buildings and Building Automation, Spon Press, London, 2009.
6. Gerardus Blokdyk “Intelligent building automation system the ultimate step by step guide”, 2018.
7. John Twin, sandipan mishra intelligent building control systems, Springer, 2018.

**COURSE OUTCOMES:**

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

**CO1:** illustrate the concept of Intelligent Buildings and compare the costs, energy savings applied to Building Management Systems.

**CO2:** demonstrate and explain the HVAC systems

**CO3:** select suitable fire alarm and surveillance system.

**CO4:** demonstrate and explain access control and intruder alarm system

**CO5:** analyze performance of buildings based on energy efficiency

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

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

The holistic understanding of building management system will lead to sustainable buildings

| CEDX 21 | AUTOMATION IN CONSTRUCTION | L | T | P | C |
|---|---|---|---|---|---|
| SDG : 9 | AND MANAGEMENT | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The course will impart knowledge on the

**COB 1 :** automation and use of robots in construction

**COB 2 :** basic concept of automation techniques and sensors in construction.

**COB 3:** existing and prototype equipment for construction.

**COB 4:** data networking and internet protocols.

**COB 5**: concept and impact of construction robots in construction.

**MODULE I BASIC CONCEPTS 9**

Automation in construction - Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Review and analysis of state- of –art in construction automation – current scenario

**MODULE II EMERGING TECHNIQUES 8**

ICT technologies – power line communication in home building automation systems – virtual reality systems – Programmable Logic Controller - Supervisory Control and Data Acquisition - sensors – type of sensors.

**MODULE III CONSTRUCTION AUTOMATION AND ROBOTICS 10**

Off- site automation in construction Information processing (computer applications), - Existing and prototype equipment for construction – Cranes – Tunnel Boring Machines - final product design session - Off-site automated prefabrication systems- On-site automated and robotic systems.

**MODULE IV NETWORKING IN CONSTRUCTION 9**

Data networking– wireless transmission media – network devices – internet protocols - Gamma building control – energy-efficient building and room automation.

**MODULE V CONSTRUCTION ROBOTS 9**

Selection of construction robots – factors - robotic technologies for customized component - Activated concrete cutting robot, concrete floor finishing robot- Ceiling panel positioning robot- Exterior wall painting robot- safety and training- case studies - Task construction robots – 3D printing.

**L- 45; Total Hours – 45**

**TEXT BOOKS:**

1. Javad Majrouhi Sardroud, “Automated Management of Construction Projects” LAP Lambert Academic Publishing, 2011.
2. Wang Shengwei,“Intelligent Buildings and Building Automation” Taylor & Francis Group, 2010.

**REFERENCES:**

1. Honglei Xu and Xiangyu Wang, “Optimization and Control Methods in Industrial Engineering and Construction (Intelligent Systems, Control and Automation: Science and Engineering)” Springer, 2014.
2. Majrouhi Sardroud Javad,, “Automation in Construction Management” Scholars' Press, 2014

**COURSE OUTCOMES:**

On completion of this course, students will be able to

**CO1 :** explain the concept of building management system and automation in construction.

**CO2** :Identify the different techniques and sensors used in automation.

**CO3 :**suggest the various robotic techniques for construction process.

**CO4** :apply the knowledge of networking in construction automation.

**CO5** :Select suitable robotic technique in construction.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

The holistic understanding of automation in the construction system will lead to sustainable construction management.

| CEDX 22 | BUILDING INFORMATION MODELING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 1 | 0 | 4 | 3 |

**COURSE OBJECTIVES:** The course will impart knowledge on

**COB1:** the fundamental concepts and principles of Building Information Modeling

**COB2:** BIM software for design, analysis, and collaboration

**COB3:** Integrating with MEP & structural design

**COB4:** Role of MSP & PRIMAVERA

**COB5:** Data Integration and energy analysis

**MODULE I INTRODUCTION TO BIM 3+12**

Introduction to Building Information Modeling (BIM), Historical context and evolution of BIM - Benefits and challenges of BIM adoption - BIM standards and industry trends - BIM Software and Tools - Overview of popular BIM software - Revit, ArchiCAD, AutoCAD.

**MODULE II BIM FOR ARCHITECTURAL DESIGN 3+12**

Using BIM for conceptual design - Navigating the BIM interface - Creating and managing BIM elements (walls, floors, roofs) - Importing and exporting data in BIM - Developing detailed architectural models - 2D drafting and 3D modeling in BIM - Creating building sections and elevations.

**MODULE III BIM FOR MEP & STRUCTURAL ENGINEERING 3+12**

Integrating MEP systems into BIM – New MEP Projects - Coordinating MEP systems with architectural and structural models - Energy analysis and sustainability in BIM - Structural modeling in BIM - Analyzing and simulating structural loads - Clash detection and resolution.

**MODULE IV BIM FOR CONSTRUCTION AND PROJECT MANAGEMENT 3+12**

BIM in the construction phase - 4D and 5D BIM (scheduling and cost estimation) - BIM in facility management (6D BIM) - Revit model can be imported with a project schedule to review the progress of the Project – Clash Detection of services - Case studies of successful BIM implementation in construction

**MODULE V BIM FOR SUSTAINABLE DESIGN 3+12**

Sustainable design principles in BIM - Life cycle analysis and environmental impact assessment - LEED and BREEAM certifications using BIM - Green building design and energy efficiency - Advanced BIM technologies.

**L – 15; P – 60; TOTAL HOURS –75**

**TEXT BOOKS:**

1. Hardin, B., & McCool, D. (2015). BIM and construction management: proven tools, methods, and workflows.John Wiley & Sons.
2. Issa, R. R., & Olbina, S. (Eds.). (2015, May). Building Information Modeling: Applications and Practices, American Society of Civil Engineers.
3. Eastman, C., Teicholz, P., Sacks, R., & Liston, C. (2011). BIM handbook: A guide to building information

**REFERENCES:**

1. Krygiel, E., & Nies, B. (2008). Green BIM: successful sustainable design with building information modeling, John Wiley & Sons.
2. Modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons.

**CO 1 :** understand concepts of Building Information Modeling.

**CO 2 :** design a building structure using software

**CO 3 :** create new MEP project, analyse the structure and link it with BIM

**CO 4 :** develop schedule using MSP and Primavera

**CO 5:** to comprehend the life cycle assessment of buildings

**Board of Studies (BoS) :**

19th of Civil held on 29.09.2023

**Academic Council:**

21st Academic council held on 20.12.2023

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | M | L | L | L | H | - | - | - | - | - | L | L | M | M | - |
| CO 2 | M | L | L | L | H | - | L | - | - | - | L | L | M | M | - |
| CO 3 | M | L | L | L | H | - | L | - | - | - | L | L | M | M | L |
| CO 4 | M | L | L | L | H | - | - | - | - | - | L | L | M | M | L |
| CO 5 | M | L | L | L | H | - | H | - | - | - | L | L | M | M | L |

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

SDG 11 :Make cities and human settlements inclusive, safe, resilient and sustainable

The holistic understanding of construction materials leads to development of sustainable buildings

| CEDX 23 | HOUSING, PLANNING AND BYELAWS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objective of the course is to impart adequate knowledge on

**COB1:** various types of housing and contemporary housing policies.

**COB2:** the different types of housing programmes and the role of various organizations.

**COB3:** the planning and design of housing projects

**COB4:** the finance for housing projects

**COB5:** building byelaws for housing projects.

**MODULE I BASIC CONCEPTS 9**

Definition of Basic Terms – House, Home, Household, Apartments, Multi storied Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of sustainable housing.

**MODULE II HOUSING PROGRAMMES 9**

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations. Institutions for Housing at National, State and Local levels.

**MODULE III PLANNING AND DESIGN 9**

Formation of Housing Projects and its principles – Elements of Site Analysis - Layout Design of Housing - Design of Housing Units (Design-Problems).

**MODULE IV HOUSING FINANCE AND PROJECT APPRAISAL 8**

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing of Housing Units, Rents, Recovery Pattern (Problems).

**MODULE V HOUSING LAWS AND DEVELOPMENT REGULATIONS 10**

Housing Laws at State level - Working of building bye-laws in planning practice at Urban and Rural level – Development Control Regulations (DCR)-

Requirements for grant of building permissions; Streamlining the development control regulations; Zoning regulations of DCR ; UDPFI Guidelines; National Building Code and its implementation - Documents required for the approval of the building plan.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Watson, D., Crosbie, M.J., “Time Saver Standards for Architectural Design”, Tata McGraw Hill, 8th Edition, 2011.
2. Hosack, W.M., “Land Development Calculations”, McGraw Hill, USA , 2nd Edition, 2010.

**REFERENCES:**

1. Development Control Rules For Chennai Metropolitan Area, CMA, Chennai, 2004.
2. Goody, J., Chandler, R., Clancy, J., Dixon, D., Wooding, G., “Building Type Basics for Housing”, John Wiley and Sons, New Jersy, 2010.

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

**CO1:** explain the basic concepts about different types of housing, policies and principle of sustainable housing.

**CO2:** impart knowledge on various housing programmes.

**CO3:** describe the basic principles of *planning* a *house* and designing the life space

**CO4:**analyse the housing cost and select finance for housing projects.

**CO5:** describe the housing bye laws at different administrative levels and its development and control regulations

**Board of Studies (BoS) :**

18th BoS of CE held on 05.04.2023

**Academic Council:**

20th Academic council held on 13.4.2023

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

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

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

The holistic understanding of housing rules, policies and byelaws will lead to sustainable housing.

## SPECIALIZATION III: GEOTECHNICAL ENGINEERING

| CEDX 31 | ENGINEERING GEOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objectives of the course are to impart knowledge on

**COB1:** various earth processes to consider them during the planning and execution of civil engineering projects.

**COB2:** demarcation and differentiation of various rock types and minerals to be used as construction materials.

**COB3:** the areas of weakness in a zone and to eradicate the weakness during civil engineering projects.

**COB4:** the geological conditions of tunnels, dams and reservoirs.

**COB5:** different remote sensing techniques in exploring the mineral and rock types.

**MODULE I PHYSICAL GEOLOGY 8**

Branches of geology – Scope of engineering geology - Earth Internal structure – Seismological evidence, the final picture of the earth, Earth processes – Weathering – Types of weathering, Physical and chemical weathering, products of weathering, Volcanism – types of volcanoes, causes and effects, Earthquake – types of seismic waves, distribution and origin - Plate tectonics theory.

**MODULE II MINERALOGY & PETROLOGY 9**

Introduction – Mineralogy, Physical properties of minerals – color, lustre, cleavage, structure, hardness, specific gravity, Rocks –Classification of rocks– Igneous, sedimentary and metamorphic rocks, Igneous rocks – types, the texture of igneous rocks, engineering properties, Sedimentary rocks – formation of clastic and non-clastic sedimentary rocks, classification of sedimentary rocks, Metamorphic rocks – types of metamorphism, engineering properties of rocks.

**MODULE III STRUCTURAL GEOLOGY 10**

Types of geological structures - Folds, Faults and Joints, Folds – Parts of a fold, classification of folds, causes, engineering properties of folds, Faults – Basic terms, types of faults, recognition of faults, causes and engineering considerations of faults, Joints – occurrence, the origin of joints, causes and their effect on civil engineering projects.

**MODULE IV GEOLOGY FOR CIVIL ENGINEERING 10**

Geological conditions necessary for the construction of tunnels, dams, reservoirs, Tunnels – types of tunnels, geological investigations, soft ground tunneling, Dams - types of dams, geotechnical considerations, geological characters for investigation, forces acting on a dam, Reservoirs – Geological Investigations, silting of reservoirs, Geophysical investigations – electric method, seismic method, gravitational method, magnetic method.

**MODULE V MISCELLANEOUS APPLICATIONS 8**

Landslides - Causes and effects, Coastal erosion and coastal prevention structures - Remote sensing applications in mineral exploration – case studies.

**L – 45; TOTAL HOURS – 45**

**TEXTBOOKS:**

1. ChennaKesavalu. N., “Textbook of Engineering Geology”, Macmillian Publishers India Ltd, New Delhi, 2009.
2. Parbin Singh, “Engineering and General Geology”, S.K. Kataria& Sons, Katson Publication House, 2013.
3. Rao. P.C. & Rao. D.B., “A Text Book of Geology”, Discovery Publishing House, New Delhi, 2010.
4. Varghese. P.C., “Engineering Geology for Civil Engineers”, PHI Learning Private Ltd, New Delhi, 2012.

**REFERENCES:**

1. Lillesand.T.M. and Kiefer.R.W., “Remote sensing and image interpretation”, John Wiley and sons, 7th Edition, 2015.
2. Sawant P.T., “Engineering & General Geology”, New India Publishing Agency, 2011.
3. https://geologyscience.com/methods-of-geology/structural-geology/

**COURSE OUTCOMES:**

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

**CO1:** identify the geological parameters required for the construction, planning and design of civil engineering structures.

**CO2:** demarcate and differentiate between rock types and minerals to be used as construction materials.

**CO3:** identify the areas of weakness in a zone, consider, and eradicate the weakness during the civil engineering projects.

**CO4:** select the necessary geological conditions of tunnels, dams and reservoirs.

**CO5:** employ remote sensing techniques in exploring the mineral and rock types.

**Board of Studies (BoS) :**
16th BoS of CIVIL held on 05.01.2022

**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 | L | H | L | L | L | M | L | - | - | - | - | M | L | - |
| **CO2** | L | L | L | L | L | L | M | L | - | - | - | - | H | M | - |
| **CO3** | M | L | H | M | L | H | H | L | - | M | - | - | H | M | - |
| **CO4** | L | L | H | M | L | H | H | L | - | M | - | - | H | M | - |
| **CO5** | M | L | M | M | L | H | H | L | - | M | - | - | H | M | - |

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

SDG 11: Make cities inclusive, safe, resilient and sustainable.

The integrated knowledge of mineral and rock properties under different geological conditions helps in designing an economical and safe foundation leading to the construction of resilient infrastructure.

| CEDX 32 | GROUND IMPROVEMENT TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To familiarize the students with geotechnical problems in soil

**COB2:** To understand the various drainage methods available for dewatering of soil

**COB3:** To impart knowledge about selection, design, and construction aspects of ground improvement techniques in problematic soils

**COB4:** To understand the application of geo-synthetics in soil reinforcement

**COB5:** To provide knowledge on stabilization of soil

**MODULE I BASIC CONCEPTS** **7**

Role of ground improvement in foundation engineering - methods of ground improvement - Geotechnical problems in alluvial, laterite and black cotton soils - Selection of suitable ground improvement techniques based on soil condition

**MODULE II DRAINAGE AND DEWATERING** **8**

Drainage techniques - Well points - Vacuum and electro osmotic methods - Seepage analysis for two dimensional flow

**MODULE III INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS** **9**

Insitu densification of cohesion less and consolidation of cohesive soils - Dynamic compaction and consolidation - Vibro floatation - Sand pile compaction - Preloading with sand drains and fabric drains- Stone columns - Lime piles - Installation techniques only - relative merits of various methods and their limitations.

**MODULE IV EARTH REINFORCEMENT** **9**

Concept of reinforcement - Types of reinforcement material - Applications of reinforced earth - use of Geotextiles for filtration, drainage and separation in road and other works.

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**MODULE V STABILISATION METHODS** **12**

Types of grouts - Grouting equipment and machinery - Injection methods – Grout - Chemical stabilization – Mechanism – factors affecting and properties – use of

additives – Lime and Bituminous stabilization - Mechanism – factors affecting and properties – types of admixtures - Stabilization of expansive soil

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Maity Joyanta Chattopadhyay Bikash Chandra., "Ground Improvement Techniques", PHI Publications, Eastern Economy Edition, 2017
2. Purushothama Raj, P., "Ground Improvement Techniques", Laxmi Publications, 2nd Edition, 2016.

**REFERENCES:**

1. Das, B.M., "Principles of Foundation Engineering", Cenage learning, 8th edition, USA, 2015.
2. Koerner, R.M., "Designing with Geosynthetics", Pearson Education, 5th Edition, 2005.
3. Moseley, M.P. and Kirsch. K, "Ground Improvement", CRC Press, 2nd edition, USA and Canada, 2004.

**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:** Explain the properties of problematic soil and necessity of different ground modification techniques

**CO2:** Describe the concept of drainage techniques

**CO3:** Describe the improvement of soil by compaction, consolidation and preloading techniques suitable for specific site conditions

**CO4:** Effectively utilize different earth reinforcement materials including Geotextile for different field conditions.

**CO5:** Implement the grouting techniques in the field condition for soil stabilization and also assess the suitable chemicals and admixtures for stabilization based on soil types

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | M | M | - | L | L | L | M | M | M | L | M | L | - |
| CO2 | M | L | M | M | - | L | L | L | M | M | M | L | M | L | - |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | M | L | M | M | - | L | L | L | M | M | M | M | H | L | - |
| **CO4** | M | L | M | M | - | L | L | L | M | M | M | H | H | L | - |
| **CO5** | M | L | M | M | - | L | L | L | M | M | M | H | H | L | - |

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

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement : The integrated understanding on stabilization of weak naturally available ground using suitable ground improvement techniques for ensuring access to safe and resilient structure.

| CEDX 33 | SUBSURFACE INVESTIGATION AND REPORT WRITING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**

**COB1:** To give exposure on basic field instrumentation techniques

**COB2:** To impart knowledge on the geophysical methods of ground investigation

**COB3:** To familiarize the field tests on soil and to correlate test results

**COB4:** To impart knowledge on subsoil investigation for offshore structures

**COB5:** To provide understanding on the report writing and foundation recommendation

**MODULE I FIELD INSTRUMENTATION 8**

Necessity and Importance of soil exploration - Field Instrumentation - Pressure meters, Piezometer, Pressure cells, Sensors, Inclinometers, Strain gauge – Interpretation of results

**MODULE II GEOPHYSICAL METHOD OF EXPLORATION 10**

Indirect method of exploration - Seismic method, Electrical resistivity, Resistivity sounding and profiling - Qualitative and quantitative interpretation of test result - Comparison of resistivity and seismic surveys – Shortcoming – Report Writing based on results

**MODULE III ADVANCED INSITU TESTS ON SOIL 10**

Field Vane shear test – Borehole Shear Test - Pressure meter test - Dilatometer test - Cyclic plate load test - Precautions to be exercised during the execution of these tests - Various corrections in the test results and interpretation of test results for design of foundations - Correlation among various test results - Report Writing based on results

**MODULE IV OFFSHORE INVESTIGATION 8**

Offshore investigation – Difference between onshore and offshore explorations - Geotechnical aspects of offshore structures - Phases of offshore site investigation

**MODULE V DATA INTERPRETATION AND REPORT PREPARATION 9**

Data interpretation from field and laboratory test results - Borehole log - Analysis of data - Preparation of detailed site investigation reports - Conclusions and Recommendation of foundation

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Alam Singh and Chowdhary G. R., "Soil Engineering in Theory and Practice", Volume-2, Geotechnical testing and instrumentation", CBS Publishers and Distributors, New Delhi, 2nd edition, 2014.
2. Alan J. Lutenegger, "In Situ Testing Methods in Geotechnical Engineering", CRC Press, 1st edition, 2021
3. Bowles, J.E.," Foundation Analysis and Design", McGraw-Hill International Publishers, New Delhi, 5th Edition, 2012

**REFERENCES:**

1. Dunnicliff, J., and Green, G.E., "Geotechnical Instrumentation for Monitoring Field Performance", John Wiley, 2007.
2. Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers, New Delhi, 3rd edition, 2016.
3. Venkatramaiah, C., "Geotechnical Engineering", New Age International Publishers, New Delhi, 6th edition, 2018.

**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:** Execute various field instrumentation techniques

**CO2:** Describe the geophysical method of soil exploration

**CO3:** Implement suitable in-situ field test based upon soil conditions

**CO4:** Adopt the appropriate investigation techniques for offshore structures

**CO5:** Prepare a standard report on sub soil investigation based on results of interpretation.

**Board of Studies (BoS) :**

18th BoS of CE held on 05.04.2023

**Academic Council:**

20th Academic council held on 13.4.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : The understanding of the importance of sub soil investigation and its implementation paves to safe environment and sustainable structure.

| CEDX 34 | APPLICATION OF SOFTWARE IN GEOTECHNICAL ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG:11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The main objective of the course is to impart students knowledge on

COB1: the importance of computational modeling and analysis of foundations
COB2: concepts of modeling using PLAXIS and GEOSTUDIO
COB3:fem analysis of foundations
COB4: modelling of slope stability and seepage in GEOSTUDIO
COB5: modelling of stress and deformation in GEOSTUDIO

**MODULE I IMPORTANCE OF SOFTWARE APPLICATIONS 9**

Importance and need of software for modeling, analysis and design in Geotechnical Engineering field - Advantages and limitations of software - Causes for errors, validation of software results. Failures due to errors in modeling - Data entry and interpretation of software results

**MODULE II CONCEPTS AND STRUCTURAL ELEMENTS IN PLAXIS 9**

Introduction to modeling – General Modelling Aspects – Points, Lines, Clusters, Elements, Nodes and Stress points – Data Input – General Settings – Creating Geometry Model

**MODULE III ANALYSIS AND MODELLING OF FOUNDATIONS IN PLAXIS 9**

FEM Analysis of simple Geotechnical Problems using PLAXIS Software - Theory and modeling of Shallow Foundations, Deep Foundations and Retaining Walls

**MODULE IV ANALYSIS AND MODELLING OF SLOPE STABILITY AND SEEPAGE IN GEOSTUDIO 9**

Analysis of Slope stability in SLOPE/W - Simple seepage analysis in SEEP/W - Define View to set up the model – Result computation and viewing of numerical solution – Real time example

**MODULE V ANALYSIS AND MODELLING OF STRESS AND DEFORMATION IN GEOSTUDIO 9**

Stress and deformation analysis in SIGMA/W - Define View to set up the model – Result computation and viewing of numerical solution – Real time example

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS**

1. Y.M. Cheng, J.H. Wang, L. Liang, W.H. Fung Ivan “Numerical Methods and Implementation in Geotechnical Engineering – Part 1”,Bentham Publishers,2020

**REFERENCES:**

1.https://www.geoslope.com/learning/support-resources/tutorial-videos/geostudio-2012
2.PLAXIS Version 8 – Reference Manual

**COURSE OUTCOMES:**

At the end of the course students will be able to

CO1:Demonstrate the use of Softwares in Geotechnical field
CO2:Model substructural elements using PLAXIS
CO3:Analyse and model foundations and retaining walls using PLAXIS
CO4:Analyse and model Slopes and seepage using **GEOSTUDIO**
CO5:Analyse and model stress and deformation in substructural elements using **GEOSTUDIO**

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic council held on 20.12.2023

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement: The integrated understanding of design of substructures results in the development of durable and resilient infrastructure throughout the life span.

| CEDX 35 | GEO-ENVIRONMENTAL ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:** To impart knowledge on causes and effects of soil contamination

**COB2:** To familiarize about the waste containment system

**COB3:** To provide an in-depth knowledge about the various waste stabilization methods

**COB4:** To give exposure on the geotechnical application of waste and its disposal

**COB5:** To provide insight on the different methods of soil remediation

**MODULE I SOIL CONTAMINATION 9**

Introduction to Geo environmental engineering - Scope - Sources, production and classification of waste – Causes of soil pollution – Factors governing soil pollution - Contaminant transport in sub surface - Fate and effect of pollutants on land environment.

**MODULE II WASTE CONTAINMENT SYSTEM 9**

Evolution of waste containment facilities and disposal practices -Site selection based on environmental impact assessment –different role of soil in waste containment – different components of waste containment system and its stability issues- MoEF guidelines.

**MODULE III WASTE STABILIZATION 9**

Stabilization - Solidification of wastes – Micro and macro encapsulation – Absorption, Adsorption, Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement – case studies.

**MODULE IV GEOTECHNICAL APPLICATION OF WASTE AND DISPOSAL 9**

Geotechnical use of different types such as Thermal power plant waste, Municipal solid waste, industrial waste - Waste disposal facilities - Parameters controlling the selection of site for sanitary and industrial landfill - Site characterization.

**MODULE V REMEDIATION OF CONTAMINATED SOILS 9**

Stabilization and solidification - Bio-remediation - Soil washing - Phytoremediation - Soil heating – Thermal desorption -Vitrification - Bio-venting – Electro kinetic remediation

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Daniel B.E., “Geotechnical Practice for waste disposal”, Chapman and Hall, London, 2012.
2. Dewan J.W. and Sudarshan K.N.., “Hazardous Waste Management”, Discovery Publishing House, India, 2011.
3. Hari D. Sharma and Krishna R. Reddy, “Geo-Environmental Engineering”, John Wiley and Sons, INC, USA, 2004.
4. Mohamed A.M.O and Paleologos E.K., “ Fundamentals of Geoenvironmental Engineering,Understanding Soil, Water, and Pollutant Interaction and Transport”, Butterworth-Heinemann, Elsevier Science, UK,2017
5. REDDI, L. N. I., Inyang, H. I. . Geoenvironmental Engineering: Principles and Applications. United Kingdom: CRC Press.(2020)

**REFERENCES:**

1. Kerry Rowe R., Geotechnical and Geoenvironmental Engineering Handbook. United States: Springer US, 2012.
2. Manoj Datta, B.P. Parida, B.K. Guha, “Industrial Solid Waste Management and Landfilling Practice”, Narosa Publishing House, 2001
3. Stalin V. K, Muttharam M.., “Geotechnical Characterisation and Geoenvironmental Engineering: IGC 2016 Volume 1. (2018). Germany: Springer Nature Singapore.

**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:** demonstrate the sources of soil pollution, pollutant interaction and its effects

**CO2:** describe the appropriate waste containment system.

**CO3:** explain the techniques of waste stabilization.

**CO4:** illustrate the geotechnical applications of solid waste.

**CO5:** identify the suitable soil remediation methods

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

**SDG 11:** Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The holistic understanding on implementation of suitable soil waste remediation techniques leads to development of safe and resilient infrastructure.

| CEDX 36 | PAVEMENT ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG :11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The main objective of the course is to impart students knowledge on
COB1:Components and functions of pavement structure
COB2:Different types of Concrete pavements
COB3:Stresses in Flexible and rigid pavements
COB4:Design of Flexible and rigid pavements under various loads.
COB5: Soil stabilization for road construction.

**MODULE I INTRODUCTION 9**

Components of pavement structure. importance of subgrade soil properties on pavement performance.Functions of subgrade,subbase,base course and wearing course.

**MODULE II TYPES OF CONCRETE PAVEMENTS 9**

Roller Compacted Concrete Pavement,Plain Jointed Concrete Pavement,Continuously Reinforced Concrete Pavement,Prestressed concrete pavement,Design of Tie Bars and Dowel Bars,Role of Dry Lean Concrete;Rigid pavements design for low volume roads

**MODULE III STRESSES IN PAVEMENTS FLEXIBLE PAVEMENTS 9**

Stresses in homogeneous masses and Layered systems,deflections,shear failures,equivalent wheel and axle loads Rigid pavements·Westergaard's and Thomlinson's analysisof warping stresses,Combination of stresses due to different causes,Effect of temperature variation on rigid pavements

**MODULE IV DESIGN ELEMENTS OF FLEXIBLE PAVEMENTS 9**

Loadingcharacteristics-static,impact and repeated loads.effects of dual wheels and tandem axles,area of contact and tyre pressure,modulus or CBR .value or dirrer.en1layers,equ1valcn1singlewheelload, equivalent stress and equivalent deflection criterion,equivalent wheel load factors,climatic and environmental factors.Design of airport pavements

**MODULE V STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS** 9

Need for stabilized soil-Design criteria-Mechanisms-factors influencing choice of stabilizers-Testing and field control-Applications of Geosynthetics in roadconstruction-Case studies.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khanna tech. Publications, New Delhi, 2005
2. Khanna, K.and Justo,C. E.G.,“Highway Engineering”, Khanna Pub lishers,Roorkee,2014.
3. Wright,P.H.,“HighwayEngineering”,John Wiley and SonsInc., NewYork, 7th Edition,2004.

**REFERENCES:**

1. Design and Specification of Rural Roads(Manual). Ministry of rural roads.Government of India.New Delhi.2001.
2. Guidelines for the Design of Flexible Pavements,IRC:37- 2001.The Indian roads Congress,NewDelhi.
3. Guideline for the Design of Rigid Pavements for Highways.IRC:58-1998,The Indian Roads Congress.NewDelhi.
4. O'Flaherty,C.A.,Highways- The location, Design.Construction & Maintenance of
Pavements,FourthEdition. Elsevier.2006.

**COURSE OUTCOMES:**

At the end of the course students will be able to

CO1:design various components of pavement like subgrade,subbase,base course and wearing course

CO2 :Suggest suitable type of concrete pavements for varied applications

CO3:Evaluate stresses in flexible ad rigid pavements due to loads and temperature variation

CO4: Design flexible and rigid pavements based on different guidelines.

CO5: Select suitable stabilizers based on mechanism and requirements for construction with a qualitv control in the field.

**Board of Studies (BoS) :**

19th of Civil held on 29.09.2023

**Academic Council:**

21ST Academic council held on 20.12.2023

| CEDX 37 | GEOSYNTHETICS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:** To impart knowledge on the different types of Geosynthetics

**COB2:** To introduce the materials and the process involved in the manufacturing

**COB3:** To familiarize the various properties and methods for testing

**COB4:** To give exposure on the various functions of Geosynthetics

**COB5:** To provide insight on the field applications

**MODULE I BASIC CONCEPTS 6**

Historical development – Field of application - Types of geosynthetics - geotextiles, geogrids, geonets, geomembranes, geocomposites - Recent use in India

**MODULE II MATERIALS AND MANUFACTURING PROCESS 9**

Raw materials - polyamide, polyester, polyethylene, polypropylene, poly vinyl chloride -Different type of geosynthetics based on manufacturing - woven, monofilament, multifilament, slit filament, non-woven - Different bonding process - Mechanically bonded, Chemically bonded, Thermally bonded

**MODULE III PROPERTIES AND TESTING 12**

Physical Properties - Mass per unit area, Thickness, Specific gravity - Hydraulic properties - Apparent open size, Permittivity, Transmissivity - Mechanical Properties - Uniaxial Tensile Strength, Burst and Puncture Strength, Soil Geosynthetic friction tests - Durability - Abrasion resistance- Ultraviolet resistance

**MODULE IV FUNCTIONS 10**

Reinforcement - Separation – Filtration -Drainage - Barrier Functions – Confinement

**MODULE V APPLICATIONS 8**

Application of geosynthetics – Roads- Retaining wall- Foundation stability- Landfills- Drainage, Lining of canals

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Koerner, R.M., "Designing with Geosynthetics", Pearson Education, 6th Edition, 2012.
2. Rao G. V., "Geosynthetics – an Introduction", Sai Master Geoenvironmental Services Pvt. Ltd. Hyderabad, 2011.
3. Sivakumar Babu G. L., "An Introduction to Soil Reinforcement and Geosynthetics", University Press, 1st edition, 2005.

**REFERENCES:**

1. Advances in Geosynthetics Engineering: Proceedings of the 2nd GeoMEast International Congress and Exhibition on Sustainable Civil Infrastructures, Egypt 2018 – The Official International Congress of the Soil-Structure Interaction Group in Egypt (SSIGE). Germany: Springer International Publishing, 2018.
2. Sarsby, R W "Geosynthetics in Civil Engineering, , Elsevier Science, United Kingdom 2006.
3. Shukla and Jian-Hua Yin, "Fundamentals of Geosynthetic Engineering", Imperial College Press, London, 2006.
4. Thyagarajan T, Ground Improvement and Geosynthetics, Springer, 2018.

**COURSE OUTCOMES:**

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

**CO1:** illustrate the different types of Geosynthetics

**CO2:** describe the different manufacturing processes of Geosynthetics.

**CO3:** elucidate the properties of Geosynthetics

**CO4:** identify the types of Geosynthetics suitable for different functions.

**CO5:** explain the types of Geosynthetics based on the field application.

**Board of Studies (BoS) :**

18th BoS of CE held on 05.04.2023

**Academic Council:**

20th Academic council held on 13.4.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable.

The knowledge of various Geosynthetics applications in the field of Civil engineering leads to the development of sustainable environment and resilient structure.

| CEDX 38 | DESIGN PRINCIPLES OF SPECIAL FOUNDATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**SDG: 11**

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:** To understand the types of foundations adopted in expansive soils.

**COB2:** To learn the design principles of the raft foundation

**COB3:** To impart knowledge on foundation suitable for machines.

**COB4:** To enable basic understanding on foundation for transmission line towers.

**COB5:** To provide knowledge on various foundations suitable for bridges.

**MODULE I FOUNDATIONS IN EXPANSIVE SOIL 9**

Introduction – Types of expansive soil - Free Swell Index – Swelling and shrinkage characteristics – IS codal provisions – Design principles of foundation in expansive soil - Replacement of soils and Cohesive Non Swelling (CNS) soil concept - Under reamed pile foundation - Remedial measures for cracked buildings

**MODULE II RAFT FOUNDATIONS 9**

Raft foundation - Types of rafts, Beams on elastic foundation - Allowable soil pressures for rafts in cohesionless and cohesive soils - Design principles of raft by rigid beam method and Winkler method – Codal provisions

**MODULE III MACHINE FOUNDATION 9**

Introduction - Soil dynamics - Free vibration and Forced vibration - Definitions -Natural frequency - Types of machines and machine foundation - General requirements - Design principle of machine foundations - Reciprocating type - Centrifugal type - Impact type - Isolation of foundation

**MODULE IV FOUNDATIONS FOR TRANSMISSION LINE TOWERS 9**

Introduction - Necessity - Forces on Tower Foundations - General design criteria - Choice and type of foundations - Design principles - Stability conditions

**MODULE V FOUNDATIONS FOR BRIDGES 9**

Bridge Foundations – Types – Design principles - Pile foundation - Well foundation - Caissons – Drilled shafts – Stability conditions

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**


1. Briaud J.L., "Foundations for Transmission Line Towers: Proceedings of a Session" Volume 8, American Society of Civil Engineers, Geotechnical special publications, 8th issue, 1987 (Digitized – 2008), ISBN: 0872625885, 9780872625884
2. Nayak, N.V., "Foundation Design manual for Practicing Engineers", Dhanpat Rai and Sons, 2012.
3. Swami Saran ,"Analysis and Design of Substructures" (LSD), Oxford & IBH Publishing Co Private Limited, 2nd Edition, 2018
4. Tomlinson, M.J. and Boorman. R., "Foundation Design and Construction", ELBS Longman, 6th edition, 2013.
5. Wayne C.Teng, "Foundation Design", Prentice Hall of India ( P ) Ltd., 13th edition, 1992.


**REFERENCES:**


1. Bowels J.E., "Foundation Analysis and Design", Mc Graw-Hill International Book Co., 5th edition, 2011
2. Braja M. Das, "Principles of Foundations Engineering", Thomson Asia (P) Ltd., 8th edition, 2015.
3. https://electrical-engineering-portal.com/design-of-overhead-transmission-line-foundation


**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:** identify various foundation and techniques suitable for problematic soil.

**CO2:** design a raft foundation based on soil type.

**CO3:** select the suitable foundation based on the machine type.

**CO4:** execute the foundation for the stability of transmission tower.

**CO5:** adopt suitable foundation based on the types of bridges

**Board of Studies (BoS) :**
19th of Civil held on 29.09.2023

**Academic Council:**
21st Academic council held on 20.12.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement: The basic understanding on design principles of various foundations corresponding to different structures and soil conditions leads to hassle free sustainable structure.

## SPECIALIZATION IV : ENVIRONMENTAL ENGINEERING

| CEDX 41 | AIR AND NOISE POLLUTION | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 3 | CONTROL | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objectives of the course are to impart knowledge on

**COB1:** the sources of air pollution and their effects on living and non-living environment.

**COB2:** sampling methods, analysis of air pollutants and dispersion of pollutants in environment

**COB3:** air pollution control equipment for gaseous and particulate pollutants

**COB4:** air quality management and regulations.

**COB5:** the sources, effects, prevention and control of noise pollution.

**MODULE I SOURCES AND EFFECTS OF AIR POLLUTANTS** **8**

Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Natural contaminants – aerosol - gases and vapour - Elements of atmosphere – Meteorological factors - Effects of air pollution on human beings, materials, vegetation, animals – global warming - ozone layer depletion.

**MODULE II SAMPLING, ANALYSIS AND DISPERSION OF POLLUTANTS** **9**

Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles – Wind roses – Lapse rate - Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.

**MODULE III AIR POLLUTION CONTROL** **9**

Concepts of air pollution control – Principles and design of control measures – Particulates pollutant control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries.

**MODULE IV AIR QUALITY MANAGEMENT 9**

Air quality standards – Air quality monitoring – Preventive measures - Air pollution control initiatives – Zoning – Town planning regulations for new industries – Legislation and enforcement – Environmental Impact Assessment and Air quality.

**MODULE V NOISE POLLUTION 10**

Sources of noise pollution – Characterization of Noise based on sources - Effects – Assessment - Standards – Prevention and Control of Noise Pollution at source, transmission, and receptor protection and other types - Noise Sound Absorbent – Noise Pollution Analyser – Acoustic quieting - Mechanical isolation technique, Acoustical absorption, Constrained layer damping – OSHA Noise standards and indices.

**L – 45; Total Hours – 45**

**TEXT BOOKS:**

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2002.
2. Chandrappa, R., Kulshrestha, U.K., “Sustainable Air Pollution Management: Theory and Practice”, Springer International Publishing House, AG Switzerland, 2015.
3. Rao, C.S., “Environmental Pollution Control Engineering”, New age International (P) Ltd., Revised 2nd Edition, 2006.
4. Surampalli, R., Zhang,T.C., Brar, S.K., Hegde,K., Pulicharla, R., Verma, M., “Handbook of Environmental Engineering”, McGraw Hill Professional, 2018.

**REFERENCES:**

1. Antony Milne, “Noise Pollution: Impact and Counter Measures”, David & Charles PLC, 2009.
2. Noel de Nevers, "Air Pollution control Engg." McGraw-Hill, New York,2005.
3. Peterson and Gross .E Jr., “Hand Book of Noise Measurement”, 7th Edn, 2003.
4. Rao.M.N , Rao, H.V.N "Air Pollution", Tata McGraw Hill, 2009.
5. Vallero, D., “Fundamentals of Air Pollution”, Elsevier Publishers, 5th Edition, 2014.

6. Wang, L.K., Pereira,N.C., “Hung,Y.T., “Advanced Air and Noise Pollution Control” Hand book of Engineering”, Vol-II, The Humana Press, Springer Science & Business Media New Jersey, 2007.

**COURSE OUTCOMES:**

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

**CO1:** classify the sources of air pollution and list its effects on living and non-living environment

**CO2:** sample, analyse the various air pollutants and demonstrate the procedure for dispersion.

**CO3:** identify and describe the functions of equipment available to control air pollution

**CO4:** suggest air pollution management through legislation and regulations

**CO5:** describe sources, characteristics, effects and control of noise pollution.

**Board of Studies (BoS) :**

16th BoS of Civil held on 5.1.2022.

**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 | - | - | L | - | - | M | M | - | - | - | - | L | - | - | L |
| CO2 | - | - | L | - | - | M | M | M | L | L | - | L | L | - | L |
| CO3 | - | - | L | - | - | M | M | M | L | L | - | L | L | - | L |
| CO4 | - | - | L | - | - | M | M | M | L | L | - | L | - | - | L |
| CO5 | - | - | L | - | - | M | M | M | L | L | - | L | L | - | L |

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

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

Statement : The understanding of air & noise pollution control and management substantially reduce the pollution and improves the health and well being of human

| CEDX 42 | SOLID WASTE MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 3 & 7 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objectives of the course are to impart knowledge on

**COB1:** sources, types, characteristics and effects of improper disposal of municipal solid waste.

**COB2:** on-site waste segregation and storage methods

**COB3:** different methods employed for waste collection and transfer

**COB4:** various types of waste processing techniques and resource recovery

**COB5:** solid waste management rules and components of a land fill.

**MODULE I INTRODUCTION TO MUNICIPAL SOLID WASTES 9**

Sources and types of solid wastes – Quantity – Factors affecting generation of solid wastes - Characteristics – Methods of sampling and characterization - Effects of improper disposal of solid wastes – Public health effects - Principle of solid waste management – Social & Economic aspects - Public awareness - Role of NGOs.

**MODULE II ON-SITE STORAGE & HANDLING 9**

Storage of household waste - Dry, wet and domestic hazardous, On-site storage methods - Materials used for containers – On-site segregation of solid wastes – Public health & Economic aspects of storage – Options under Indian conditions – Critical Evaluation.

**MODULE III COLLECTION AND TRANSFER 9**

Methods of Collection – Primary and secondary collection - Types of vehicles –Light commercial vehicles, Four wheeled mini trucks, Skip truck - Manpower requirement – Collection routes - Transfer stations – Selection of location, operation & maintenance - Extended producer responsibility.

**MODULE IV OFF-SITE PROCESSING 9**

Processing techniques – Mechanical volume reduction, Thermal volume reduction and Chemical volume reduction – Equipment - Compactors, Hydro-pulper, Hammer Mill, Shredder, Magnetic Seperators ; Resource recovery from solid wastes – composting, incineration, Pyrolysis, Emerging trends in gasification.

**MODULE V DISPOSAL OF SOLID WASTE 9**

Solid Waste management Rules 2016- Salient features- Duties and responsibilities of various authorities - Dumping of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment – Emerging challenges in solid waste management.

**L – 45; Total Hours – 45**

**TEXT BOOKS:**

1. George Tchobanoglous, Hilary Theisen, Vigil, S. A. Integrated Solid Waste Management, Engineering Principles and Management Issues, McGraw-Hill Education (India) Private Limited, 2014.
2. Ramesha Chandrappa, Diganta Bhusan Das, Solid Waste Management Principles and Practice, Springer Berlin Heidelberg, London, 2012
3. Ramachandra, T. V. Management of Municipal Solid Waste, TERI Press, New Delhi, 2011
4. Sasikumar, K., Sanoop Gopi Krishna, Solid Waste Management, PHI Learning, New Delhi, 2009.

**REFERENCES:**

1. CPHEEO, "Manual on Municipal Solid Waste Management", Central Public Health and Environmental Engineering Organisation, New Delhi, 2016.
2. Gomes, Maria Isabel, Martinho, G., Pires, A., Rodrigues, S., “Sustainable Solid Waste Collection and Management”, Springer International Publishing, Germany, 2018.
3. MSW Management Rules 2016, Govt. of India https://cpcb.nic.in/rules-2/

**COURSE OUTCOMES:**

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

**CO1:** describe the different sources, types and the effects of improper disposal of municipal solid waste

**CO2:** describe the storage, segregation and handling of solid waste

**CO3:** explain the methods of collection of solid waste

**CO4:** identify the offsite processing techniques and resource recovery from solid waste

**CO5:** explain the SWM rules and detail the operation of a land fill.

**Board of Studies (BoS) :**
16th BoS of Civil held on 5.1.2022.

**Academic Council:**18th Academic Council held on 24.02.2022

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

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

SDG 3: Ensure healthy lives and promote well-being for all at all ages
SDG 7: Affordable & Clean Energy

The knowledge about the management of solid waste and implementing techniques to minimize their adverse impacts on human health and environment will ensure the promotion of a healthy community

| CEDX 43 | INDUSTRIAL WASTEWATER | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 6 | TREATMENT | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge on the sources of industrial wastewater, environmental impacts and the statutory requirements.

**COB2:** To provide the knowledge on preliminary treatment methods of industrial wastewater.

**COB3:** To familiarize on the advanced treatment employed for industrial wastewater.

**COB4:** To provide insight knowledge on the process for waste audit and pollution prevention techniques.

**COB5:** To impart knowledge on the wastewater treatment method for different industrial effluent.

**MODULE I TYPES AND GENERATION 9**

Water use in industries - Industrial wastewater generation rates - Sources, types of industrial wastewater - Disposal standards - Environmental impacts on streams, land and sewerage system - Difference between industrial & municipal wastewaters - Regulatory requirements for treatment - Toxicity and Bioassay tests

**MODULE II INDUSTRIAL WASTEWATER TREATMENT 9**

Principle and functions of - Equalization - Neutralization – Oil Separation – Flotation - Aerobic and anaerobic biological treatment - High rate reactors - Nutrient removal - Quality requirements for wastewater reuse

**MODULE III ADVANCED TREATMENT TECHNIQUES 9**

Heavy metal removal - Membrane Separation Process - Chemical oxidation - Ozonation – Photo catalysis - Wet air Oxidation - Evaporation – Ion Exchange - Zero effluent discharge systems

**MODULE IV INDUSTRIAL POLLUTION PREVENTION 9**

Strength reduction – Volume reduction techniques - Waste Audit - Evaluation of pollution prevention options - Waste minimisation - Barriers for waste minimisation - Cleaner production.

**MODULE V TREATMENT OF WASTEWATER FOR SPECIFIC INDUSTRIES** 9

Industrial wastewater characteristics, Wastewater treatment for Textiles - Tanneries - Pulp and paper - Pharmaceuticals - Sugar - Distilleries - Food Processing - Fertilizers – Steel and Thermal Power Plants

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Athar Hussain, Sirajuddin Ahmed. “Advanced Treatment Techniques for Industrial Wastewater”, IGI Global, USA, 2018.
2. Arceivala, S.J., “Wastewater Treatment for Pollution Control & Reuse”, McGraw-Hill, New Delhi, 3rd Edition, 2006.
3. Narayana Rao M and Amal K. Datta “Wastewater Treatment, Rational methods of Design and Industrial practices”, Oxford and IBH Publications, Third Edition, New Delhi, Reprint 2009.
4. NG Wun Jern. “Industrial Wastewater Treatment”. World Scientific, Imperial College Press, Singapore, 2020.
5. Patwardhan, A. D, “Industrial Wastewater Treatment”, PHI Learning (P) Ltd., New Delhi, 2017.

**REFERENCES:**

1. Frank Woodard, "Industrial Waste Treatment Handbook", Butterworth Heinemann, New Delhi, 2001.
2. John Arundel, “Sewage and Industrial Effluent Treatment”, Wiley Blackwell, 2nd Edition, 2013.
3. Metcalf and Eddy, “Wastewater Engineering: Treatment and Reuse”, McGraw – Hill, New Delhi, 2017.
4. Srinu Naik Sapavatu, Shirish H. Sonawane, Y. Pydi Setty, T. Bala Narsaiah, “Innovative Technologies for the Treatment of Industrial Wastewater: A Sustainable Approach”, Apple Academic Press and CRC Press, Taylor & Francis Group, Canada, 2017.
5. Vivek V. Ranade and Vinay M. Bhandari, “Industrial Wastewater Treatment, Recycling and Reuse”, Butterworth Heinemann, Elsevier, USA, 2014.

**COURSE OUTCOMES:**

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

**CO1:** Identify the various sources of industrial wastewater and will be able to list the statutory requirements.

**CO2:** Describe the functions of the common units of industrial

wastewater treatment

**CO3:** Explain the advanced methods of industrial wastewater treatment

**CO4:** Describe the waste audit and pollution prevention techniques.

**CO5:** Identify the wastewater treatment method based on different industrial effluent.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

SDG 6: Ensure availability and sustainable management of water and sanitation for all.

Statement: The holistic understanding of industrial wastewater treatment leads to the prevention of pollution caused by the industrial effluents and improves the possibility for recycling and safe reuse.

| CEDX 44 | HAZARDOUS WASTE MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 6 & 12 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:** To impart knowledge on the various sources, characterization of hazardous wastes and various collection methods.

**COB2:** To familiarise the knowledge on the on-site and off-site processing techniques of hazardous waste including disposal methods.

**COB3:** To create the understanding on the reclamation and remediation techniques for the hazardous waste.

**COB4:** To impart knowledge on the types of electronic waste, methods of waste separation, reuse and recycle of E-waste.

**COB5:** To give an exposure to types, collection and separation of plastic waste and management of plastic waste.

**MODULE I HAZARDOUS WASTE AND COLLECTION METHODS 9**

Hazardous substances and wastes- Sources and quantity of generation – Composition and its physical form- Waste Collection, segregation at source, on and off site collection - Pre transport requirements - Safety in handling, transportation, storage, treatment and disposal technologies - Legal and Administrative requirements - Regulations for pollution control - Administrative liability.

**MODULE II TREATMENT METHODS 9**

Physical, chemical and biological treatment technologies – Criteria for treatment, storage and disposal facilities (TSDF) - Site selection for TSDF - Landfill, standards and guidelines for accepting a waste for land disposal- Leachate management - Thermal treatment - Incinerability tests, different types of incinerators and their applicability - Waste minimisation.

**MODULE III RECLAMATION AND REMEDIATION 8**

Reclamation of hazardous wastes - Management of gaseous emissions/air pollutants generated during treatment and disposal operations of hazardous wastes - Remediation of hazardous waste sites – Physical remediation – Bioremediation - Case studies.

**MODULE IV ELECTRONIC WASTE MANAGEMENT 9**

Introduction to electronic waste – Categories in electronic waste – Electronic waste management rules (2016) - Collection, separation of E-waste - Health hazard due

to informal recycling of E-Waste - Social impacts of recycling of E-Waste – E-waste Management - Life cycle assessment of E- waste

**MODULE V PLASTIC WASTE MANAGEMENT 10**

Introduction to plastics – Characteristics of plastics - Types of plastics - Plastic waste management rules (2016) - Size reduction of recycled plastics – cutting / shredding, densification, pulverization and chemical size reduction processes – Onsite recycling of plastics (household and industry) - Recycling of polymer thermoset composites – regrind processes – Pyrolysis and energy recovery - Recent Plastic Waste Management Practices.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Blackman, W.C “Basic Hazardous Waste Management”, CRC Press, New Delhi, 2016.
2. Habibur Rahman.M and Abdullah Al-Muyeed, “Solid and Hazardous Waste Management”, ITN – BUET, Bangladesh, 2010.
3. Plastic waste management in India: An integrated solid waste management approach, World Scientific Publishing Co., Singapore, 2014.
4. Stanley E. Manahan, “Industrial Ecology: Environmental Chemistry and Hazardous Waste”, Routledge, 2017.

**REFERENCES:**

1. Electronic Waste Management Rules 2016, Govt. of India. https://cpcb.nic.in/e-waste/
2. Michael D. Lagrega, Phillip L. Buckingham and Jeffrey C. Evans., “Hazardous Waste Management” 2nd Edition, McGraw Hill International, London, 2010.
3. MSW Management Rules 2016, Govt. of India https://cpcb.nic.in/rules-2/
4. Plastic waste Management Rules 2016, Govt. of India https://cpcb.nic.in/rules-4/.
5. Plastic waste management Issues, solution & case studies, Ministry of housing urban affairs, Government of India, 2019. (WWW.Mohua.gov.in.)
6. Rules and Regulation of Hazardous substance management”, Ministry of Environment, Forest and Climate change, 2015.

**COURSE OUTCOMES:**

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

**CO1:** Identify the various sources, collection and treatment process of hazardous waste and will be able to explain about its legal provision.

**CO2:** Specify the basic requirements needed for land disposal and its management techniques.

**CO3:**Assess the various treatment methods of hazardous waste and summarise the various remediation techniques based on case studies

**CO4:** Enumerate about the classification of e-waste, health and social impacts due to e-waste and its management Rules.

**CO5:** Explain the characteristics of various types of plastics and regulate the plastic waste reuse, recycling and management process using plastic waste management Rules.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

SDG 6 : Ensure availability and sustainable management of water and sanitation for all.

SDG 12 : Ensure sustainable consumption and production patterns

The environmentally sound management of hazardous waste through treatment and remediation would substantially reduce its impact on the environment.

| CEDX 45 | ENVIRONMENTAL RISK ASSESSMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 3&6 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge on various types of risk and regulatory perspectives and requirement of risk management

**COB2:** To make them to assess, analyse and categorize the various types of risks and vulnerability.

**COB3:** To give knowledge on various assessing tools and methods for risk assessment.

**COB4:** To enable them to manage the risk under various situations and provide the preparedness plan.

**COB5:** To familiarise them about the various environment health risk and its assessment based on various industries.

**MODULE I RISK ASSESSMENT** **8**

Sources of Environmental hazards – Environmental and Ecological Risks – Environmental risk assessment framework – Regulatory perspectives and requirements – Risk analysis and management

**MODULE II ELEMENTS OF ENVIRONMENTAL RISK ASSESSMENT** **9**

Hazard identification – Receptor exposure to environmental contaminants - Dose Response Evaluation – Exposure Assessment – Exposure Factors, Slope factors, dose response calculations and dose conversion factors – Risk characterization – Vulnerability assessment – Uncertainty analysis.

**MODULE III TOOLS AND METHODS** **9**

HAZOP and FEMA methods – Cause failure analysis – Event tree and Fault tree modelling and analysis – Estimation of carcinogenic and non-carcinogenic risks to human health – Methods in ecological risk assessment – Radiation risk assessment – Data sources and evaluation.

**MODULE IV RISK MANAGEMENT** **9**

Risk communication and Risk perception – Comparative Risks – Risks based decision making – Risk based environmental standard setting – Risk cost benefit optimization and tradeoffs – Emergency preparedness plans- Design of Risk management programs – Risk based remediation.

**MODULE V HEALTH RISK ASSESSMENT &CASE STUDIES** **10**

Health risk assessment (HRA) - Characteristics of HRA - Benefits – General guide line for HRA - Linkage between environmental hazard and human health - Case studies on risk assessment and management for hazardous chemical storage, Tanneries, Textile industries, Hazardous waste disposal facilities, Nuclear power plants.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 2009.
2. Dalezio, N.R, "Environmental Hazards Methodologies for Risk Assessment and Management", IWA Publishing, UK, 2017.
3. Gruiz, K., Meggyes, T., Fenyvesi, E., "Engineering Tools for Environmental Risk Management", Taylor and Francis, 2014.
4. Kasperson,J.K., Kasperson,R.E., "Global Environmental Risks", V.N.University Press, New York, 2003.

**REFERENCES:**

1. Joseph F Louvar and B Diane Louver "Health and Environmental Risk Analysis fundamentals with applications", Prentice Hall, New Jersey 2011.
2. Kofi Asante Duah Risk Assessment in Environmental management, John Wiley and sons, Singapore, 2013.
3. Mark G.Robson, William S.Toscono, Qingyu Meng and Debra A.Kaden, "Risk Assessment for Environmental Health", CRC Press, 2nd Edition 2022.
4. Theodore, L., Dupont, R.R., "Environmental Health and Hazard Risk Assessment: Principles and Calculations", CRC Press, Taylor and Francis, 2012.
5. Ted Simson, "Environmental Risk Assessment a Toxicological Approach" CRC Press, Taylor & Francis group, Second Edition, 2020.
6. Susan L.Cutter, "Environmental Risks and Hazards" Prentice Hall of India, New Delhi 2009.

**COURSE OUTCOMES:**

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

**CO1:** Attain knowledge on environmental risk and its framework

**CO2:** Evaluate the hazard exposure level and characterize the risk based on its vulnerability.

**CO3:** Identify the risk by using various risk assessing tools and methods.

**CO4:** Manage the risk situations and provide preparedness plans

**CO5:** Explain the environmental health hazard and the risk assessment for various industries.

**Board of Studies (BoS):**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | M | - | L | M | H | L | - | - | - | - | - | - | H |
| CO2 | L | L | M | - | L | M | H | L | - | - | - | - | - | - | H |
| CO3 | L | L | M | - | H | M | H | L | - | - | - | - | - | - | H |
| CO4 | L | L | M | - | L | M | H | L | - | - | - | - | - | - | H |
| CO5 | L | L | M | - | L | M | H | L | - | - | - | - | - | - | H |

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

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

SDG 6: Ensure availability and sustainable management of water and sanitation for all.

Statement: The knowledge about the risk assessment leads to protection of environment and health against any hazard.

| CEDX 46 | ENVIRONMENTAL IMPACT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 3,6, 15 | ASSESSMENT | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge on the importance and stages of Environmental Impact Assessment.

**COB2:** To give exposure to the methodologies of EIA.

**COB3:**To impart an understanding of the public participation, resettlement and rehabilitation processes in EIA.

**COB4:** To familiarize the students with the documentation of EIA and environmental management plan.

**COB5:**To enhance knowledge on the exposure related to the environmental audit and life cycle assessment

**MODULE I BASIC CONCEPTS 9**

Evolution of EIA (Environmental Impact Assessment) - Concepts - Stages of EIA -Screening - Scoping – Mitigation- Need for EIA – Environmental Impact Statement (EIS) - EIA capability and limitations-, Types of EIA - Rapid and Comprehensive EIA - Legislative and Environmental Clearance procedure in India

**MODULE II EIA METHODOLOGIES 9**

Methods of EIA –Check lists – Matrices – Networks – Cost-benefit analysis –Analysis of alternatives- Impact of development projects – Sustainable development-Assessment of Impact - Air - Water - Soil – Noise and Biological environment.

**MODULE III PUBLIC PARTICIPATION 9**

Socio-cultural impact assessment - Public participation – Addressing the issues related to the Project - Resettlement and rehabilitation– Policy, Regulation frame work and its amendment- Environmental and Social Management Frame work (ESMF).

**MODULE IV MONITORING 9**

Documentation of EIA - Environmental management plan– ISO 14000 - Plan for mitigation of adverse impact on environment -options for mitigation of impact on water, air and land, flora and fauna; Post project monitoring.

**MODULE V ENVIRONMENTAL AUDIT & CASE STUDIES 9**

Environmental Audit- Life cycle assessment case studies – Environmental Management System - Industrial ecology – carbon trading- EIA for infrastructure projects – Bridges – Highways – Dams.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Canter, R. L., “Environmental Impact Assessment”, McGraw Hill, New Delhi, 2006.
2. David P.Lawrence, “Environmental Impact Assessment: Practical Solutions to Recurrent Problems”, John Wiley & Sons, Inc.,2003.
3. Hundloe, Tor., “ Environmental Impact Assessment: Incorporating Sustainability Principles”, Springer International Publishing, 2022.
4. Kevin Hanna, “Routledge Handbook of Environmental Impact Assessment”, Taylor & Francis, 2022.

**REFERENCES:**

1. Environmental Assessment Source book”, Vol. I, II & III. The World Bank, Washington, D.C., 2001.
2. Judith Petts, “Handbook of Environmental Impact Assessment Vol. I & II”, Blackwell Science, 2006.
3. John G. Rau and David C Hooten(Ed)., “Environmental Impact AnalysisHandbook”, McGraw-Hill Book Company, 2000.
4. “Ministry of Environmental, Forest and Climate Change, “EIA Manual”, Impact Division, Government of India, 2001. http://www.moef.nic.in/division/eia-manual.
5. Raman, N. S.., Gajbhiye, A. R.., Khandeshwar, S. R.. Environmental Impact Assessment. India: I.K. International Publishing House Pvt. Limited, 2014.
6. Shukla, S. K., and Srivastava.P.R. “Concept in Environmental Impact Analysis”, Common wealth publishers, New Delhi, 2002.

**COURSE OUTCOMES:**

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

**CO1:**Describe the concepts of Environmental impact assessment.

**CO2:**Explain the methodologies of EIA and apply the prediction tools to assess the impact

**CO3:**Describe the process of public participation, settlement & rehabilitation in EIA

**CO4:**Prepare documentation of EIA and develop environmental management plan

**CO5:**Conduct environmental audit and life cycle assessment.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

SDG 3: Ensure healthy lives and promote well-being for all at all ages
SDG.6: Ensure availability and sustainable management of water and sanitation for all
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
Statement : The knowledge about the process of EIA leads to reduction of impact on environment due to any infrastructure project

| CEDX 47 | SUSTAINABLE WATER AND | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 6 &11 | SANITATION FOR SMART CITIES | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge on The concepts of smart water management in cities.

**COB2:** To provide insight on the tools used in the implementation of smart water management.

**COB3:**To familiarize the components of smart wastewater management and sustainable treatment techniques.

**COB4:** To impart knowledge on the policy requirements and faecal sludge management in smart cities.

**COB5:**To introduce the recent initiatives opted in the smart cities for sustainable water and sanitation.

**MODULE I SMART WATER MANAGEMENT(SWM) 9**

Need for Smart Cities – Smart Environment- Institutional and political responsibility - Urban water management challenges- Urban water balance –Climate change effects on urban water resources – Smart water management tools - Economic, Social and Environmental benefits of Smart water management.

**MODULE II IMPLEMENTATION OF SWM TOOLS 9**

Smart pipes and Sensors networks-Water Quality monitoring using sensors- Novel Sensing Techniques - Advanced metering infrastructure and Smart metering – Applications of GIS, Cloud computing, SCADA, Web based communication tools in smart water and flood management in cities.

**MODULE III SMART WASTEWATER MANAGEMENT 9**

Definition, need and components of Smart wastewater management systems-Smart solutions- Prevention of combined sewage overflow - leak detection, chemical detection in sewage - Application of sensors in wastewater treatment plants and networks - Onsite and offsite challenges in wastewater treatment - Decentralized wastewater treatment systems- Onsite greywater treatment - wetland treatment- Capturing nutrients.

**MODULE IV FAECAL SLUDGE MANAGEMENT 9**

National Policy on Faecal Sludge and Septage Management - Current practice of FSM in Indian cities and challenges-Sanitation service chain-Identification of smart operative solution and treatment options

**MODULE V INITIATIVES & CASE STUDIES 9**

Water saving initiative- Wastewater recycling initiative- Smart agriculture and irrigation initiatives- Cases studies.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Anil Ahuja, “Integration of nature and technologies for smart cities” Third edition, Springer, Switzerland, 2016.
2. David A. Lloyd Owen, “Smart Water Technologies and Techniques: Data Capture and Analysis for Sustainable Water Management”, Wiley-Blackwell, 2018.
3. Pradeep Tomar, Gurjit Kaur, “Green and Smart Technologies for Smart Cities”, CRC Press, 2019
4. Vinod Kumar, TM. “Smart Environment for Smart Cities”, Springer, Singapore, 2019.

**REFERENCES:**

1. Linda Strande, “Faecal Sludge Management: Systems Approach for Implementation and Operation”, IWA ,UK, 2014.
2. “Smart Cities Mission Statement & Guidelines”, Ministry of Urban Development, Government of India, New Delhi, 2015.
3. Vinod Kumar, T.M., “E-Democracy for smart cities”, Springer, Singapore, 2017.

**COURSE OUTCOMES:**

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

**CO1:**Describe the concepts of smart water management in cities.

**CO2:**Illustrate the tools used in the implementation of smart water management.

**CO3:**Explain the components of smart wastewater management and sustainable treatment techniques.

**CO4:**Illustrate the concepts of faecal sludge management in smart cities.

**CO5:**Describe the various initiatives opted in the smart cities for sustainable water and sanitation.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | L | H | | | | | M | | | H |
| CO2 | | | | | | L | H | | | | | M | | | H |
| CO3 | | | | | | L | H | | | | | M | | | H |
| CO4 | | | | | | L | H | | | | | M | | | H |
| CO5 | | | | | | L | H | | | | | M | | | H |

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

SDG No.6 : Ensure availability and sustainable management of water and sanitation for all.

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable
Statement : The understanding of Smart techniques for managing water , wastewater and sanitation leads to the development of sustainable smart cities

## SPECIALIZATION V: HYDROLOGY AND WATER RESOURCES ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| **CEDX 51** | **HYDROLOGY** | **L** | **T** | **P** | **C** |
| **SDG: 13** | | **3** | **0** | **0** | **3** |

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:**To impart knowledge on hydrological cycle and fundamentals of precipitation

**COB2:** To enable the students to understand the various losses from precipitation.

**COB3:**To provide basic analytical concepts of hydrograph

**COB4:**To familiarize with the computation of runoff.

**COB5:**To equip knowledge on the hydrological aspects of flood and flood routing.

**MODULE I PRECIPITATION 10**

Hydrologic cycle – Types of precipitation – Forms of precipitation – Measurement of Rainfall – Spatial measurement methods – Temporal measurement methods – Frequency analysis of point rainfall – Intensity, Duration, Frequency relationship – Probable maximum precipitation

**MODULE II ABSTRACTION FROM PRECIPITATION 8**

Losses from precipitation – Evaporation process – Reservoir evaporation – Infiltration process – Infiltration capacity – Measurement of infiltration – Infiltration indices – Effective rainfall.

**MODULE III HYDROGRAPHS 10**

Introduction - Factors affecting Hydrograph – Base flow separation – Unit hydrograph – Derivation of unit hydrograph – S curve hydrograph – Unit hydrograph of different durations - Synthetic Unit Hydrograph-Problems.

**MODULE IV RUNOFF ESTIMATION 9**

Watershed, catchment and basin - Catchment characteristics - factors affecting runoff -Runoff calculation using empirical formulae - SCS curve number method - Rational formulae – Hydrograph methods – Introduction to rainfall runoff modeling - Application of GIS in rainfall runoff analysis - Case studies.

**MODULE V FLOODS AND FLOOD ROUTING 8**

Natural Disasters-Flood Estimation -Flood frequency studies – Recurrence interval – Gumbel's method – Flood routing – Reservoir flood routing – Muskingum's Channel Routing – Flood control measures.

**L –45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Jayarami Reddy, P., "Hydrology", Laxmi Publications (P) Ltd., New Delhi, 3rd Edition, 2016.
2. Patra.K.C, "Hydrology and Water Resources Engineering", Narosa Publications, 2nd Edition, New Delhi,2nd Edition, 2015.
3. Raghunath, H.M., "Hydrology – Principles, Analysis and Design", New Age International (P) Ltd., New Delhi, 3rd Edition 2014.
4. Subramanya, K., "Engineering Hydrology", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 3rd Edition 2009.

**REFERENCES:**

1. Bedient, P.B., Huber, W.C., Vieux, B.E., "Hydrology and Floodplain Analysis", Pearson Education India, 5thEdition, 2012.
2. Chow, V.T. and Maidment, "Hydrology for Engineers", McGraw-Hill Inc. Ltd., New York, 2000.
3. Singh, V.P., "Hydrology", McGraw-Hill Inc. Ltd., New York, 2000.

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

**CO1:** describe about the hydrologic cycle, precipitation and frequency rainfall analysis.

**CO2:** estimate the losses from precipitation and compute the effective rainfall.

**CO3:** analyze the hydrograph of different duration and different intensity of rainfall.

**CO4:** estimate runoff using different methods.

**CO5:** analyze the frequency of flood and suggest the flood control measures.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

**SDG 13**: Climate change is a global challenge that effects everyone and everywhere.

The effect of climate change may affect the entire hydrological cycle process which may be lead to protect the atmosphere and save our environment.

| CEDX 52 | GROUNDWATER ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 12 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To introduce the basic concepts of hydro geological parameters.

**COB2:**To acquire the knowledge towards the concepts of well hydraulics

**COB3:**To study about the groundwater quality and the effect of saline intrusion

**COB4:** To understand the application of various groundwater extraction methods.

**COB5:** To impart knowledge on the importance of ground water conservation and management.

**MODULE I HYDROGEOLOGICAL PARAMETERS 10**

Introduction – Water bearing Properties of Rock – Type of aquifers – Aquifer properties – Permeability, Specific yield, Transmissivity and Storage coefficient – Methods of Estimation– Ground water table fluctuation and its interpretations – Groundwater development and Potential in India – GEC norms.

**MODULE II WELL HYDRAULICS 10**

Objectives of Groundwater hydraulics – Darcy's Law – Groundwater equation – Steady state flow – Dupuit's Forchheimer assumption – Unsteady state flow – Theiss method – Different methods of well construction - Construction of well casings and screens - Natural and artificial gravel packed wells - Safe yields – Estimation of pumping and recuperation tests – Image well theory – Partial penetrations of wells.

**MODULE III GROUNDWATER QUALITY 8**

Ground water chemistry – Origin, movement and quality – Water quality standards – Health and aesthetic aspects of water quality – Saline intrusion – Environmental concern and Regulatory requirements

**MODULE IV GROUNDWATER EXTRACTION 9**

Tube wells- Types and Parts- Silting of tube well - Construction and working of tube wells- Site selection, Drilling operation, Alignment of tube wells, Gravel packing- Methods - Cable tool method- Hydraulic method -

Bore hole - Strains – Types - Pumping equipment and hydraulic testing of pumps.

**MODULE V GROUNDWATER CONSERVATION AND MANAGEMENT** **8**

Artificial recharge techniques - Remediation of Saline intrusion - Ground water management studies - Protection zone delineation - Contamination source inventory - Remediation schemes - Ground water pollution and legislation - Need for management model - Database for groundwater management - Groundwater balance study - Conjunctive use - Collector well and Infiltration gallery.

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Raghunath H.M., “Ground Water Hydrology”, New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., “Ground Water Hydrology”, John Wiley and Sons, New York, 2011.

**REFERENCES:**

1. Chahar BR, Groundwater hydrology, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2015.
2. Fitts R Charles, “Groundwater Science”. Elsevier, Academic Press, 2012.
3. Ramakrishnan, S, “Ground Water”, K.J. Graph arts, Chennai, 2011.
4. Rastogi A.K. , Numerical Groundwater Hydrology, 2011

**COURSE OUTCOMES:**

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

**CO1:**describe the aquifer properties and interpretation of groundwater

**CO2:**apply the knowledge of groundwater flow in steady and unsteady flow characteristics of well hydraulics

**CO3:**describe the importance of groundwater quality

**CO4:**apply the knowledge on groundwater extraction methods

**CO5:** apply the creative and innovative technique on conservation of groundwater

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 18th BoS of CE held on 05.04.2023 | 20th Academic council held on 13.4.2023 |

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

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

SDG 12: Securing a responsible production and consumption

The concept of groundwater engineering is to conserve the water instead of over exploiting, as it is major natural resource which can be saved for future generation if it is consumed in a sustainable way.

| CEDX 53 | STORM WATER AND FLOOD MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 13 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To understand the concept of storm water flow and its conservation

**COB2:**. To impart the knowledge on watershed management and flood estimation.

**COB3:** To provide knowledge on flood modeling and its software.

**COB4:** To expose knowledge on flood prevention, preparedness and mitigation measures

**COB5:** To provide exposure to flood damage assessment, recovery, rehabilitation measures and National disaster management guidelines on flood management.

**MODULE I STORM WATER SYSTEM 10**

Storm water flows in Channels and Conduits - Gutters and Inlets - Hydraulic routing - Engineered Channels - Hilly Terrain - Coastal Terrain -Buried Storm Water Conduits- Storage Reservoir - Pumping Station - Storm water Storage Pond/Basin - Integration of rainwater harvesting & recharge systems with storm water drainage design

**MODULE II HYDROLOGICAL PROCESS 9**

Water shed - Watershed management- Rain fall runoff process – Hydrologic extremes – Flood – Types of Floods – Effects of Flood – Causes of flood – Impacts - Design concepts of Flood - SPF/MPF - Estimation of design flood – Physical Indicators - Envelope curves - Empirical methods – Rational method.

**MODULE III FLOOD MODELING 8**

Basic principles and aspects of flood modelling - Flood Hazard Modeling – Flood Plain delineation & mapping using GIS – Introduction about HEC RAS & HEC HMS.

**MODULE IV FLOOD RISK MANAGEMENT 9**

Flood plain management – Tools for flood plain management –Flood prevention, preparedness and mitigation – Frame work - Structural and Non-structural flood mitigation measures– Integrated watershed management-Urban and Rural development planning – Public awareness and capacity building.

**MODULE V FLOOD MONITORING AND MANAGEMENT 9**

Flood forecasting and warning–Indian context - Emergency response planning and management – Evacuation process and Rescue process– Environmental health - Concepts of recovery and rehabilitation – Flood damage assessment – Management of recovery and rehabilitation activities- National disaster management guide lines on flood management - Case studies

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Andreas H. Schumann., “Flood Risk Assessment and Management”, Springer Science & Business Media B.V.2011
2. Rangapathy.V. Karmegam. M and Sakthivadivel.R., “Monograph in flood routing methods as applied to Indian Rivers” Anna University Publication,2000

**REFERENCES:**

1. Ashley R., Garvin S., Pasche E. and Vassilopoulos A., Advances in Urban Flood Management, Balkema, 2007.
2. James C Y Guo. “Urban Flood Mitigation and Stormwater Management” CRC Press, 2017
3. Engineering hydrology by K. Subramanya, Tata McGraw-Hill Education, 2017
4. Frans Klijn and Timo Schweckendiek. “Comprehensive Flood Risk Management: Research for Policy and Practice” CRC Press, 1st edition 2012.
5. Manual on storm water drainage system, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2019.
6. Paul Sayer, “Flood Risk: Planning, Design and Management of Flood Defense Infrastructure” ICE Publication, 2012.

**COURSE OUTCOMES:**

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

**CO1:** manage the urban storm water systems to reduce the detrimental impacts

**CO2:** apply the technical knowledge on hydrological process and flood estimation

**CO3:** demonstrate their knowledge on flood mapping and modeling

**CO4:**. acquire the knowledge on flood mitigation measures and public awareness.

**CO5:** analyze the flood forecasting and flood disaster

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

**SDG 13**: Take urgent action to combat climate change and its impacts

Climate change action is increasing the frequency and intensity of extreme weather events such as floods and cyclones, aggravating water management problems, damaging critical infrastructure and interrupting the provision of basic services such water, sanitation and energy etc.

**CEDX 54** **DESIGN OF HYDRAULIC STRUCTURES** **L T P C**

**SDG: 9** **3 0 0 3**

**COURSE OBJECTIVES:** The objectives of the course are

**COB1:** To provide basic knowledge on analyzing the various forces acting on the dam and functions of energy dissipators.

**COB2:** To impart knowledge on the design aspects of regulation structures

**COB3:** To study the design features of various canal drops.

**COB4:** To know about the types of cross drainage works and the design concepts.

**COB5:** To acquire the knowledge on the design aspects of various components of tank structure.

**MODULE I** **IMPOUNDING STRUCTURES** **9**

Introduction - Design and drawing of Gravity Dam – Earth dam – Energy dissipation devices – Intake structures

**MODULE II** **CANAL REGULATION STRUCTURES** **10**

Introduction - Design and drawing of Diversion head works – Cross and Head Regulators -Canal escape – Silt Exclusion structures

**MODULE III** **CANAL DROPS** **9**

Introduction - Design and drawing of Canal drops – Notch type – Syphon well drops

**MODULE IV** **CROSS DRAINAGE WORKS** **8**

Introduction – Design and drawing of Aqueducts – Syphon aqueducts – Super passage – Canal syphon

**MODULE V** **TANK IRRIGATION STRUCTURES** **9**

Introduction - Design and drawing of Tank surplus weirs - Tank sluice

**L –45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Garg, S.K., “Irrigation Engineering and Design of hydraulic structures”, Khanna Publishers, New Delhi, 2009.
2. Novak P, Hydraulic Structures, Taylor and Francis Group publishers, 2001
3. Satyanarayana Murthy, “Irrigation Design and Drawing”, L. Banumathi Publishers, Tuni, East Godavari District, A.P., 1998.

**REFERENCES:**

1. Mohanakrishnan. A, “A few Novel and Interesting Innovative Irrigation Structures: Conceived, Designed and Executed in the Plan Projects in Tamil

Nadu", Publication. No. 44 and Water Resources Development & Management Publ.No.43, IMTI Thuvakudy, Trichy, 2011.
2. Sharma, R.K., "Irrigation Engineering and Hydraulic Structures", Oxford and IBH Publishing Co., New Delhi, 2002.

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

**CO1:** analyze and design gravity dam and earth dam based on the hydraulic particulars
**CO2:** plan and design the regulating structures based on the discharge released.

**CO3:** assess the design aspects of the canal irrigation structures.

**CO4:** design the aqueducts based on the site condition

**CO5:** differentiate the design of tank surplus weir and tank sluice

**Board of Studies (BoS) :** **Academic Council:**

19th of Civil held on 29.09.2023

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

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

SDG 9: Investments in infrastructure are crucial to achieving sustainable development.

To provide the sustainable development in the field of irrigation, the storage structures like dams, tanks etc., are constructed.

| CEDX 55 | WATER POWER | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 12 | ENGINEERING | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:** The objectives of the course are

**COB1:** To provide the basic concepts of hydropower engineering and its classification.

**COB2:** To get an exposure on concept of water conveyance system

**COB3:** To gain knowledge on the operation of waterpower generation units.

**COB4:** To study the estimation of waterpower potential.

**COB5:** To familiarize on the hydropower generation by various case studies

**MODULE I HYDROPOWER 9**

Introduction – Sources and forms of energy - Hydropower Plants Classification: Surface and Underground power stations - Low, medium and high head plants - Pumped storage plants - Environmental Considerations - Hydropower Development in India – Development of hydropower schemes.

**MODULE II WATER CONVEYANCE SYSTEM 9**

Components - Intake, gates, valves, canals, penstocks – Classification - Design criteria - Water hammer – Rigid and Elastic Water column theories – Surge tanks – Behaviour - Types of surge tank – Stability.

**MODULE III WATER POWER GENERATION SYSTEM 9**

Location of power house – Site selection of hydropower plant - General arrangement of hydropower unit - Number and size of units - Safety requirements - Operation and maintenance of hydropower plants.

**MODULE IV WATERPOWER POTENTIAL AND ANALYSIS 9**

Collection and analysis of stream flow data, mass curve, flow duration curves - Effect of storage and pondage - Estimation of available water - Reservoir capacity and Capacity factor - Data requirement for assessment of hydropower.

**MODULE V CASE STUDY 9**

Koteshwar project on Bhagirathi River in India - Sardar Sarovar Hydropower Project on Narmada River in India – Mettur Hydropower project in TamilNadu – Kundah Hydropower in TamilNadu - Bhavani Kattalai Hydropower Project in TamilNadu.

**L –45; TOTAL HOURS –45**

**TEXT BOOKS:**


1. Modi.P.N, "Irrigation Water Resources and Water Power Engineering" standard book house 9th edition, 2011.
2. Nag P.K., "Power Plant Engineering" Tata McGraw Hill, 2nd Edition, Fourth reprint, 2003.
3. Rai-Khanna. G.D., "An introduction to power plant technology" Publishers, Delhi, 2013
4. Sharma R.K. & Sharma T.K., A Text book of "Water Power Engineering", S. Chand Publication, 2003.


**REFERENCES:**


1. Dr. B. C. Punmia, Dr. Pande Brij Basi Lal, Ashok Kumar Jain, and Arun Kumar Jain,"Irrigation and Water Power Engineering", Laxmi Publication,17th Edition, New Delhi,2021.
2. Sharma P.C, Kataria S. K. & Sons, "Power Plant Engineering" 2009.


**COURSE OUTCOMES:**

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

**CO1:** classify the various types of hydropower plants

**CO2:** assess the components and behaviors of water conveyance system

**CO3:** acquire knowledge on the installation, safety measures, maintenance and operation of hydropower units

**CO4:** analyze the power potential, demand and its estimation

**CO5:** apply knowledge on different hydropower plant projects

**Board of Studies (BoS):** **Academic Council:**

19th of Civil held on 29.09.2023

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

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

SDG 12: Securing a responsible, production and consumption

The study on waterpower engineering will be useful for the students in generating the hydropower with the available resources.

| CEDX 56 | WATER DISTRIBUTION SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 6 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To educate the students with basic concepts of water distribution system

**COB2:** To emphasis on the analysis of water distribution network.

**COB3:** To familiarize on the storm water runoff estimation and buried pipes.

**COB4:** To assess the design concepts of water distribution system.

**COB5:** To gain knowledge on the basic concepts of fluid transients

**MODULE I WATER SUPPLY SYSTEMS 9**

Water requirement – Sources of water – Water demand – Reservoir storage – Nodal hydraulic gradient level values - Water supply consideration, Types of water supply systems- Piping system- Distribution network –Labeling- Network components – Network models – Design – Optimization in practice.

**MODULE II HYDRAULIC PRINCIPLES AND NETWORK PARAMETERS 10**

Energy and hydraulic gradient lines – Head loss in links – Equivalent pipes – series – Parallel pipes – Path head loss and loop head loss – Analysis of water distribution network- Static node and Dynamic node – Network performance – flow analysis - Layout – in situ lining - Pipes material – Appurtenances – Minimization of water losses – Leak detection.

**MODULE III STORM WATER DISTRIBUTION AND BURIED PIPES 9**

Planning – Runoff estimation – Rainfall data analysis – Storm water drains design Introduction to Buried pipes – External loads – Gravity flow design, Pressurized flow- Rigid and Flexible pipes – Installation – Trenchless technology.

**MODULE IV RELIABILITY ASSESSMENT AND DESIGN 8**

Uncertainty and Reliability – Affecting events- Assessment – Reliability parameters –Configurations - Design methodology - Strengthening and Expansion.

**MODULE V FLUID TRANSIENTS 9**

Basic equations of unsteady flows through closed conduits – methods – characteristics - Transients caused by centrifugal pumps and hydroelectric power plants.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Bajwa. G. S, Practical handbook on Public Health Engineering, Deep publishers, Shimla 2003.
2. Bhave P. R, Optimal design of water distribution networks, Narosa publishing House, New Delhi, 2003.
3. Wurbs R.A., and James W.P. Water Resources Engineering. Prentice Hall of India, Eastern Economic Edition. ISBN: 81-203-2151-0, New Delhi, 2007.

**REFERENCES:**

1. Larry.W. Mays., “Water Distribution System Handbook”,2021.
2. Manual on storm water drainage system, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 2019.
3. Manual on water supply and treatment, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999.
4. Moser A. P, Buried pipe Design, 3rdEdition, American Water Works Association, 2008.

**COURSE OUTCOMES:**

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

**CO1:** define the water supply and demand and water distribution network creation for the effective water supply system.

**CO2:** assess the knowledge of hydraulics in the field of pipe line system and analyze the branch and loop network flow

**CO3:** explain storm water drain buried pipeline system. Design the underground storm water drainage system with hydraulic appurtenances

**CO4:** analyze the reliability of the water supply distribution system and prepare the detailed methodology for risk management and strengthening the system.

**CO5:** apply and design the unsteady flow pipe line network in order to with stand the surge/transient developed due to power failure of centrifugal pump and also due to hydroelectric power plant.

**Board of Studies (BoS) :**
16th BOS of Civil held on 5.1.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 | PO 12 | PSO1 | PSO2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | M | - | - | - | M | - | - | - | - | - | H | H | M | L |
| **CO2** | H | H | H | - | M | M | M | - | L | - | M | H | H | H | M |
| **CO3** | H | H | H | - | H | M | M | - | L | - | M | H | H | H | M |
| **CO4** | M | M | - | - | H | M | M | - | L | - | M | H | H | M | L |
| **CO5** | M | - | - | - | - | - | - | - | - | - | - | H | H | M | L |

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

SDG 6: Clean and accessible water for all which is an essential part of the world we want to live in.

Proper installation of pipelines for water distribution will be useful for the sustainable development of domestic and irrigation purposes.

## SPECIALIZATION VI : TRANSPORTATION ENGINEERING

| CEDX 61 | TRAFFIC ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:** The objectives of the course are

**COB1:**Study the various components of Traffic Engineering.

**COB2:**Familiarize with traffic surveys and their analysis.

**COB3:**Study about the traffic control method.

**COB4:** Understand the principles involved in the geometric design of Intersection.

**COB5:** Know the concepts of Traffic management

**MODULE I INTRODUCTION 9**

Significance and scope, Characteristics of Vehicles and Road Users, Skid Resistance and Braking Efficiency(Problems), Components of Traffic Engineering -Road,Traffic and Land Use Characteristics.

**MODULE II TRAFFICSURVEYSANDANALYSIS 9**

Surveys and Analysis – Volume survey and its characteristics – Capacity-Speed and Delays-Origin and Destination studies.

**MODULE III TRAFFICCONTROL 9**

Traffic Signs, Road Markings, Design of Traffic Signals and Signal Co-ordination (Problems), Traffic control Aids and Street Furniture, Computer Applications in Signal Design.

**MODULE IV DESIGNOFGEOMETRICINTERSECTIONS 9**

Conflicts at Intersections, Classification of Intersections at Grade, GradeSeparators (Concepts only), Principles of Intersection Design, Elements of Intersection Design, Channelization and Rotary Design (Problem).

**MODULE V TRAFFIC MANAGEMENT 9**

Traffic Management- Traffic System Management (TSM) and Travel Demand Management (TDM), Restrictions on Turning Movements, One-way Streets,Traffic Segregation, Traffic Calming, Tidal Flow Operations, Exclusive BusLanes -Introduction to Intelligence Transport System(ITS) General outline of traffic studies - Parking studies – Accidental studies – Congestionstudies–Fuel conception and emission studies.

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway

Engineering", Nemchand Publishers, 2014.

2. Kadiyali, L.R., “Traffic Engineering and Transport Planning”, Khanna Technical Publications,NewDelhi,2013.
3. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.2009

**REFERENCES:**

1. Subhasg C. Saxena, “A Course in Traffic Planning and Design”, Dhanpat Rai Publications,NewDelhi,2011.
2. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011
3. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
4. Hobbs.F.D. "Traffic Planning and Engineering", University of Brimingham, Peragamon Press Ltd, 2005
5. Taylor MAP and Young W, "Traffic Analysis – New Technology and New Solutions", Hargreen Publishing Company, 1998.

**COURSE OUTCOMES:**

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

**CO1:** Explain the characteristics of vehicles and road users and determine skid Resistance and Braking Efficiency

**CO2:** Prepare traffic study report after conducting different types of surveys.

**CO3:**Design the traffic signals and traffic simulation models.

**CO4:** Enumerate the intersection elements and design a rotary intersection

**CO5:** Develop the skill on Traffic Management and Traffic Forecasting techniques and the Accidental studies.

**Board of Studies (BoS) :**

19th of Civil held on 29.09.2023

**Academic Council:**

21st Academic council held on 20.12.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable.

Statement :

The role of efficient traffic management system leads to infrastructure development.

| CEDX 62 | URBAN PLANNING AND DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** understand the scope and nature of urban design as a discipline.

**COB2:** gain knowledge on various planning process

**COB3:** familiarize the urban planning and its environment

**COB4:** enable the student to analyze the implementation of management information system in urban planning

**COB5:** impart knowledge on management information system

**MODULE I BASIC CONCEPTS 9**

Definition of terms –trend of urbanization at international, national, state and district levels national and regional development policies and strategies – urbanization, housing and sustainable urban development-definition and principles.

**MODULE II PLANNING PROCESS 10**

Types of urban and regional plans, stages in the planning process – delineation of planning areas, goals and objectives of plans, surveys and analysis, formulation of plans, evaluation of alternative plans, plan implementation, legal, financial and institutional constraints in the planning process social orientation in the planning process.

**MODULE III URBAN PLANNING AND ENVIRONMENT 9**

Environment and Resources, Sustainability Assessment, Future Scenarios, Form of Urban Region, Managing the change, Integrated Planning, Sustainable Development Urban Form, Land Use, Compact Development, Guidelines for Environmentally sound urban design.

**MODULE IV DEVELOPMENT MANAGEMENT SYSTEMS 9**

Development control rules – zoning regulations, sub divisional regulations, building bye-laws, co-ordination between urban local bodies and other functional agencies such as water supply & sewerage boards, housing boards including slum boards and planning authorities

**MODULE V MANAGEMENT INFORMATION AND DECISION SUPPORT** **8**

Database, management information system, decision support system for land suitability, urban renewal and network analysis.

**L-45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Donald Natson, “Time Saver Standards for Urban Design”, McGraw Hill, 2003
2. Jonathan Barnett,‘ Redesigning Cities: Principles, Practice, and Implementation’, Planners 2019
3. .Randall Crane and Rachel Weber, ‘The Oxford Handbook of Urban Planning’, Oxford 2014
4. Viviana Kaminski, ‘Urban Studies and Planning. World Technologies’, NewDelhi, 2012

**REFERENCES:**

1. Gary Hack, “Local Planning: Contemporary Principles International City/County Management Association, 2012
2. Malcolm Moor, “Urban Design Futures”, Routledge, 2006
3. Bivand, R. S., E. J. Pebesma, and V. Gomez-Rubio’, Applied Spatial Data Analysis .2018

**COURSE OUTCOMES:**

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

**CO1:** Explain the role of Urban design as blocks, density, neighborhood, Streets and their interdependencies

**CO2:** Ascertain the types of Urban and Regional Plans.

**CO3:** Illustrate the stages of planning process

**CO4:** understand the development control rules and zoning regulations and building bye-laws

**CO5**: Recognize the management information system through which an urban setting could be perceived

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 18th BoS of CE held on 05.04.2023 | 20th Academic council held on 13.4.2023 |

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable.

Urban planning and design will enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries

| CEDX 63 | INTELLIGENT TRANSPORTATION SYSTEM | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**SDG: 11**

**COURSE OBJECTIVES:** The objectives of the course are

**COB1:** To impart knowledge on Intelligent Transportation system

**COB2:** To understand the role of telecommunications in ITS

**COB3:** To impart knowledge on the functional areas and services in ITS

**COB4:**To gain knowledge on ITS operations

**COB5:** To understand the application of ITS

**MODULE I INTRODUCTION** **8**

Definition, Objectives, Historical Background, Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

**MODULE II TELECOMMUNICATIONS IN ITS** **8**

Information Management, Traffic Management Centres (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts..

**MODULE III ITS FUNCTIONAL AREAS** **12**

Advanced Traffic Management Systems (ATMS) , Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS). ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

**MODULE IV ITS OPERATIONS** **8**

Regional and Project ITS architecture; Concept o f operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning.

**MODULE V ITS APPLICATIONS** **9**

Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations ; public transportation applications; Automated Highway Systems- Vehicles in Platoons – ITS in World – Overview of ITS implementations in developed countries, ITS in developing countries. [Case study]

**L – 45 ; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005.
2. US Department of Transportation, “National ITS Architecture Documentation”, 2007 (CDROM).
3. Tony S. Lee, Sumit Ghosh “Intelligent Transportation Systems: Smart and Green Infrastructure Design, Second Edition” CRC press 2015

**REFERENCES:**

:

1. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House.2009
2. Kan Paul Chen, John Miles, “Recommendations for World Road Association (PIARC)” ITS Hand Book 2012
3. Aleksander Sładkowski, “Intelligent Transportation Systems – Problems and Perspectives” Springer 2015

**COURSE OUTCOMES:**

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

**CO1:** Enumerate the advantages of ITS

**CO2:** Select the appropriate technologies for field conditions

**CO3:** Describe various system and plan of ITS

**CO4:** Specify appropriate system in various functional areas

**CO5:** Demonstrate the application of ITS

**Board of Studies (BoS) :**

19th of Civil held on 29.09.2023

**Academic Council:**

21st Academic council held on 20.12.2023

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

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

SDG 11 : Sustainable Cities and Communities

Statement : The overall understanding of Intelligent transport system leads to Sustainable cities and communities.

| CEDX 64 | PAVEMENT DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart sufficient knowledge on pavement design

**COB2:** To familiarize knowledge on various IRC guidelines for designing flexible pavement

**COB3:** To study various IRC guidelines for designing rigid pavement

**COB4:** To give an exposure to desirable pavement evaluation.

**COB5:** To impart knowledge on concept of pavement strengthening

**MODULE I PRINCIPLES 9**

Components of a road and their function – Factors affecting pavement stability – Equivalent Single wheel load – Vehicle and traffic factors, moisture, Climate and soil factors – Stress distribution in different conditions –Modulus of elasticity of various layers.

**MODULE II FLEXIBLE PAVEMENT 9**

Empirical method using soil classification tests-Estimation of CBR values-method of designing pavement-plate bearing test method-asphalt institute method – AASHTO Method-bur mister design method –principles of bituminous mix design-IRC Methods.

**MODULE III RIGID PAVEMENT 9**

General design consideration – Stresses in concrete pavement- Design procedure as per IRC method — Design of different joints in concrete pavement and their maintenance.

**MODULE IV PAVEMENT EVALUATION 9**

Method of pavement evaluation–Distress in flexible pavements–Distress in rigid pavements–Structural evaluation of flexible and rigid pavements–Evaluation by deflection measurements.

**MODULE V PAVEMENT STRENGTHENING AND MAINTENANCE 9**

Strengthening of pavement-Methods –Flexible overlays and types-Rigid overlays - Case studies – Maintenance of Bituminous surface, concrete roads and low cost roads – maintenance of shoulders and

drainage system.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khanna tech. Publications, New Delhi, 2005
2. Khanna,K.andJusto,C.E.G.,“HighwayEngineering”,KhannaPublishers,Roorkee,2014.
3. Wright,P.H.,“HighwayEngineering”,JohnWileyandSonsInc., NewYork,7thEdition,2004.

**REFERENCES:**

1. Guidelines for the Design of Flexible Pavements, IRC-37–2001, The Indian roads Congress, New Delhi.
2. Guideline for the Design of Rigid Pavements for Highways, IRC 58-2007, the Indian Road Congress, New Delhi.
3. Subhasg C. Saxena, “A Course in Traffic Planning and Design”, Dhanpat Rai Publications, New Delhi, 2001.
4. Yoder, R.J. and Witchak M.W. “Principles of Pavement Design”, John Wiley 2000.

**COURSE OUTCOMES:**

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

**CO1:** Explain the basic principles and factors to be considered for pavement design.

**CO2:** Analyze and design flexible pavement by various methods.

**CO3:** Analyze and design rigid pavement as per IRC method.

**CO4:** Describe the structural and functional evaluation for pavement performance.

**CO5:** Assess the overlay construction methods and method of maintaining different roads for longer durability and serviceability.

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 18th BoS of CE held on 05.04.2023 | 20th Academic council held on 13.4.2023 |

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

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

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement:

The good pavement road Make cities and human accessible and sustainable transport systems for all, improving road safety, A well-designed transportation system that supports walking, cycling and public.

| CEDX 65 | RAILWAY ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 7 | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

**COB1:** To give an exposure on the role of railways for the development of nation

**COB2:** To study the geometric design of railways tracks.

**COB3:** To impart the knowledge on the construction, maintenance and operation of railway track

**COB4:** To introduce the different modern techniques used in railway Engineering

**MODULE I BASIC ELEMENTS 7**

Railways: Role of Railway Transportation, Advantages and Disadvantages of Railway Transportation, Elements of permanent track way: Rails, Rail Gauges, Sleepers, Ballast, Rail Joints, Fittings, Principal of Traction: Tractive Effort, Train resistances.

**MODULE II GEOMETRIC DESIGN OF RAILWAYS 8**

Elements of Geometric Design: Gradients and Grade compensation on Curves, Cant, Transition Curve, Vertical curve, Sub grade and Embankments: Cutting, Level, Function, Formation of sub grade, Materials used, Slope and Stability of Embankment, Points and Crossings: Turnouts, Diamond crossings, Crossovers, Stations and Yards.

**MODULE III RAILWAY SIGNALS & MAINTENANCE 8**

Signals: Signaling and interlocking, Necessity, Mechanical Devices, Detectors, Stretcher bar, Point lock, Slotting of signals, Connecting Devices, Temperature compensation, Track Drainage, Safety in Railways, Modernization of Track for High Speeds, Modern Methods for Track Maintenance, Railway Expenses, Rates and Fares.

**MODULE IV MODERN RAILWAYS 7**

Different types of modern railway Engineering – Advantages and disadvantages of modern railways- Metro rail – Mono Rail- Mass Rapid Transit system (MRTS) – High speed rails – Bullet trains – Hyperloop rail transport –Light rail transport (LRT) – case studies.

**L – 30; TOTAL HOURS –30**

**TEXT BOOKS:**

1. Satish Chandra, M.M. Agarwal, Railway Engineering, Oxford University press, 2013.
2. Saxena Subhash, C.and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 2020
3. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, V Scitech Publications (India), Chennai, 2014

**REFERENCES:**

1. Mundrey J S, Railway Track Engineering, McGraw Hill Education ( India) Private Ltd, New Delhi, 2013
2. Vassilios Profillidis, "Railway Management and Engineering", Ash gate Publishing Ltd., Surrey U.K. & Burlington U.S, 2006.
3. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels. Universities Press (India) Private Limited, Hyderabad, 2015.

**COURSE OUTCOMES:**

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

**CO1:** Identify the components of permanent way.

**CO2:** Design railway tracks with proper cant and curves.

**CO3:** Explain the railway signals according to standards and elucidate the railway maintenance.

**CO4:** Develop knowledge on modern railways.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

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

SDG 7 : Ensure access to affordable, reliable, sustainable and modern energy for all

The railway transport for public is affordable and to ensure health and well-being for all, at every stage of life.

| CEDX 66 | AIRPORT PLANNING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | AND ENGINEERING | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:** The Objectives of the course are

**COB1:** To provide an understanding on the concepts of airport planning

**COB2:** To familiarize the geometric design of airway engineering

**COB3:** To give an exposure on the various airport markings and lighting

**COB4:** To impart knowledge on airport maintenance

**MODULE I PLANNING 7**

Introduction: Advantages and limitations of air transportation - - Airport planning - Selection of sites - survey and drawings to be prepared for airport planning - Airport layout - Characteristics of good layout - Airport configuration, Components of airport- Airport obstruction - location of terminal buildings, aprons and hangers.

**MODULE II GEOMETRIC DESIGN 8**

Runways and taxiways: Runway orientation, basic runway length, corrections for elevation, temperature and gradient as per ICAO and FAA recommendation - Airport classification by ICAO- geometric standards – taxiway layout. Zoning requirements regarding permissible heights of constructions and landing within the airport boundary, wind rose diagram.

**MODULE III MARKING AND LIGHTING 8**

Airport Design consideration – exit taxiways, aprons, holding aprons, fillets, blast pads- air traffic control – control aids – airport markings and lighting - aircraft parking systems, planning and development of terminal building.

**MODULE IV MAINTENANCE 7**

Airport maintenance –types of maintenance- daily maintenance – runway – Taxiway maintenance – Airport drainage maintenance system – terminal building maintenance

**L – 30 ; TOTAL HOURS –30**

**TEXT BOOKS:**

1. Khanna. S.K., Arora. M.G and Jain. S.S., Airport Planning and Design, Nemchand and Brothers, Roorkee, 2002.
2. Saxena S.C , Airport Engineering Planning And Design CBS , Publisher 2020

3. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, V Scitech Publications (India), Chennai, 2014

**REFERENCES:**

1. Norman J. Ashford, Saleh Mumayiz, Paul H. Wright, “Airport Engineering: Planning, Design and Development of 21st Century Airports”, 2011.
2. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.Universities Press (India) Private Limited, Hyderabad, 2015

**COURSE OUTCOMES:**

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

**CO1:**Develop knowledge on planning and site selection of Airport Planning

**CO2:** Prepare the layout on airport design

**CO3:**Illustrate the different types of airport markings and lighting system.

**CO4:** ascertain the airport maintenance report

**Board of Studies (BoS) :**

18th BoS of CE held on 05.04.2023

**Academic Council:**

20th Academic council held on 13.4.2023

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

The air transport system Promote sustained, inclusive and sustainable economic growth.

| CEDX 67 | DOCKS AND HARBOUR PLANNING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | | 1 | 0 | 0 | 1 |

**COURSE OBJECTIVES:**

**COB1:** study about the layout of harbors and construction of lock gates

**COB2:** impart knowledge on various break water types

**MODULE I DOCKS AND HARBOUR COMPONENTS 8**

Role of water transportation, Dock: Wet, dry and floating docks, Breakwater structures different types, Coastal Structures: Piers, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage. Case studies

**MODULE II HARBOUR PLANNING 7**

Basic consideration- Ocean Winds, Waves, Tides, Definition of Basic Terms: Harbour, Port, Satellite Port, Layout of Harbour, Port entrance, Construction and operation of Lock gates, Definition of Basic Terms: Harbour, Port, Satellite Port– Planning and Design of Harbours: Terminal Facilities

**L –15 ; TOTAL HOURS –15**

**TEXT BOOKS:**

1. Bindra S. P., A course in docks and harbor Engineering, Dhonpat raipublication, 2013.
2. Rangwala, "Harbor Engineering", Charotar Publishing House, 2022.
3. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, V Scitech Publications (India), Chennai, 2014

**REFERENCES:**

1. Oza.H.P. and Oza.G.H., “A course in Docks & Harbour Engineering”. Charotar Publishing Co., 2013
2. Srinivasan, R., "Harbour, Dock and Tunnel Engineering”, Charotar Publishing House Pvt. Limited, Anand, Gujarat, 2022.

**COURSE OUTCOMES:**

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

**CO1:** Develop knowledge on the layout of harbour

**CO2:** Elucidate the components of docks and harbour

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | H | M | M | L | L | | | H | M | M | H | H | |
| CO2 | H | M | H | M | M | L | L | | | H | M | M | 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

The water transport system Promote sustained, inclusive and sustainable economic growth.

## SPECIALIZATION VII: SURVEYING & ARCHITECTURE

| CEDX 71 | GPS AND DRONE SURVEYING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objectives of the course are to impart knowledge on

**COB1:** the determination of the precision of the GPS measurements and the working of GPS.

**COB2:** applying the measuring principle of GPS and Drones in civil engineering projects.

**COB3:** classifying the differences between relative and autonomous GPS positioning, code phase, carrier phase, DGPS and RTK.

**COB4:** the components of drones in surveying and mapping.

**COB5:** the various applications of GPS and Drone Surveying.

**MODULE I GLOBAL POSITIONING SYSTEM 8**

History of GPS, GPS design objectives and details of segments space, control and user, blocks of GPS- Block I, II/IIA, IIR Satellites and IIF. GPS Signal Structure - Carriers, GPS codes: C/A, P, navigational message and GPS receiver: Types and Structure of receivers, Principles of GPS position fixing: Pseudo ranging, Determination of GPS satellite coordinates, Types of ephemerides, GPS errors.

**MODULE II GPS SURVEY METHODS AND APPLICATIONS 10**

Single Point or Point Vs Relative, Static Vs Kinematic, Real-time Vs Post mission, Practical GPS survey field procedures: Code and Carrier-based positioning, Accuracy and recording time, GPS Applications - Geodetic control surveys, Cadastral surveys, Engineering and monitoring, Military applications, Vehicle tracking and car navigation.

**MODULE III DIFFERENTIAL GLOBAL NAVIGATION SATELLITE SYSTEM (DGNSS) 9**

Introduction to GLONASS, Real-Time Kinematic (RTK) - Satellite Based Augmentation System (SBAS) - GNSS Errors - GNSS Correction Methods - Global Navigation Satellite Systems (GNSS) Applications - Current trends and future.

**MODULE IV DRONE SURVEYING 9**

Introduction to drone surveying – Components of drone – Autonomous UAVs –Architecture of an Autonomous system – Path planning – Innovative technological UAVs/Drones – UAV Communication Systems – UAV Data Collection – Data Processing Approaches – Regulatory systems for UAVs – SWOT Analysis of UAV Technology.

**MODULE V APPLICATIONS OF GPS AND DRONE SURVEYING 9**

Applications in Civil Engineering- mining process- Public infrastructure – resources management - disaster & rescue service - oil & gas monitoring, Forestry, Agriculture - goods delivery- crowd management, traffic regulation - urban planning - infrastructure monitoring, 3D mapping, surveillance, search & rescue - businesses.

**L – 45; TOTAL HOURS – 45**

**TEXTBOOKS:**

1. Awange, J. L., "Environmental Monitoring using GNSS: Global Navigation Satellite Systems", Springer, London, 2012.
2. Bhatta, B., "Global Navigation Satellite Systems: Insights into GPS, Glonass, Galileo, Compass, and Others", BS Publications, New Delhi, 2010.
3. Grewal, M. S., Weill, L. R., Andrews, A. P., "Global Positioning Systems, Inertial Navigation, and Integration", John Wiley & Sons, New York, 2006.
4. P.K.Garg, “Introduction to Unmanned Aerial Vehicles”, New Age International Private Limited, New Delhi, 2020.

**REFERENCES:**

1. Hofmann-Wellenhof, B., Lichtenegger, H. and Collins, J., “Global Positioning System: Theory and Practice”, Springer, Berlin, 2001.
2. Xu Guochang, “GPS: Theory, Algorithms and Applications”, Springer, Berlin, 2007.
3. https://geodesy.noaa.gov/PUBS_LIB/Geodesy4Layman/TR80003D.HTM

**COURSE OUTCOMES:**

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

**CO1:** determine the position of the points with GPS measurements.

**CO2:** use different GPS survey methods to improve the positional accuracy

**CO3:** categorize the differences between relative and autonomous GPS positioning, code phase, carrier phase, DGPS and RTK.
**CO4:** apply the important concepts and components of drones in surveying and mapping.
**CO5:** explore the various applications of GPS and Drone Surveying.

**Board of Studies (BoS) :**
16th BoS of CIVIL held on 05.01.2022

**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 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | L | L | H | L | L | - | L | L | - | - | L | M | - |
| CO2 | H | H | M | M | H | L | L | - | L | L | - | - | L | M | - |
| CO3 | H | H | M | M | H | L | L | - | L | L | - | - | L | M | - |
| CO4 | H | H | M | M | H | L | L | - | L | L | - | - | L | M | - |
| CO5 | H | H | M | M | H | L | L | - | L | L | - | - | L | M | - |

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

SDG 11: Make cities inclusive, safe, resilient and sustainable.

Statement:
The gained knowledge leads to map the cities to enable better planning and to provide living space to all creating inclusive growth and better utilization of resources to enhance sustainability.

| CEDX 72 | REMOTE SENSING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objectives of the course are

**COB1:** To impart knowledge on the principles of remote sensing data acquisition and analysis of satellite data.

**COB2:** To explore the spectral signatures of various earth features and electromagnetic interactions.

**COB3:** To apply image enhancement techniques to improve the interpretability of satellite images.

**COB4:** To identify the characteristic features of microwave remote sensing.

**COB5:** To explore the usage of aerial photos for measurement of height determination and the use of remote sensing for different applications.

**MODULE I FUNDAMENTALS 8**

Remote sensing: definition – components of remote sensing - energy sensor, interacting body – Active and Passive remote sensing – platforms – aerial and space platforms – balloons, helicopters, aircraft and satellites – synoptivity and repeativity – electromagnetic radiation (EMR) – EMR spectrum – visible, infrared (IR) near IR, middle IR, thermal IR and microwave – black body radiation – Wien's Displacement Law – Stefan Boltzman law.

**MODULE II EMR INTERACTION WITH EARTH SURFACE FEATURES 9**

Atmospheric characteristics – the scattering of EMR – Rayleigh, Mie, Non-selective and Raman scattering – EMR interaction with water vapour and ozone – atmospheric windows – the significance of atmospheric windows – EMR interaction with earth surface material, radiance, irradiance, incident, reflected, absorbed and transmitted energy – reflectance – specular and diffused reflection surfaces – spectral signature – spectral signature curves – EMR interaction with water, soil and earth surface.

**MODULE III DIGITAL IMAGE PROCESSING 10**

Digital processing of satellite images: Geometric rectification, spatial and radiometric enhancement, spectral-domain enhancement, Filtering - edge detection, Image Transformation - band ratio, Supervised and unsupervised classification for thematic map generation.

**MODULE IV MICROWAVE REMOTE SENSING 9**

Microwave Remote Sensing: Basic principles – Advantages of Microwave Remote Sensing – Types of Microwave Remote Sensing – working principle of RADAR – components of RADAR imaging – Factors affecting the radar backscattered energy, System and terrain parameters – spatial resolution of SAR system, geometric characteristics – Applications of Microwave Remote Sensing.

**MODULE V MISCELLANEOUS REMOTE SENSING TECHNIQUES 9**

Aerial photography/photogrammetry: Introduction – Types of photogrammetry – Basic Terminologies – Types of an aerial photograph – Derivation of the scale of a vertical photograph, Orthophotos, Mosaics – Procedure for an aerial survey – Flight planning – Digital Stereo Model (DSM) – Advantages – Applications – Airborne Laser Scanning (ALS) – Introduction, Components of LIDAR – Working principle of ALS – Applications of ALS, Case Studies.

**L – 45; TOTAL HOURS – 45**

**TEXTBOOKS:**

1. Anji Reddy, “Remote sensing and Geographical systems”, 4th Edition, B.S Publications, Hyderabad, 2014.
2. Basudeb Bhatta, “Remote Sensing and GIS”, 3rd Edition, Oxford Higher Education / Oxford University Press, 2020.
3. Lillesand. T.M. and Kiefer. R.W., “Remote sensing and image interpretation”, 7th Edition, John Wiley and sons, 2015.

**REFERENCES:**

1. De Merse and Michael, N., “Fundamentals of Geographic Information System”, 4th Edition, John Wiley and Sons, New York, 2012.
2. Srinivas M.G., “Remote sensing applications”, 2nd Edition, Narosa Publishing House, New Delhi, 2011.
3. https://www.gislounge.com/gis-essentials
4. https://www.geospatialworld.net/article/technology-trends-in-remote-sensing-and-data-analysis

**COURSE OUTCOMES:**

After completion of the course, the students will be able

**CO1:** To describe the basic principles of remote sensing data, types of remote sensing and laws related to remote sensing.

**CO2:** To explore the interactions of EMR with earth features based on their spectral signatures.

**CO3:** To evaluate the processing techniques for interpretation of the satellite images.

**CO4:** To analyze the characteristic features of microwave remote sensing.

**CO5:** To explore the use of aerial photos for measurement of height determination and the use of remote sensing for different applications.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

Statement :

The integrated understanding of remote sensing helps one to build sustainable industrialization through optimization of resource utilization in a better innovative way.

| CEDX 73 | SPATIAL DATA MODELLING AND ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge on the fundamental representation of geospatial data and analysis of geospatial phenomena.

**COB2:** To visualize the 3D spatial data such as continuous and discrete data.

**COB3:** To explore the various methods and algorithms used in GIS analysis.

**COB4:** To analyze terrain modeling, geomorphometry, watershed analysis.

**COB5:** To perform GIS-based modeling of landscape processes (water, sediment) in 3D.

**MODULE I GEOSPATIAL DATA 9**

Mapping natural phenomena – Concept of continuous fields and discrete sampling – Units, projections, coordinate transformation – Georeferencing, geospatial formats, conversions, geospatial data abstraction library – Raster and vector representation, raster and vector conversions and resampling.

**MODULE II DATA DISPLAY AND VISUALIZATION 9**

Display of continuous and discrete data, use of color, shading, symbols, to extract the spatial pattern and relationships – 3D visualization: multiple surfaces and volumes, 3D vector objects – visualization for data analysis (lighting, scaling, transparency, cutting planes, animations) – view/create maps/post your data on-line (Google Earth/Maps, GPS visualizer).

**MODULE III GEOSPATIAL ANALYSIS 9**

Foundations for analysis of continuous and discrete phenomena – neighborhood operations and buffers – analysis and modeling with map algebra – cost surfaces and least-cost path – spatial interpolation and approximation (gridding).

**MODULE IV TERRAIN MODELING AND ANALYSIS 9**

Terrain and bathymetry mapping – mathematical and digital representations (point clouds, contour, raster, TIN) – DEM and DSM, working with multiple

return lidar data – spatial interpolation of elevation data and topographic analysis, line of sight, viewshed analysis – solar irradiation, photovoltaic energy potential, time series of elevation data, analysis of coastal change.

**MODULE V MODELING OF GEOSPATIAL PROCESSES** **9**

Model formulation, input data processing – introduction to GIS-based hydrologic, erosion and environmental modeling – Geocomputational methods, including agent-based modeling, artificial neural networks and evolutionary computing.

**L – 45; TOTAL HOURS – 45**

**TEXTBOOKS:**

1. Hassan A, Karimi, "Geospatial Data Science Techniques and Applications", 1st Edition, CRS Press & Co, Taylor & Francis Group, 2017.
2. Sudipto Banerjee, Bradley P, Carlin, Alan E. Gelfand, "Hierarchical Modeling and Analysis for Spatial Data", CRS Press & Co, Taylor & Francis Group, 2014.

**REFERENCES:**

1. Maguire, D., M. Batty, M. Goodchild, "GIS, Spatial analysis and modeling", ESRI Press (G70.212 .G584 2005), Redlands, California 2015.
2. Zeiler, M., "Modeling Our World: The ESRI Guide to Geodatabase Design", 2nd Edition, ESRI Press, Redlands, California, 2010.
3. https://www.intechopen.com/books/spatial-analysis-modelling-and-planning/introductory-chapter-spatial-analysis-modelling-and-planning
4. https://www.geospatialworld.net/article/technology-trends-in-remote-sensing-and-data-analysis

**COURSE OUTCOMES:**

After completion of the course, the students will be able

**CO1:** To apply the basic concepts of conceptualizing models as representations of real-life systems with inputs, outputs, and processes.

**CO2:** To identify the various data types to extract the spatial pattern for 3D spatial data visualization.

**CO3:** To integrate and develop models with geospatial data through GIS.

**CO4:** To evaluate models in terms of accuracy, sensitivity, and uncertainty.

**CO5:** To execute the hydrological, erosion and environmental modeling through GIS.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic council held on 13.4.2023

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

Statement :
The integrated knowledge in spatial data modelling and analysis helps to decide and to act to sustain the industries and develop cities through a better understanding of innovation.

| CEDX 74 | PRINCIPLES OF ARCHITECTURE | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To understand the elements of design

**COB2:** To gain knowledge of various principles of organization from nature.

**COB3:**To explore the ideologies of design communication and graphics

**COB4:** To gain knowledge of various architect in the contemporary architecture

**COB5:** To understand the landscaping of functional areas

**MODULE I ELEMENTS OF DESIGN IN NATURE 9**

Points, lines and shapes found in nature. Role of elements to emphasize the location, as landmark, for direction and dominance, etc. Patterns in nature and building design. Chaos and Order. Study: examples of nature inspired man made design.

**MODULE II PRINCIPLES OF ORGANIZATION FROM NATURE 9**

Fractals — patterns, proportion, repetition, harmony- Axis, Symmetry/Asymmetry, Massing, Form generating exercises to approach site planning in small scale and large scale projects.

**MODULE III DESIGN COMMUNICATION AND GRAPHICS 9**

Importance of graphics in architectural design. Study of site plans, city plans, conceptual Drawings. Interpretation of architects, Space planning standards and principles conceptual sketches and the respective buildings.

**MODULE IV RECENT TRENDS 9**

Contemporary Architecture- contribution of master builders like Lecorbusier, Frank Loyed wright, Vanderrohe, Buckminster fuller, Larry Bakker.

**MODULE V LANDSCAPING OF FUNCTIONAL AREAS 9**

Urban open spaces and principle of urban landscape; Street landscaping, landscape design for waterfront areas and functional areas in urban centers. Green infrastructure including green roofs and walls.

**L - 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Francis D.K. Ching, Architecture-Form, Space and Order, Van Nostrand, Wiley Publisher , 4th edition 2014
2. Goldsmith.S “the responsive city: engaging communities through data – smart governance” John Wiley & sons, 2014
3. Simon Unwin, Analysing Architecture, Routledge, London, 2003.

**REFERENCES:**

1. Leland M. Roth - Understanding Architecture, its experience history and Steen Eiler Rasmussen - Experiencing architecture, MIT Press, 2004.
2. Peter von Meiss -Elements of architecture - from form to place, Spon Press2012.
3. Yogeswari. K, Principles of Architecture, Ramalinga Publishers 2005

**COURSE OUTCOMES:**

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

**CO1:** describe elements of design in nature

**CO2:** apply the principles of architecture and applications of the same in buildings and spaces

**CO3:** explain the character and style of buildings with examples using design communications and graphics

**CO4:** describe the role of various architect in the contemporary architecture

**CO5:** ascertain the role of landscape design in the shaping of outdoor environments.

**Board of Studies (BoS) :**
16thBoS of Civil held on 05.01.2022

**Academic Council:**
18th Academic Council held on 24.02.2022

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

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

SDG 4 : Quality Education

Statement : The Principles and elements of architecture will enhance the quality of knowledge in construction of aesthetical buildings.

| CEDX 75 | ISLAMIC ARCHITECTURE | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To study about the Islam

**COB2:** To impart knowledge on the specific cultural context

**COB3:** To expose the character of Islamic architecture

**COB4:** To describe the style and character of Mughal architecture in the Indian context

**COB5:** To study about the expertise of the Mughal rulers in city building

**MODULE I BASIC CONCEPTS 8**

History of Islam- birth, spread and principles Islamic architecture as rising from Islam as a socio-cultural and political phenomenon. Advent of Islam into the Indian subcontinent and its impact including the change in the architectural scene- overview of development based on political history and the corresponding classification of architecture - Islamic architecture in India: sources and influences.

**MODULE II BUILDING TYPES AND FORM 10**

Evolution of building types in terms of forms and functions: mosque, tomb, minaret, madarasa, palace, caravanserai, market. Establishment of the Delhi Sultanate- evolution of architecture under the Slave, Khalji, Tughlaq, Sayyid and Lodhi Dynasties – tombs in Punjab- important examples for each period.

**MODULE III DESIGN ELEMENTS 10**

character of Islamic architecture: principles, structure, materials, and methods of constructions, elements of decoration colour, geometry and light. Shift of power to the provinces and evolution of regional architecture with their own unique influences: geographic, cultural, political, etc., - Bengal, Gujarat, Jaunpur, Malwa, Kashmir, Deccan (Gulbarga, Bidar, Golconda and Bijapur) - important examples for each region.

**MODULE IV MUGHAL ARCHITECTURE 9**

Mughals in India- various style of Mughals architecture and evolution of architecture and outline of Mughal cities and gardens under the Mughal rulers.- important case studies - evolution of architecture and ouline of Mughal cities and gardens under the Mughal rulers: Babur, Humayun,

Akbar, Jahangir, Shahjahan, Aurangazeb- important examples- decline of the Mughal empire.

**MODULE V CROSS- CULTURAL INFLUENCES 8**

Cross cultural influences across India and secular architecture- important case studies. Cross cultural influences across India and secular architecture of the princely states: Oudh, Rajput, Sikh, Vijayanagara, Mysore, Madurai- important examples

**L-45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. George Michell and Helen Philon ., “Islamic Architecture of Deccan India”, ACC Art Books Publisher 2018
2. Moya Carey, Caroline Chapman , “An Illustrated History of Islamic Architecture:” Southwater Publisher ., 2012
3. Satish Grover,”Ïslamic Architecture in India”, CBS Pub, New delhi, 2020

**REFERENCES:**

1. Leyla Uluhanli, Jai Imbrey “Mosques: Splendors of Islam” Rizzoli publisher 2017
2. Luca Mozzati .” Islamic Art: Architecture, Painting, Calligraphy, Ceramics, Glass, Carpets”,Prestel Publisher 2019
3. Richard Ettinghausen, Oleg Grabar,”” Islamic Art and Architecture 650-1250” Yale University Press,2003

**COURSE OUTCOMES:**

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

**CO1:** Explore the fundamental concepts of Islamic Architecture

**CO2:** Describe the component of Islamic Architecture

**CO3:** Illustrate the design and implementation of Islamic art

**CO4:** Elucidate the design of Mughal architecture

**CO5:** Explain the importance of different linkages of Islam in Indian culture

**Board of Studies (BoS) :**

18th BoS of CE held on 05.04.2023

**Academic Council:**

20th Academic council held on 13.4.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : The holistic understanding of Islamic Architecture leads to Sustainable cities and communities.

| CEDX 76 | VASTHU SASTRA AND | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | ARCHITECTURAL DESIGN | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To introduce the principles of vastu

**COB2:** To gain knowledge on astrology and muhurta in vastu

**COB3:** To understand the relationship between site and vastu

**COB4:** To gain knowledge on vastu rules for rooms

**COB5:** To understand the vastu dosha and its remedies

**MODULE I INTRODUCTION TO VASTU 9**

Overview of mythological and scientific background of Vastu - Understanding Life force Energy - Importance of Five Elements - Use of Magnetic Compass - Importance of Cardinal Directions & extensions – energy patterns in vastu.

**MODULE II ASTROLOGY AND MUHURTA IN VASTU 9**

Astrological combinations for Vastu – Planetary combination for learning vastu – Bhumi shayan – Ghriarambha Muhurta – Important Rituals at different levels of constructions.

**MODULE III ORIENTATION OF HOME 9**

Selection of land - Open Space planning and Building Design - Floor level Height factors – Verandas- Balconies -Porch Basements- Water flow - Mezzanine floors - Plants and Greenery.

**MODULE IV VASTU RULES FOR ROOMS 9**

Master Bed Room - Kids room - Living Room- Kitchen- Dining Room – Bathroom - Drawing room - Study Room - Puja Room – Doors - Windows and ventilators - Main Entrance - Staircase – Guest room.

**MODULE V IDENTIFYING VASTU DOSHA AND REMEDIES 9**

Use of compass – Points to be checked for the identification of vastu dosha- reading of map – use of Google map – vastu dosha and remedy related to extensions and curtailments – door planning – brahma and marmasthan – distribution of rooms and sitting – sleeping postures.

**L - 45; Total Hours – 45**

**TEXT BOOKS:**

1. Ganapati Sthapati Dr.V, “Sthapatya Veda”, Dakshina Publishing house,Chennai, India, 2001.
2. Stella Kramrish, “The Hindu Temple” Volume — I, Motital Banarsidass Publishers, 2002.
3. Subramanya Sastri K.S, “Viswakarma vastusatrum”, Thanjavur Maharaja Sarojoji SaraswathI Mahal Library society– Thanjavur, 2006.

**REFERENCES:**

1. Anand Bhardwaj “Scientific approach to Vastu Shastra” Abhinav Publications; First edition, 2013.
2. Suman Pandit “ Golden rules of vastu shastra “ Remedies Publishers, 2004

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

**CO1:** Summarize the Vastu Principles

**CO2:** Explain the open space planning and building design to demonstrate the orientation of rooms based on vasthu

**CO3**: Ascertain the role of vastu in the selection of land and the open space planning

**CO4**: Explain the building design to demonstrate the orientation of rooms based on vasthu

**CO5:** Apply the remedies for the various vasthu dosha

**Board of Studies (BoS) :**

16$^{th}$BoS of Civil held on 05.01.2022

**Academic Council:**

18$^{th}$ Academic Council held on 24.02.2022

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO9 | PO 10 | PO1 1 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | L | L | L | L | M | L | L | M | L | L | L | L | L |
| CO2 | M | M | L | L | L | L | M | L | L | M | L | L | L | L | L |
| CO3 | H | M | L | L | L | L | M | L | L | M | L | L | L | L | L |
| CO4 | M | M | L | L | L | L | M | L | L | M | L | L | L | L | L |
| CO5 | H | M | L | L | L | L | M | L | L | M | L | L | L | L | L |

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

SDG 11 : Sustainable Cities and Communities

Statement : Vastu Sastra explains the concept of sustainable development based on ancient Indian traditional knowledge, through its culture, heritage and orientation towards forest sustainability, as a way to address elements within sustainable development.

## HUMANITIES ELECTIVE – (SEMESTER III)

| | | | | | |
|---|---|---|---|---|---|
| **SSDX 01** | **ENGINEERING ECONOMICS** | **L** | **T** | **P** | **C** |
| **SDG: 4, 8, 9,12** | **AND 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.
5. R. Paneerselvam, “Engineering Economics”, PHI Publication, 2nd Edition, New Delhi, India, 2014.
6. 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 |
| CO2 | | H | M | | | M | | | | | H | H |
| CO3 | | | M | M | | H | H | | H | | | H |
| CO4 | | | | | | M | H | H | M | | M | H |
| CO5 | | | | | | M | H | H | M | | M | H |

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

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

**SDG 8:** Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
**SDG 9**: Build resilient infrastructure, promote sustainable industrialization and foster innovation.
**SDG 12:** Ensure sustainable consumption and production patterns.

Inclusive and equitable quality education can make a critical difference to production patterns, consumer understanding of more sustainably produced goods, promote inclusive and sustainable economic growth along with productive employment and decent work for all.

| | | | | | |
|---|---|---|---|---|---|
| **SSDX 02** | **SOCIOLOGY OF SCIENCE AND TECHNOLOGY** | **L** | **T** | **P** | **C** |
| **SDG: 17** | | **3** | **0** | **0** | **3** |

**COURSE OBJECTIVES:**

**COB1:** To recognize and define the basic concepts of society and the ways in which sociologists use these concepts in constructing explanations for individual and group problems.

**COB2:** To illustrate the convergence and divergence of sociology with engineering subjects in terms of the subject matter, nature and scope of the discipline and its approach.

**COB3:** To demonstrate the relationship between science, technology and society.

**COB4:** To understand the issues relating to science, technology and change in India both in the historical and globalization contexts.

**COB5:** To appraise the impact of science and technology on different socio-cultural institutions and processes.

**MODULE I INTRODUCTION 8**

Sociology - Definition, scope and importance, relationship with other social sciences - Major theoretical perspectives: Functionalism, Conflict Theorizing and Interactionism - Elements of social formation - Society, Community, Groups and Association - Institutions, family and kinship, religion, education, politics - Social process - Associative Social Process - Co-operation, Accommodation and Assimilation - Dissociative Social Process - Competition and Conflict.

**MODULE II INDIVIDUAL AND SOCIETY 9**

Culture - characteristics, functions, types, cultural lag and civilization - Socialization – process, stages, agencies and anticipatory socialization - Social Control - characteristics, importance, types and agencies - Social stratification. - Meaning, forms - caste and class.

**MODULE III SCIENCE, TECHNOLOGY AND SOCIETY 9**

Relationship between society and science and vice-versa - Science as a social system - Norms of science - Relationship between science and technology - History of modern science in India – colonial–independence and post-independence science - Science education in contemporary India – primary level to research level - Performance of

universities in the development of technology - Interrelationship between industry and universities.

**MODULE IV SCIENCE, TECHNOLOGY AND SOCIAL ISSUES** **10**

Technology, media, identity and global society - Conformity and deviance and role of science and technology - Technology and development issue - S&T and sustainable development -Role of science and technology in the creation of environmental crisis - Social inequality, social exclusion and digital divide - Science, technology and ethical issues -Gender and technology.

**MODULE V GLOBALIZATION, SCIENCE, TECHNOLOGY AND CHANGE** **9**

Social Change - nature, direction, forms - Technology and rate of social change – Globalization - characteristics, historical and social context- Social consequences of science and technology on civil society - Globalization - Liberalization - Their impact on Indian science and technology - WTO and issues related to intellectual property rights - MNCs and Indian industry.

**L – 45; Total Hours – 45**

**TEXT BOOKS:**

1. Giddens A. “Sociology” Wiley India Pvt. Ltd2017
2. Heald Haralambos, R.M “Sociology Themes and Perspectives”, Oxford, New Delhi-92. 2014
3. Sergio Sismondo. An Introduction to Science and Technology Studies Malden: Wiley Blackwell.2010
4. R.K. Merton, Sociology of Science, Theoretical and Empirical Investigations, University of Chicago Press, 1973.

**REFERENCES:**

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Bilton, T. et al “Introductory Sociology”, Palgrave, New York. 2002
3. Das Gupta, Samir and ‘‘An Introduction to Sociology”, Pearson, Delhi. 2012.

4. Francis Abraham M. “Contemporary Sociology: An Introduction to Concepts and Theories”**,** New Delhi, Oxford University Press. 2014
5. Inkless, A, “What is Sociology”, Prentice Hall, New Delhi. 1987
6. Tumin, Melvin M “Social Stratification”, Prentice Hall, New Delhi. 1969.

**COURSE OUTCOMES:**

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

**CO1:** recognize the fundamental tenets of Sociology.

**CO2:** interpret the relationship between individual and society in a sociological perspective.

**CO3:** categorize and constructively identify their own assumptions about the relationships among society, science and technology

**CO4:** appraise the dynamics of human society with special reference to the science, technology and contemporary trends of globalization.

**CO5:** able to link and reflect on current and ongoing sociological debates on development and role of technology.

**Board of Studies (BOS) :**
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 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | H | | | H | H | M | L | H | L | |
| CO2 | | | M | | | H | H | M | H | H | M | L |
| CO3 | | | H | M | H | H | M | | M | H | H | M |
| CO4 | | | M | | | H | H | L | L | M | H | H |
| CO5 | | | M | | | H | | | | M | | L |

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

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

| SSDX 03 | INDUSTRIAL ECONOMICS AND MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 and 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To provide a wholesome idea about the concept of industrial economics and identify the classifications of firms based on ownership and control.

**COB2:** To impart theoretical and analytical knowledge on the different market structures, pricing practices and government policies.

**COB3:** To equip the students with the framework that will be useful for applying economic models in business strategy, competition policy and regulations.

**COB4:** To understand the importance of Industrial Policy in the development of Industries in India.

**COB5:** To elucidate industrial growth in India by examining its performance and problems in industrial sector.

**MODULE I INTRODUCTION TO INDUSTRIAL ECONOMICS 9**

Definition and scope of industrial economics - Concept and importance of industry; Concept and organization of a firm - Classification of firms based on ownership - sector (industries, formal vs. Informal) - size and use - based classification - Separation of ownership and control - Localization of industries
.

**MODULE II MARKET STRUCTURE 9**

Perfect Competition – Imperfect Competition: Monopoly – Monopolistic – Oligopolistic Strategy, Cartels, Cournot Kinked Demand and Price Leadership – Measurement of economic concentration – Policy against monopoly and restrictive trade practices – Competition Law – Pricing Practices: Objectives – Determinants – Pricing Methods – Government Policies and Pricing.

**MODULE III PRODUCTION ECONOMICS AND THEORY OF FIRM 9**

Production and Production function – Types, Factor Inputs – Input-Output Analysis**,** Undifferentiated Products - Cournot, Stackelberg, Dominant firm model, Bertrand-Heterogeneous products - Chamberlin's small and large number case - Kinked demand curve theory - Bain's limit pricing – Production Possibility Frontier.

**MODULE IV INDUSTRIAL POLICY 9**

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) :**
Mention details of BoS
5thBoS of SSSH held on 29.12.2021

**Academic Council:**
18th Academic council held on 24.02.2022

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

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

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

**SDG 9**: Build resilient infrastructure, promote sustainable industrialization and foster innovation.

A comprehensive and holistic approach towards the way for sustainable development and economic growth through the inclusive economic strategy and thereby to reduce the poverty, hunger among people by familiarizing them industry and its importance as survival strategy for earning decent standard of living.

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

**COURSE OBJECTIVES:**

**COB1:** To provide knowledge on the components of the Indian social structure.

**COB2:** To learn the nature and contemporary structure of Indian social institutions.

**COB3:** To sensitize students about social stratification in Indian Society.

**COB4:** To create awareness about the social problems occurring in contemporary India.

**COB5:** To explicate the changing institutions, the processes, the agents and the interventions that brings about change in the Indian society.

**MODULE I INDIAN SOCIAL STRUCTURE 9**

Demographic composition - Racial, religious, ethnic and linguistic -Types of communities - rural, urban, agrarian and tribal - Social backwardness - OBC, SC, ST and EWS - Indian minorities- religious, ethnic, linguistic and LGBT.

**MODULE II INDIAN SOCIAL INSTITUTIONS 9**

Family - types, characteristics, functions of family - Joint Family- definition features, functions of joint family, dysfunctions of joint family, disintegration of joint family – Marriage - definition, characteristics, marriage as sacrament or contract.

**MODULE III SOCIAL STRATIFICATION IN INDIA 9**

Social stratification - Concept of hierarchy - inequality, meaning and characteristics - Social Stratification and Social Mobility - Functions of Social Stratification - Caste, definition, principles, contemporary changes, dominant caste - Caste - class interface - Religious minorities.

**MODULE IV SOCIAL PATHOLOGY 9**

Social Problem - nature, social disorganization - Population explosion- causes, effects, relationship with development - Child Labour- causes, magnitude and consequences – Unemployment - nature, types, causes and effects - Gender issues - social status of women, violence against women and women in work place - Contemporary issues - communalism, terrorism and corruption.

**MODULE V SOCIAL CHANGE IN INDIA 9**

Socio-cultural change - Sanskritization – Westernization - Secularization, Modernization - Processes of Social change - Industrialization – Urbanization – Globalization - Social movement - concept, characteristics, functions - New social movement-Women and Environment movement.

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Sharma,K.L., “Indian Social Structure and Change”, Jaipur: Rawat Publications, 2008.
2. Ahuja Ram., “Social Problems in India”, Rawat Publication: New Delhi, 2014.
3. Ahuja Ram., “Society in India”, Rawat Publication: New Delhi, 2014.

**REFERENCES:**

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Dube S.C., “India's Changing Villages: Human Factors in Community Development”, London, Routledge and Kegan Paul, 2003.
3. Hasnain N., “Indian Society: Themes and Social Issues”, Mc Graw Hill, 2019.
4. Jayapalan, N., **“**Indian Society and Social Institutions” Atlantic Publishers, 2001.
5. Pandey Vinita., “Indian Society and Culture”, Rawat Publications, New Delhi, 2016
6. Rao Sankar., “Sociology of Indian Society”, S. Chand Publisher, New Delhi, 2004.

**COURSE OUTCOMES:**

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

**CO1:** explain about the social structure and social institutions that constitute society in India.

**CO2:** differentiate the various categories of inequalities and their challenges.

**CO3:** describe the social stratification and its impact in society.

**CO4:** analyze the social problems encountered in contemporary India.

**CO5:** correlate the various forms and trends of the social change in Indian society and realize the relevance of their role in bringing about development.

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 5$^{th}$BoS of SSSH held on 29.12.2021 | 18$^{th}$ Academic council held on 24.02.2022 |

| | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | H | | | H | M | | | M | | |
| CO2 | | | M | | | M | H | L | | | | H |
| CO3 | | | M | | | M | H | L | | | | H |
| CO4 | | | H | | | H | H | | M | | | M |
| CO5 | | | H | | H | M | H | M | | H | | H |

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

SDG 10: Reduce inequality within and among countries.
SDG16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

To sensitize and impart pertinent knowledge to youths to combat the contemporary issues and challenges facing Indian society in order to remedy its social pathos and injustices in the path of achieving sustainable development in India.

## HUMANITIES ELECTIVES – VI SEMESTER

| | | | | | |
|---|---|---|---|---|---|
| **SSDX 11** | **ECONOMICS OF SUSTAINABLE DEVELOPMENT** | **L** | **T** | **P** | **C** |
| **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) :** 4thBoS of SSSH held on 28.06.2021

**Academic Council:** 17th AC held on 15.07.2021

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

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

SDG 1: End poverty in all forms and everywhere.

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

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

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

SDG 5: Achieve gender equality and empower all women and girls

SDG 6: Ensure availability and sustainable management of water and sanitation for all.

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

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

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

SDG 10: Reduce income inequality within and among countries

SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.

SDG 12: Ensure sustainable consumption and production patterns
SDG 13: Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The holistic understanding of all the 17 SDGs aims to end poverty, ensure prosperity, and protect the planet.

| | | | | | |
|---|---|---|---|---|---|
| **SSDX 12** | **SOCIOLOGY OF INDUSTRIAL RELATION** | **L** | **T** | **P** | **C** |
| **SDG: 8, 9** | | **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) :**
4thBoS 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** | **PROFESSIONAL ETHICS AND** | **L** | **T** | **P** | **C** |
| **SDG: 8** | **HUMAN VALUES** | **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

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

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

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

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.

| | | | | | |
|---|---|---|---|---|---|
| **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) :** 4thBoS 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

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PHDX 01** | **NON DESTRUCTIVE TESTING OF MATERIALS** | | | | |
| **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 |
|---|---|---|---|---|---|
| SDG: 4 | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

**COB1**: To impart knowledge on the fundamentals of materials science and engineering.

**COB2:** To provide a basis for understanding properties and applications of dielectric materials.

**COB3**: To expose the students to different classes of materials, their properties, structures and imperfections

**COB4**: To aid the teaching learning process through relevant illustrations, animations, web content and practical examples

**MODULE I CLASSIFICATION OF MATERIALS 6**

Concept of amorphous, single crystals and polycrystalline materials, crystallinity and its effect on physical properties, metal, ceramic, polymers, classification of polymers, structure and properties, additives for polymer products, effect of environment on materials, composites

**MODULE II PROPERTIES OF MATERIALS 10**

Mechanical Properties: Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture- Electronic Properties:Free electron theory, Fermi energy, density of states, band theory of solids, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials - Magnetic Properties: Origin of magnetism in metallic and ceramic materials, para-magnetism, diamagnetism, ferro and ferrimagnetism- Thermal Properties: Specific heat, thermal conductivity and thermal expansion, thermoelectricity- Optical Properties: Refractive index, absorption and transmission of electromagnetic radiation in solids, electro-optic and magneto-optic materials.

**MODULE III CRYSTALLOGRAPHIC STRUCTURES AND IMPERFECTIONS 7**

Crystal symmetry, point groups, space groups, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals.

**MODULE IV THERMODYNAMICS AND KINETICS 7**

Phase rule, phase diagrams, solid solutions, invariant reactions, lever rule, basic heat treatment of metals, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, temperature dependence of diffusivity.

**L – 30; TOTAL HOURS –30**

**TEXT BOOKS:**

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

**REFERENCES:**

1. William D. Callister, Jr., David G. Rethwisch, Materials Science and Engineering, Edition 9, Wiley, 2014.
2. Michael F. Ashby, David R.H. Jones , Engineering Materials 1 An Introduction to Properties, Applications and Design · Volume 1, Elsevier Science, 2012
3. Michael F. Ashby, David R.H. Jones , Engineering Materials 2: An Introduction to Microstructures, Processing and Design · Volume 2, Elsevier Science, 2013
4. Reza Abbaschian, Robert E. Reed-Hill, Physical Metallurgy Principles - SI Version, Cengage Learning, NY, 2009
5. "Encyclopedia of Polymer Science and Technology" 3rd Edition, Vol.1-12, Wiley Interscience , 2003

**COURSE OUTCOMES**

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

**CO1:** select suitable material for specific application.

**CO2**: analyse crystallographic structure of metals and their imperfections.

**CO3**: develop metal alloys with varying properties by selecting suitable heat treatment

**CO4:** correlate the various properties of material with their structure.

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

**Academic Council:**
17th AC held on 15.07.2021

| | PO1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 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 | | 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 | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4 | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

**COB1**: To facilitate the knowledge about optical fibres and its transmission characteristics.

**COB2**: To make the students to learn about LED and laser diodes.

**COB3**: To make the students understand the various types of optical Receiversand sensors.

**COB4**: To enrich the knowledge on optical amplifiers and networks.

**MODULE I INTRODUCTION TO OPTICAL FIBRES 7**

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers.

**MODULE II FIBER OPTICAL SOURCES 7**

Light Emitting Diodes (LED) – power and efficiency - double hetero LED – LED structure - LED characteristics – Semiconductor Lasers diode, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers - applications.

**MODULE III FIBER OPTICAL RECEIVERS AND SENSORS 8**

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode Avalanche Photodiode (APD) characteristics - APD design of detector arrays – Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells - Fiber optic sensors: Intrinsic and Extrinsic sensors, amplitude, phase, wavelength and polarization modulation.

**MODULE IV OPTICAL AMPLIFIERS AND NETWORKS 8**

Optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers - Optical Networks: Basic networks, SONET/SDH, WDM Networks, Nonlinear effects on network performance, Performance of WDM + EDFA systems, Solitons, Optical CDMA, Ultrahigh capacity networks.

**L – 30; TOTAL HOURS – 30**

**TEXT BOOKS:**

1. Gerd Keiser, Optical Fiber Communication, 3rd Edition, McGraw-Hill International, Singapore, 2013.

**REFERENCES:**

1 Govind P. Agrawal, Fiber-Optic Communication Systems (Wiley Series in Microwave and Optical Engineering) , Wiley 4th Edition, 2010.
2 J. Senior, Optical Communication, Principles and Practice, Prentice Hall of India, 3rd Edition, 2010.
3 D. C. Agrawal, Fiber Optic Communication, S.Chand& Co Ltd., 2005.
4 Rajiv Ramaswami, KumarSivarajan, Galen Sasaki, Optical Networks: A Practical Perspective, 3rd Edition, Morgan Kaufmann, 2009.
5 B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd, 2014.

**COURSE OUTCOMES:**

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

**CO1:** realize basics of optical fiber and differentiate various modes and configurations.

**CO2:** understand and assimilate the working principle of LED and Diode Laser.

**CO3:** select suitable photodetectors/sensorsfor different types of applications.

**CO4:** analyze the mechanism of optical amplifiers and analyze optical networks.

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

**Academic Council:** 17th AC held on 15.07.2021

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

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

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

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

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PHDX 05** | **SEMICONDUCTOR PHYSICS FOR INFORMATION TECHNOLOGY** | | | | |
| **SDG: 4** | | **2** | **0** | **0** | **2** |

**COURSE OBJECTIVES:**

**COB**1: To understand the physics of semiconductor devices

**COB2**: To gain knowledge on various methods involved in nanofabrication 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 the realization 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) :** **Academic Council:**

BOS of Physics was held on 21.6.21 17th AC held on 15.07.2021

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

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

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

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

| PHDX 06 | SENSORS AND ACTUATORS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4 | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

**COB1**: To understand the basic concept of sensors towards detection of pressure, position, velocity and temperature.

**COB2**: To avail knowledge on sensor which are sensitive to light, magnetic field, and acoustic waves

**COB3**: To study the different types of fabrication techniques towards realization of various sensors.

**COB4**: To get introduced towards MEMS technology and various actuators.

**MODULE I INTRODUCTION TO SENSORS: PRESSURE, POSITION, VELOCITY AND TEMPERATURE** 8

Introduction to sensors – working principles– classification – static and dynamic characteristics, Error Analysis, Pressure sensors – strain gauge, piezoelectric force sensor, vacuum sensors, Position sensor -Proximity sensor, Capacitive, Inductive and displacement sensor, velocity and acceleration sensors, Temperature sensor-thermocouples- thermistors-Thermo-EMF Sensors, metal Junction and metal Semiconductor junction types.

**MODULE II SENSORS : LIGHT, MAGNETIC FIELD AND ACOUSTIC** 8

Photocondutors- Optical Detectors - Photodiodes, Phototranistors, Optical encoder-Charge Coupled Device (CCD), Fabry Perot sensor, Hall effect, magneto resistive, magneto strictive sensors, Acoustic sensors- microphones-resistive, capacitive, piezoelectric, fiber optic, solid state -electrect microphone.

**MODULE III SENSORS FABRICATION TECHNIQUES** 7

Fabrication techniques – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD),magnetron sputtering,Types of lithography:Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

**MODULE IV MICROSYSTEMS AND ACTUATORS** 7

Microelectro-mechanical systems (MEMS) - RF- MEMS, Micro fabrication and Applications, Classification of transducers: electrostatic, piezoelectric, thermal, Microsystem design and fabrication.working principles of Actuators.

Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications Solid-state switches, relays Solenoids, D.C. Motors, A.C. Motors, Stepper motors. Shape memory alloy actuators.

**L – 30; TOTAL HOURS – 30**

**TEXT BOOKS:**

1. Jacob Fraden, Hand Book of Modern Sensors: physics, Designs and Applications, 3rd edition, Springer, New York, 2015.
2. Jon. S. Wilson, Sensor Technology Hand Book, 1st edition, Elsevier, Netherland, 2011.
3. John G Webster, Measurement, Instrumentation and sensor Handbook, 2nd edition, CRC Press, Florida, 2014.

**REFERENCES:**

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2. Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3. D. S. Dhaliwal et al., PREVAIL :Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.
4. Tai-Ran Hsu, MEMS & Microsystem, Design and Manufacture, 1st ed., McGraw Hill India, New Delhi, 2017.
5. MassoodTabibArar, Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures, 1st ed., Kluwer Academic publishers, New York, 2014.

**COURSE OUTCOMES:**

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

**CO1:** get exposed to various types of sensors and apply the ideas to distinguish between pressure, position, velocity and temperature based sensors

**CO2:** familiarize towards light, magnetic field, and acoustic based sensors and recognize their importance in commercial applications.

**CO3:** gain insight into various fabrication techniques towards the realization of sensors

**CO4:**apply the ideas to conceptualize MEMS technology and different actuators in engineering field

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

**Academic Council:**
17th AC held on 15.07.2021

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

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

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

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

| PHDX 07 | FUNDAMENTALS OF NANOTECHNOLOGY AND ITS APPLICATIONS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4 | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

**COB1**:To introduce the basic concepts of Nanoscience through quantum mechanical theories and solid state physics.

**COB2:**To provide knowledge about the various synthesis methods applicable to different nano materials

**COB3**:To enrich the knowledge of students in various characterisation techniques.

**COB4**:To provide knowledge on applications of poymer based nano materials in various fields.

**MODULE I BASICS OF NANO SCIENCE 7**

Introduction to Nanoscience & Nanotechnology : Review of classical mechanics – overview Quantum Mechanics. Background to nanoscience and nanotechnology - scientific revolutions - nanosized effects – surface to volume ratio – atomic structure – molecular and atomic size - quantum effects - formation of nano sized particles – energy at the nanoscale.

**MODULE II SYNTHESIS OF NANOMATERIALS 8**

Nanomaterial Fabrication: Bottom-up vs. top-down - Preparations of Nanomaterials by mechanical and physical methods : – High energy ball milling – melt quenching and annealing – vapour deposition – Pulsed laser deposition – Magnetron sputtering - Microwave plasma evaporation. Chemical Methods of Preparation : Sol-gel method –Electrodeposition – Electrospinning. Arc method for carbon nanotubes – nanofibres and rods – synthesis of Graphene- Handling of nano particles - Health hazards – Precautions.

**MODULE III CHARACTERIZATION OF NANOMATERIALS 8**

Characterisation of Nanomaterials: XRD – particle size determination - SEM - FESEM - TEM – AFM – Nanoindentor – UV-VIS spectroscopy – FTIR, FT-Raman, Photoluminescence, NMR, ESR - Dielectric characterization – Magnetic characterization

.

**MODULE IV APPLICATION OF NANO MATERIALS 7**

Applications of Carbon based nanomaterials (CNT, CNF, Graphene) - Biosensor (principle, component, types, applications) - agriculture (nano-fertilizers, herbicides, nano-seed science, nano-pesticides) and food Systems

(encapsulation of functional foods, nano-packaging) – Nano - electronics, Nano-optics.

**L – 30; TOTAL HOURS – 30**

**TEXT BOOKS:**

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

**REFERENCES:**

1 Nanotechnology: basic science and emerging technologies by Mick Wilson, Kamali Kannangara, Geoff Smith, and Michelle Simmons, Chapman & Hall/CRC; I edition, 2002.

2 Handbook of NanoScience, Engineering and Technology by Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., CRC Press, 2012.

3 Nanocomposite Science and Technology by P. M. Ajayan, L. S. Schadler, P. V. Braun, WILEY-VCH Verlag GmbH, 2003.

4 Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.

**COURSE OUTCOMES:**

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

**CO1:** understand basic principles of nanomaterials and apply them to differentiate the significance of nanomaterials compared to bulk materials.

**CO2:** familiarize the various synthesis methods of nanomaterials and compare them with the preparation of materials in bulk form.

**CO3:** get useful ideas about characterization techniques and differentiate different 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

| | | | | | |
|---|---|---|---|---|---|
| **CHDX01** | **CHEMISTRY OF CONSTRUCTION MATERIALS** | **L** | **T** | **P** | **C** |
| **SDG: 9** | | **2** | **0** | **0** | **2** |

**COURSE OBJECTIVES:**

To impart knowledge on

**COB1:** the chemistry of cement and concrete

**COB2:** the properties of steel and mechanism of corrosion

**COB3:**the quality of water and its impact on concrete

**COB4:** the 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. WieslawKurdowski, 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) :** 11$^{th}$BoS of Chemistry held on 17.06.2021

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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | 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** **L T P C**

**SDG: 9 CHEMISTRY OF MATERIALS AND ELECTROCHEMICAL DEVICES 2 0 0 2**

**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, EkkehardDaschner "*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) :**
11$^{th}$BoS of Chemistry held on 17.06.2021

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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | 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. AuliceScibioh, 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) :** 11$^{th}$BoS of Chemistry held on 17.06.2021

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

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | 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 (CSE – cyber security, AI, IOT, IT) | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11, 12 | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

To make the students conversant with

**COB1:** specific materials for hardware components fabrication, data storage and their related properties

**COB2:** selection of advanced materials for various current applications

**COB3:** materials for the fabrication of sensors

**COB4:** essential characterization techniques and software tools with chemistry 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. AaftaabSethi, Khusbhoo Joshi, K. Sasikala and MallikaAlvala, 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:**

The students will be able to

**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) :**
15thBoS of Department of Chemistry held on 15.06.2021

**Academic Council:**
Mention Number and date
Ex: 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 | - | 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.

| CHDX 05 | CHEMISTRY OF FUELS, | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | COMBUSTION AND LUBRICANTS | 2 | 0 | 0 | 2 |

**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 - 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:**

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, EkkehardDaschner “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) :** 11$^{th}$BoS of Chemistry held on 17.06.2021

**Academic Council:** !7$^{th}$ 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** | 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.

| CHDX 06 | INSTRUMENTAL METHODS OF POLYMER ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| SDG4 | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

To impart knowledge on

**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) :**
11thBoS 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** | - | - | - | 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 |
|---|---|---|---|---|---|
| SDG: 9 | | 2 | 0 | 0 | 2 |

**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. 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.

## OPEN ELECTIVE COURSES – VI SEMESER

| GEDX 201 | APPLICATIONS OF FLUID MECHANICS IN EVERY DAY LIFE | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To introduce the basic concepts of fluid mechanics and its measurement methods.

**COB2:** To make the student understand the various clouds formation and its effects.

**COB3:** To understand the application of fluid mechanics in automobile

**COB4**: To understand the application of fluid mechanics in biological system.

**COB5:** To understand the application of fluid mechanics in sport

**MODULE I FUNDAMENTALS OF FLUID MECHANICS 9**

Definition of fluids, Types of fluids, Classification of fluid flows, Units and dimensions, Various properties related to fluid. Approaches of fluid statics and dynamics condition. Digital pressure measurement systems.

**MODULE II EFFECT OF FLUID IN ATMOSPHERE 9**

Circulation of Water in the Atmosphere, Foggy Weather, Classification of Cloud, Cloud Identification, Cloud Development and Precipitation, Weather Forecasting methods, Tools for Forecasting the Weather, Overview of global climate.

**MODULE III VEHICLE AERODYNAMICS 9**

Introduction to automobile aerodynamics- Performance of cars and light vans, Aerodynamic drag of passenger cars, High-performance vehicles, heating, ventilation and air conditioning of motor vehicles

**MODULE IV BIO-FLUIDICS 9**

Introduction to Bio-fluid Mechanics - Fluidics in living systems and mechanobiology - Pressure driven flows - Analysis of Total Peripheral Flow - Circulatory Biofluid Mechanics - Blood Rheology - Blood Composition and Structure - Flow Properties of Blood - Blood Vessel Structure - Applications of Poiseuilli's Law for the study of Blood Flow

**MODULE V SPORTS AERODYNAMICS 9**

Factors influencing on running, Cycling Aerodynamics, Performance factors in bicycling: Human power, drag, and rolling resistance, Sports Ball Aerodynamics, Skin Suit Aerodynamics in Speed Skating

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Frank M. White, “Fluid mechanics”, Tata McGraw Hill, 2015.
2. Ahrens CD. Essentials of meteorology: an invitation to the atmosphere. Cengage Learning; 2014.
3. Lighthill, J. “Physiological Fluid Mechanics.” Springer-Verlag.
4. Fung, Y.C. (1996). “Biomechanics: Properties of Living Tissues.” Springer-Verlag

**REFERENCES:**

1. Helge Nørstrud, “Sport Aerodynamics”, Springer Vienna, 2010
2. Fung, Y.C. (1993). “First Course in Continuum Mechanics of Physical and Biological Engineers and Scientists.” 3rd Ed. Prentice-Hall.

**COURSE OUTCOMES:**

Students will be able to

**CO1:** Identify the different types of fluid and its related properties

**CO2:** Demonstrate the tools used for weather forecasting.

**CO3:** Know the fluid mechanics principle in vehicle design

**CO4:** Know the fluid mechanics in biological systems

**CO5:** Know the aerodynamics variables and parameter effecting the performance in sports

**Board of Studies (BoS) :**
17th BoS of aero held on 03.02.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

**Statement** : Holistic understanding of fluid mechanics in various filed of everyday life

| GEDX 202 | BASICS OF MANAGEMENT AND ORGANIZATIONAL BEHAVIOUR | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** Familiarize students with the evolution and fundamentals of management

**COB2: :** Introduce various functions of management

**COB3**: Impart knowledge on different elements of individual personality and behavior manifestation

**COB4:** Facilitate closer understanding of organization dimensions for maintaining a working relationship

**COB5:** Examine different styles and best approaches for better workforce management

**MODULE I NATURE AND THEORIES OF MANAGEMENT 8**

Evolution of management Thought-Classical, Behavioral and Management Science Approaches Management- meaning, levels, management as an art or science, Managerial functions and Roles, Evolution of Management Theory-Classical era- Contribution of F.W.Taylor, Henri Fayol, Neo-Classical - Mayo & Hawthorne Experiments. • Modern era – system & contingency approach Managerial Skills.

**MODULE II PLANNING AND ORGANIZING 10**

Planning - Steps in Planning Process - Scope and Limitations - Forecasting and types of Planning - Characteristics of a sound Plan - Management by OBJECTIVE (MBO) - Policies and Strategies - Scope and Formulation - Decision Making - Types, Techniques and Processes.

Organization Structure and Design - Authority and Responsibility Relationships - Delegation of Authority and Decentralization - Interdepartmental Coordination - Impact of Technology on Organizational design - Mechanistic vs Adoptive Structures - Formal and Informal Organization. Control: meaning, function, Process and types of Control.

**MODULE III INDIVIDUAL BEHAVIOUR 10**

Meaning of Organizational behavior, contributing disciplines, importance of organizational behavior, Perception and Learning - Personality and Individual Differences - Motivation theories and Job Performance - Values, Attitudes and

Beliefs - Communication Types-Process - Barriers - Making Communication Effective.

**MODULE IV GROUP BEHAVIOUR 9**

Groups and Teams: Definition, Difference between groups and teams, Stages of Group Development, Group Cohesiveness, Types of teams, Group Dynamics - Leadership - Styles - Approaches - Power and Politics - Organizational Structure - Organizational Climate and Culture, Conflict: concept, sources, Types, Stages of conflict, Management of conflict Organizational Change and Development.

**MODULE V EMERGING ASPECTS OF ORGANIZATIONAL BEHAVIOUR 8**

Comparative Management Styles and approaches - Japanese Management Practices Organisational Creativity and Innovation - Organizational behavior across cultures - Conditions affecting cross cultural organizational operations, Managing International Workforce, Productivity and cultural contingencies, Cross cultural communication, Management of Diversity.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Koontz Harold & Weihrich Heinz “Essentials of Management”, Tata McGraw Hill, 10th Edition, 2015.
2. Stephen P. Robbins., Timothy A. Judge. and Neharika Vohra, “Organizational Behavior”, Pearson, 18th Edition, New Delhi, 2018.
3. Fred Luthans, Brett C. Luthans and Kyle W. Luthans, “Organizational Behavior, An Evidence Based Approach”, McGraw Hill Education, 13th Edition, New Delhi, 2013.

**REFERENCES:**

1. Udai Pareek. Understanding Organizational Behaviour, Oxford University Press, 4th Edition, New Delhi, 2016.
2. Prasad, L.M, “Principles and Practices of Management” Sultan Chand & Sons, 2019.
3. Tripathy P. C. and Reddy P. N., “Principles of Management”, 5th Edition, Tata McGraw Hill, 2015.

**COURSE OUTCOMES:**

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

**CO1:** Describe and discuss the elements of effective management

**CO2:** Discuss and apply the planning, organizing and control processes

**CO3:** Describe various theories related to the development of leadership skills, motivation techniques, team work and effective communication

**CO4:** Have a better understanding of human behaviour in organization

**CO5:** Know the framework for managing individual and group performance

**Board of Studies (BoS) :**
15th BoS of CSB held on 15.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | | H | M | | | | | |
| CO2 | | | | | | | | | M | L | | L | | | |
| CO3 | | | | | | | | | H | H | M | | | | |
| CO4 | | | | | | | | | M | L | | L | | | |
| CO5 | | | | | | | | | M | M | L | M | | | |

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

SDG 9 : Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: Understanding of the basics of functioning of management and people's behavior in organization help to improve the productive employment leading to sustainable economic growth.

| GEDX 205 | CONSUMER ELECTRONICS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4,9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To discuss the fundamentals of audio systems.

**COB2:** To analyze the video systems and e communication systems

**COB3:** To adapt the fundamentals of electronics in consumer gadgets.

**COB4:** To compare the difference between CIoT and IoT

**COB5:** To choose the consumer electronics using IoT for an application

**PREREQUISITE:**

Fundamentals of electronic circuits, communication engineering, microprocessor and microcontrollers.

**MODULE I AUDIO FUNDAMENTALS AND DEVICES 9**

Basic characteristics of sound signal, Microphone: working principle, sensitivity, nature of response, directional characteristics, Types: carbon, condenser, crystal, electrets, tie- clip, wireless, Loud speaker: working principle, characteristic impedance, Types: electrostatic, dynamic, permanent magnet etc., woofers and tweeters, Sound recording: Optical recording, stereophony and multichannel sound

**MODULE II AUDIO SYSTEMS 9**

Audio system: CD player, home theatre sound system, Digital console: block diagram, working principle, Applications, FM tuner: concepts of digital tuning, ICs used in FM tuner TDA7021T, PA address system: speaker impedance matching, Characteristics, power amplifier, Specification.

**MODULE III TELEVISION SYSTEMS 9**

Composite video signal: horizontal and vertical sync details, scanning sequence ,Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance ,Different types of TV camera, Transmission standards: PAL system, channel bandwidth

**MODULE IV TELEVISION RECEIVERS AND VIDEO SYSTEMS 9**

PAL-D colour TV receiver, block diagram, Precision IN Line color picture tube. Digital TVs: LCD, LED, PLASMA, HDTV, 3-D TV, projection TV, DTH receiver. Video interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI Multimedia Interface, Digital Video Interface, CD and DVD player: working principles, interfaces.

**MODULE V CIOT AND ITS CASE STUDIES 9**

Introduction to Consumer Internet of Things (CIoT), difference between CIoT and IoT, Application of home appliances, Wearable devices and other case study of consumer electronic equipments.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. R R. GULATI, Modern Television Practice Transmission, Reception and Applications,New Academic Science, 2021
2. Bali S.P., Consumer Electronics, Pearson Education India, 2010, latest edition.

**REFERENCES:**

1. Bali R and Bali S.P, Audio video systems : principle practices & troubleshooting, Khanna Book Publishing Co. (P) Ltd., Delhi , India, 2010.
2. Gulati R.R., Modern Television practice, New Age International Publication (P) Ltd. New Delhi Year, 2011,
3. Gupta R.G.,Audio video systems, Tata Mc graw Hill, New Delhi, India,2nd edition, 2010.
4. Whitaker Jerry & Benson Blair, Mastering Digital Television: The Complete Guide to the DTV Conversion, McGraw-Hill Professional, 5th edition, 2006.
5. Whitaker Jerry & Benson Blair, Standard handbook of Audio engineering, McGraw-Hill Professional, 2nd edition, 2002.
6. Yashwant Kanetkar, “21 Internet of Things Experiments”, Kindle edition, BPB, January 2018
7. Mourade Azrour, Azeem Irshad, Rajasekhar Chaganti, “IoT and Smart Devices for Sustainable Environment”, Springer Cham, 2022

**COURSE OUTCOMES:**

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

**CO1**: Demonstrate the working of audio and television products.

**CO2**: Select suitable PA system for a specific scenario.

**CO3**: Apply the troubleshooting procedure of a typical TV receivers and video systems

**CO4**: Describe the troubleshooting procedure of audio devices

**CO5**: Illustrate the troubleshooting procedure of a typical TV camera

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

**Academic Council:**
19th Academic Council held on 29.09. 2022

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

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

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

Statement: Provides quality education by understanding the fundamental concepts of home appliances and promotes research in the area of consumer electronic gadgets and electronic communication.

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

Statement: Basic of consumer electronics perseveres on safety measurement of e-gadget used by us. It helps to build resilient Infrastructure; promote inclusive and sustainable industrialization through various electronics appliances used in day to day to life.

| GEDX 207 | CYBER FORENSICS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:**To inculcate the fundamentals of digital forensics from the viewpoint of courtroom legalities

**COB2:** To introduce the different types of cyber crimes.

**COB3:** To begin the policies and procedures to investigate cyber crime

**COB4:** To create forensics concepts and practices focusing on networks and internet

**COB5:** To gain the knowledge on digital investigations.

**MODULE I FORENSICS FUNDAMENTALS 9**

Introduction- Law Enforcement – Services- Benefits of Professional Forensics Methodology – Types of computer forensics technology.

**MODULE II FORENSICS SYSTEM AND SERVICES 9**

Internet Security Systems – Intrusion Detection System – Firewall Security System Storage area network security systems – Network disaster Recovery System – Satellite Encryption Systems – Fighting Cyber Crime with Risk Management Techniques- Computer Forensics Investigation Services – Forensics Process Improvement

**MODULE III DATA RECOVERY 9**

Live data collection – Forensics Duplication – Collecting Network based Evidence – Evidence Handling – Hiding and Recovering Hidden Data – Data backup and Recovery

**MODULE IV EVIDENCE COLLECTION AND DATA SEIZURE 9**

Collection Options – Types of Evidence – Rules of Evidence – Volatile Evidence – Collection& Archiving – Methods of Collection – Artifacts – Collection Steps – Reconstructing the Attack

**MODULE V DATA ANALYSISAND DIGITAL FORENSICS 9**

Computer System Storage Fundamentals – Data analysis techniques – Analyzing network traffic – Investigating hacker Tool –Investigating Routers – Writing - Types of cyber crime-Credit card and cyber crime-Web hacking Digital Detective Work-Cell Phone Forensics - Email and Webmail Forensics

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. John Sammons, “The Basics of Digital Forensics, The Primer for Getting Started in Digital Forensics”, Elsevier, 2nd Edition, ISBN: 9781597496612, 2014

**REFERENCES:**

1. Eoghan Casey, “Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet“, Published by Elsevier, 3rd Edition, ISBN:9780123742681, 2011.
2. John Sammons, “The Basics of Digital Forensics, The Primer for
3. Getting ,Started in Digital Forensics”, Elsevier, 2nd Edition, ISBN: 9781597496612, 2014
4. Nina God bole, Sunlit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley, 2011.
5. Chuck East tom, “Computer Security Fundamentals”, 2nd Edition, Pearson Education, 2012.

**COURSE OUTCOMES:**

**CO1:** Describe the general security issues

**CO2:**Analyze various cybercrimes and offenses.

**CO3:** Outline the occurrence of Cybercrime in mobile and wireless environment.

**CO4:** Use relevant tools and methods in cybercrime

**CO5:** Apply security policies in cyber forensics

**Board of Studies (BoS) :**
19th BoS of CSE held on 28.12.2021

**Academic Council:**
18th Academic Council Meeting held on 24.02.2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | L | | | | | | | | | |
| CO2 | | | | | | | | | | | | | M | |
| CO3 | | H | | | | | | M | | | | | | |
| CO4 | | | | L | | | | | | | | | | H |
| CO5 | | | | | | | | | | H | | | | |

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

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

Statement : The comprehensive understanding of analysis, design and implementation of secure and efficient cyber security features that leads to reduction of offenses.

| GEDX 208 | CYBER SECURITY | L | T | P | C |
|---|---|---|---|---|---|
| SDG - 8 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

- To know the impact of various cybercrimes and cyber offenses.
- To understand cybercrimes in mobile devices.
- To know the tools and techniques used to secure from cybercrimes.
- To understand the basics of cyber security standards and policies.
- To learn about the basics of cyber forensics and cyber laws

**MODULE I CYBERCRIME AND CYBEROFFENSES 9**

Cybercrime and Information Security – Cybercriminals – Classifications of Cybercrimes – Email Spoofing – Spamming – Cyber defamation – Internet Time Theft – Forgery – Web jacking – Hacking – Online Frauds – Software Piracy – Mail Bombs – Password Sniffing – Cyberoffenses – Categories – Planning the attacks – Cyberstalking – Cybercafe and Cybercrimes.

**MODULE II CYBERCRIME: MOBILE AND WIRELESS DEVICES 9**

Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card frauds in Mobile and Wireless Computing – Security Challenges – Authentication Service Security – Attacks on Mobile Phones – Android OS - iOS.

**MODULE III INTRODUCTION TO CYBER CRIME LAW AND INVESTIGATION 9**

Basics of Law, Understanding Cyber Space, Defining Cyber Laws, Scope and Jurisprudence, Concept of Cyber Jurisdiction, Overview of Indian Legal System, Introduction to IT Act 2000, Amendments in IT Act, Cyber Laws of EU – USA – Australia - Britain, other specific Cyber laws. Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks – Introduction to Incident Response – Methodology – Steps - Activities in Initial Response Phase after detection of an incident.

**MODULE IV SECURITY POLICIES 9**

Introduction - Defining User Policies – Passwords – Internet Use – Email Usage – Installing/ Uninstalling Software – Instant Messaging – Defining System Administrative Policies – Defining Access Control – Developmental Policies – Standards, Guidelines and Procedures – Basics of Assessing a System - Firewalls.

**MODULE V COMPUTER FORENSICS 9**

History of Forensics – Computer Forensic Flaws and Risks – Rules of Computer Forensics – Legal issues – Digital Forensic Principles – Digital Environments – Digital Forensic Methodologies-Forensic Hardware and Software-Case study.

**Total Hours : 45**

**TEXT BOOK:**


1. Charles J. Brooks, Christopher Grow, “Cyber Security Essentials”, Sybex Jons Wiley and sons, 2018
2. William Stallings, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015.
3. Andre Arnes, Digital Forensics, ISBN: 9781119262381 Wiley, 2017
4. Anthony Reyes, Jack Wiles, “Cybercrime and Digital Forenscis”, Elsevier Publications, 2007.
5. John Sammons, “The Basics of Digital Forensics”, Elsevier, 2012.
6. Linda Volonins, Reynalds Anzaldua, “Computer Forensics for dummies”, Wiley Publishing 2008.


**COURSE OUTCOMES:**

Upon completion of this course, students will be able to

- Know various cybercrimes and offenses.
- Identify cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime.
- Apply security policies in cyber forensics.
- Outline the strategies adopted in computer forensics.

**Board of Studies (BoS) :** : 16th BoS of IT held on 18.8.2022

**Academic Council:** 19th AC held on 29.9.2022

| | 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** | 2 | 2 | 2 | | 1 | | 2 | | | 2 | | | | 1 | 1 |
| **CO2** | 2 | 2 | 2 | | | | 2 | | | | | | 2 | 1 | 1 |
| **CO3** | 2 | 2 | 2 | | 2 | 2 | | 2 | | 2 | | | | 1 | 1 |
| **CO4** | 2 | | 2 | | | | | | | | | | | 1 | 1 |
| **CO5** | 2 | 2 | 2 | | 2 | | 2 | | | 3 | | | | 1 | 1 |

1.Low Correlation 2. Medium correlation 3. High Correlation

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

**Statement:** It enable better management of infrastructure roll-out and maintenance, increase agricultural productivity, and provide additional business opportunities and market intelligence through online services.

| GEDX 209 | DISASTER MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 3,11,13 & 15 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:**To impart knowledge on the concept related to disaster, hazard and risk.

**COB2:**To provide an understanding about the types of natural disasters and man-made disasters

**COB3:**To gain knowledge related to the different impacts of disaster on health and environment

**COB4:** To provide an understanding about the concept of disaster risk reduction and management

**COB5:** To provide exposure related to various environmental policies & programs for disaster management

**MODULE I BASIC CONCEPTS 7**

Concepts and definitions: Disaster, Hazard and its types - Biological, Chemical, Ergonomic, Physical, Psychosocial- Vulnerability and its types –Risks and its types, Factors influencing degree of risk- Risk severity, Frequency and its capacity – Risk impact, prevention, mitigation.

**MODULE II TYPES OF DISASTERS 10**

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Floods, Droughts, Cold waves, Heat waves and Fire, Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India - Man-made Disasters - Industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, War etc.

**MODULE III IMPACTS OF DISASTER 9**

Disaster impacts - environmental, physical, social, ecological, economic, political, Health, psycho-social issues, demographic aspects - gender, age, special needs, hazard locations, global and national disaster trends, climate change and urban disasters.

**MODULE IV NATURAL DISASTER REDUCTION & MANAGEMENT 10**

Disaster management cycle –Disaster preparedness - Early warning systems - Post disaster environmental response (water, sanitation, food safety, waste

management, disease control, security, communications) - Roles and responsibilities of government, community, Local institutions, NGOs and other stakeholders - Applications of Satellite Communications, GPS, GIS and Remote Sensing in disaster management.

**MODULE V ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA** **9**

Environmental Legislations in India - Environmental policies & programmes- National Disaster Management Authority and its functions - Role of Panchayats in Disaster mitigations - Sustainable rural and urban development- Awareness, Conservation Education & training related disaster management.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Gupta, H.K., "Disaster Management", University Press, India, 2003.
2. Gupta, M.C., "Manuals on Natural Disaster management in India", National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.
3. Ghosh G.K., "Disaster Management", APH Publishing Corporation, 2006.
4. Satish Modh, "Introduction to Disaster Management", Macmillan Publishers India Limited, 2009.
5. Sulphey, M. M., "Disaster Management", Prentice Hall India Pvt., Limited, 2016.

**REFERENCES:**

1. Bhattacharya, T., "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.
2. Dave, R.K., "Disaster Management in India: Challenges and Strategies", Prowess Publishing, 2018.
3. Kapur Anu, "Vulnerable India: A Geographical Study of Disasters", Sage Publishers, New Delhi, 2010.
4. Satender, "Disaster Management in Hills", Concept Publishing Co., New Delhi, 2003.

**COURSE OUTCOMES:**

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

**CO1:**Elaborate about the origin, changes and management of environmental hazards.

**CO2:**Define about the natural disasters and man-made disasters.

**CO3:** List down the different impacts of disaster.

**CO4:** Apply the concept of disaster management and relief measures in the real-time situation.

**CO5:** Suggest solutions based on the National Policy on Disaster Management.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic Council held on 13.04.2023

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

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

SDG 3: Ensure healthy lives and promote well-being for all at all ages
SDG 11. Make cities and human settlements inclusive, safe, resilient and sustainable
SDG 13 : Take urgent action to combat climate change and its impacts
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.
Statement :
The knowledge on disaster management can strengthen resilience and adaptive capacity to natural disasters and make cities and human settlements inclusive, safe, resilient and sustainable.

| GEDX 211 | ENTERPRISE RISK MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To understand the nature and scope of risk management.

**COB2:** To know the enterprise risk management's (ERM) benefits and regulatory standards.

**COB3:** To have a better understanding of ERM process's programming and analysis**.**

**COB4:** To know the ERM process's solution assessment.

**COB5:** To know the ERM process's decision and system administration.

**MODULE I INTRODUCTION TO RISK MANAGEMENT 7**

Nature of risk, terms and definitions - Organizing for Risk Management- Objectives of Risk Management - Scope of Risk Management - legal, financial and social benefits of managing risk.

**MODULE II INTRODUCTION TO ENTERPRISE RISK MANAGEMENT (ERM) 7**

Definition - Hallmarks of ERM - Goals, risk rulers and risk position - Influences and benefits of a risk management programme - Potential consequences of failing to manage risk. Risk management legislation, regulatory standards and compliance obligations - Risk management and the role of the Board and senior management.

**MODULE III ERM PROCESS – RISK PROGRAMMING AND RISK ANALYSIS 10**

Risk programming: vision, mission, values – Strategic planning and ERM – Role of Engineers in risk programming – Risk analysis: Identifying, measuring and analyzing risk – Identification methods - Risk description and expression methods - Role of engineers in risk analysis.

**MODULE IV ERM PROCESS – SOLUTION ASSESSMENT 10**

Risk response categories: prevention, mitigation, avoidance, resilience - Occupational health and safety: environmental risk and construction practices - physical and corporate security - Financial solutions: insurance and contract management - Claims and incident management - Role of engineers in risk solution assessments.

**MODULE V ERM PROCESS – DECISION PROCESS AND SYSTEM ADMINISTRATION** 11

Risk based decision making - Multi hierarchy attribute process - Role of engineer in risk decisions - Risk management structure - Board committees (audit, finance, HR), risk management function, internal audit and compliance function - Key risk indicators and risk position statements - Risk registers, dashboards, reports - Organizational Risk Management Maturity assessments - Risk monitoring and reporting obligations - Role of engineers in risk administration.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

13. Krishnamurthy N., "Introduction to Enterprise Risk Management: A Guide to Risk Analysis and Control for Small and Medium Enterprises", Patridge Publishing, 1st edition, Singapore, 2019.

**REFERENCES:**

5. Alka Mittal, Gupta S.L. "Principles of Insurance and Risk Management", Sultan Chand and Sons, 2010.
6. James T.Gleason, "Risk; The New Management Imperative in Finance", JaicoPublishing House, 2004.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** understand the nature and scope of risk management.

**CO2:** know the enterprise risk management's (ERM) benefits and regulatory standards.

**CO3:** have a better understanding of ERM process's programming and analysis.

**CO4:** know the ERM process's solution assessment.

**CO5:** know the ERM process's decision and system administration.

**Board of Studies (BoS) :**
15th BoS of CSB held on 15.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO3** | M | L | L | - | L | - | H | - | L | - | M | - | - | - | - |
| **CO4** | M | - | M | - | - | - | H | - | - | - | M | - | - | - | - |
| **CO5** | M | - | M | L | - | M | H | - | - | - | M | - | - | - | - |

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

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

Statement : The contents of the syllabus is intended to enable students to understand the enterprise risk management and it's process.

| GEDX 212 | FUNDAMENTALS OF PROJECT MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 12 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To gain insight into the basics of project management

**COB2:** To learn to manage project scope, time and cost

**COB3:** To establish measures to monitor and control project progress

**COB4:** To learn about the dynamics of project closure

**COB5:** To gain knowledge on recent trends in project management

**MODULE I INTRODUCTION 8**

Objectives of Project Management- Importance of Project Management- Types of Projects Project Management Life Cycle- Project Selection – Feasibility study: Types of feasibility Steps in feasibility study.

**MODULE II PROJECT PLANNING AND IMPLEMENTATION 10**

Defining Project Scope - Establishing Project Priorities - Creating Work Breakdown Structure (WBS) - Estimating Project Times and Costs - Developing a Project Schedule - Resource Leveling – Resource Allocation - Developing & Managing Project Teams - Project Risk Management - Risk Identification –- Risk Assessment – Risk Response Development

**MODULE III PROJECT MONITORING AND CONTROL 10**

Project Monitoring Information System – Project Control Process – Monitoring Time – Gantt Chart – Control Chart – Milestone Schedules – Indices to Monitor Progress – Technical Performance Measurement

**MODULE IV PROJECT CLOSURE 8**

Types of Project Closure - Project evaluation - Project Auditing –Project Audit Process - Project Closeout Checklist - Guidelines for closeout reports.

**MODULE V RECENT TRENDS IN PROJECT MANAGEMENT 9**

Managing International Projects – Environmental Factors – Project Site Selection – Cross Cultural Considerations – Selection and Training for International Projects - Agile Project Management - Traditional versus Agile methods

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Erik W. Larson, Clifford F. Gray, and Rohit Joshi, Project Management: The Managerial Process, 8th Edition, McGraw Hill, 2021

**REFERENCES:**

1. Schwalbe, K., “Information Technology Project Management”, 9th Edition, Course Technology Inc., London, 2018.
2. Hughes, B. and Cotterrel, M., “Software Project Management”, 1st Edition, Tata McGraw-Hill, New Delhi, 2009 (ISBN 13: 9780077122799)

**COURSE OUTCOMES:**

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

**CO1:** Conduct feasibility studies to select projects

**CO2:** Manage project scope, time and cost

**CO3:** Monitor and control the progress of a project by identifying performance indices

**CO4:** Successfully close the project

**CO5:** Implement international projects and employ agile management

**Board of Studies (BoS) :** 15th BoS of CSB held on 15.09.2023

**Academic Council:** 21st Academic Council held on 20.12.2023

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

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

SDG 12 : Ensure sustainable consumption and production patterns

Statement : The understanding of the concepts of project management leads to the execution of a project within the time and cost deadline.

| GEDX 213 | INDUSTRIAL ROBOTICS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To learn the fundamentals of robotic systems.

**COB2:** To study about various drives and control systems required for robot system.

**COB3:** To gain knowledge about the kinematics and dynamics of robots.

**COB4:** To familiarize with programming language and futuristic robot systems.

**MODULE I FUNDAMENTALS OF ROBOTIC SYSTEMS L:6 P:6**

History and Terminology of Robotics- Robot anatomy: Definition, law 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.

**MODULE II DRIVES AND CONTROL SYSTEMS FOR ROBOTS L:7 P:6**

Objectives –Motivation -Open loop control - Closed loop control with velocity and position feedback - Types of drive systems - Components of drive system: Lead Screws, ball Screws, Chain and linkage drives, Belt drives, Gear drives, Precision gear boxes, Harmonic drives, Cyclo speed reducers - General aspects of robot control - Basic control techniques - Mathematical modelling of robot servos -Error responses and steady state errors in robot servos -Feed back and feed forward compensations - Hydraulic position servo - Selection of robot drive systems.

**MODULE III KINEMATICS AND DYNAMICS OF ROBOTS L:8 P:9**

Link coordinates -Denavit-Hartenberg(D-H) representation - The ARM equation - Direct kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots.

The inverse kinematics problem - General properties of solutions - Tool configuration - Inverse kinematics of four axis SCARA robot and three and five axis Articulated robot.

**MODULE IV ROBOT PROGRAMMING AND FUTURISTIC ROBOT SYSTEMS L:9 P: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. Robot intelligence - Tele robotics– Mechanical design Features: Mobility, locomotion and Navigation -Robots for Industrial applications.

**PRACTICAL'S:**

**List of experiments:**

**Robot Anatomy**

1. Robot Anatomy studies
2. Fundamentals of V-Rep and software control
3. Building Robot Environment in V-REP
4. Importing robot and virtual controller
5. Robot Jogging
6. Robot Programming
7. Motion Commands in RAPID
8. Path planning
9. Forward kinematics -1 DOF and 2 DOF
10. Inverse kinematics -1 DOF and 2 DOF

**L – 30; TOTAL HOURS – 30**

**TEXT 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 drive system required for particular robot system.

**CO3:** Describe the kinematics and dynamics of robots.

**CO4:** Elucidate the robot programming language and futuristic robot systems.

**Board of Studies (BoS):**

20th BOS held on 08.08.2022

**Academic Council:**

19th Academic Council held on 29.09. 2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | L | L | | | M | | | | L | | | L | | |
| CO2 | L | L | | | M | | | | L | | | L | | |
| CO3 | L | L | L | | M | | | | L | | | L | | |
| CO4 | L | L | | | M | | H | | 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 understanding of robots promotes automation and helps to improve work environment, ultimately achieving improved productivity in labor-intensive industries through technology.

| GEDX 214 | INTERNET OF THINGS AND ITS APPLICATIONS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4,9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To discuss the basic concepts of IoT

**COB2:** To elaborate the vision of IoT from a global context

**COB3:** To choose different protocols for IoT design

**COB4:** To explain the security issues in IoT

**COB5:** To estimate the Market perspective of IoT.

**PREREQUISITE:**

Basics of embedded system and networking

**MODULE I BASICS OF IOT** **9**

IoT & Web Technology, The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues

**MODULE II IOT ARCHITECTURE** **9**

A Basic Perspective– Introduction, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View

**MODULE III IOT PROTOCOLS** **9**

Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols

**MODULE IV IoT SECURITY** **9**

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps

Towards a Secure Platform, Smartie Approach- Data Aggregation for the IoT in Smart Cities, Security

**MODULE V APPLICATIONS OF IoT 9**

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. S. Misra, A. Mukherjee, and A. Roy, " Introduction to IoT"Cambridge University Press, 2020
2. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web", Wiley Publications , 2010
3. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", WileyPublications, 2012
4. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, 2014.

**REFERENCES:**

1. Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications, 2013
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

**COURSE OUTCOMES:**

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

**CO1:** Explain the various concepts, terminologies and architecture of IoT systems.

**CO2:** Apply various protocols for design of IoT systems

**CO3:** Use of Devices, Gateways and Data Management in IoT

**CO4:** Design IoT applications in different domain

**CO5: A**nalyze performance of IoT application

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

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

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

SDG No: 4 - Quality Education
Improving lives through the advancement of learning.

SDG No: 9 - Industry, Innovation and Infrastructure
To increase the performance by providing scalable computing and storage resources.

| GEDX 216 | IPR AND PATENT LAWS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.

**COB2:** To disseminate knowledge on Copyrights and Design with their registration aspects

**COB3:** To learn the requirement of patentability, learn how to read and interpret patent specifications

**COB4:** To inculcate basic understanding on patent prosecution

**COB5:** To know about the enforcement agencies and rights

**MODULE I OVERVIEW OF INTELLECTUAL PROPERTY 10**

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994

**MODULE II COPY RIGHTS AND DESIGN 9**

Nature of Copyright - Subject matter of copyright, Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties. Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection

**MODULE III INTRODUCTION TO THE INDIAN PATENT SYSTEM 9**

Patent Laws as Concepts; Understanding the Patents Rules, 2003; Statutory Exceptions to Patentability; Novelty and Anticipation; Inventive Step; Capable of Industrial Application; How to Make a Patent Application, What to include in a Patent Application, Types of Patent Applications.

**MODULE IV PATENT PROSECUTION 8**

Publication and Examination; Powers of Controller—Examination Stage, Consideration of report by examiner, Refuse or Amend Applications, Division of Applications, Dating of Application, Anticipation, Potential Infringement

**MODULE V PATENT LICENSING AND ENFORCEMENT 9**

Compulsory Licensing—Working of Patents, Grounds for Grant of Compulsory License, Revocation; Patent Licensing; Patent Enforcement, International Arrangements and Other Miscellaneous Provisions Intellectual Property Appellate Board; Declaratory Suits, Infringement Suits

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

**REFERENCES:**

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
2. Basil, Lucas, Izumi and Nakanishi (2018), Patent law for scientist and engineers, LexisNexis.

**COURSE OUTCOMES:**

**CO1:** Enriched knowledge on types of IPRs

**CO2:** Better knowledge on copyrights and designs

**CO3:** Ability to classify the charateristics that are patenable and apply for patent

**CO4:** Know how to track a patent application and prosecute

**CO5:** Can apply for licensing and know the remedy in case of infringement

**Board of Studies (BoS) :**
15th BoS of CSB held on 15.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

Statement : It is established that intellectual property touches different aspects of a country's economic growth and social development, so an engineer or technocrat should know the implications of their innovations

| GEDX 217 | LOGISTICS AND SUPPLY CHAIN MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 12 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1**: To identify of the role of logistics in adding value to the final product .

**COB2**: To gain knowledge on warehouse and transport operations in logistics.

**COB3:** To learn the fundamentals of supply chain management.

**COB4:** To learn to locate the facilities, design network in a supply chain.

**COB5:** To get exposed to the latest developments in the field of Logistics and Supply Chain Management.

**MODULE I INTRODUCTION TO LOGISTICS MANAGEMENT 11**

Definition and scope of logistics management-Importance of logistics in supply chain management Evolution and trends in logistics management-Functions -In-bound and Out-bound logistics – Components of Logistics Management - Logistics Service Provides (LSP)-Role of 2 PL, 3 PL and 4 PL - Concepts and importance of reverse logistics

**MODULE II WAREHOUSING & TRANSPORTATION 7**

Warehousing Functions - Types - Site Selection - Decision Model - Layout Design - Costing - Virtual Warehouse. Transportation System - Evolution - Infrastructure and Networks - Freight Management - Vehicle Routing – FTL and LTL.

**MODULE III SUPPLY CHAIN MANAGEMENT 9**

Introduction to Supply chain management - Definition, objectives - functions of Supply chain and drivers – Drivers of supply chain performance –Material flow-financial flow- information flow-- Lack of supply chain coordination and the Bullwhip effect,VMI – CPFR.

**MODULE IV SUPPLY CHAIN NETWORK 9**

Distribution network design – role - factors influencing options, design options – network design decisions – factors influencing options - models for facility location and capacity allocation - network optimization models.

**MODULE V CURRENT TRENDS 9**

Logistics Information Systems - Need - Characteristics and Design – E Logistics - Structure and Operation - Logistics Resource Management -

e- LRM Role of information technology in a supply chain – e-business and supply chain management – Green supply chain management and environmental sustainability of supply chain.

**L –45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Bowersox, D. and Closs, D., “Logistical Management: The Integrated Supply Chain Process”, Tata McGraw - Hill, New Delhi, 2010.
2. Chopra, S., Meindl, P. and Kalra, D.V., “Supply Chain Management: Strategy, Planning, and Operation”, 6th Edition, Pearson Education, New Delhi, 2016.

**REFERENCES:**

7. Vinod V. Sople., “Logistics Management”, 3rd Edition, Pearson Education, New Delhi, 2012.
8. Sharma S., “Supply Chain Management: Concept, Practices and Implementation”, Oxford University Press, New Delhi, 2010.
9. Martin Christopher, “Logistics & Supply Chain Management”, 9thEdition,2010.

**COURSE OUTCOMES:**

**CO1:** Appreciate the role of logistics in adding value to the final product

**CO2:** Bring about changes warehousing practices of an organization and Effectively manage transportation.

**CO3:** Recognize the processes in a supply chain and make suitable decisions.

**CO4:** Design supply chain network and locate various facilities in an optimal
Manner.

**CO5:** Execute logistics and supply chain management desires of a company from a global perspective.

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 15th BoS of CSB held on 15.09.2023 | 21st Academic Council held on 20.12.2023 |

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

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

SDG No. 9 - Ensure sustainable consumption and production patterns

Statement : The understanding of the concepts of supply chain management leads to the production and distribution of goods and services for the mankind with a focus on improving the overall supply chain profitability.

| GEDX 220 | OPTIMIZATION TECHNIQUES | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4, ,9,11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1**: To introduce the basic concepts of linear programming

**COB2**: To educate on the advancements in Linear programming techniques

**COB3:** To introduce non-linear programming techniques

**COB4**: To introduce the interior point methods of solving problems

**COB5**: To introduce the dynamic programming method

**MODULE I LINEAR PROGRAMMING** **9**

Introduction - formulation of linear programming model-Graphical solution–solving LPP using simplex algorithm – Revised Simplex Method.

**MODULE II ADVANCES IN LPP** **9**

Dual simplex method - Sensitivity analysis – Transportation problems– Assignment problems-Traveling sales man problem -Data Envelopment Analysis.

**MODULE III NON LINEAR PROGRAMMING** **9**

Classification of Non Linear programming – Lagrange multiplier method – Karush – Kuhn Tucker conditions–Reduced gradient algorithms– Quadratic programming method – Penalty and Barrier method.

**MODULE IV INTERIOR POINT METHODS** **9**

Karmarkar's algorithm–Projection Scaling method–Dual affine algorithm–Primal affine algorithm - Barrier algorithm.

**MODULE V DYNAMIC PROGRAMMING** **9**

Formulation of Multi stage decision problem–Characteristics–Concept of sub-optimization and the principle of optimality–Formulation of Dynamic programming–Backward and Forward recursion– Computational procedure–Conversion offinal value problem into Initial value problem.

**TEXT BOOKS:**

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000.
2. R.Panneerselvam, "Operations Research", PHI, 2006

3. Hamdy ATaha, “Operations Research –An Introduction”, Prentice Hall India, 2003.

**REFERENCES:**

1. Philips, Ravindran and Solberg, “Operations Research”, John Wiley, 2002.
2. Ronald L.Rardin, “Optimization in Operation Research” Pearson Education Pvt. Ltd. New Delhi, 2005.

**COURSE OUTCOMES:**

At the end of the course, the student will

**CO1** be proficient in formulating and solving linear programming problems by employing graphical techniques and the simplex algorithm.

**CO2** solve intricate optimization problems through techniques like dual simplex method, sensitivity analysis, and solving transportation and assignment problems.

**CO3** solve non-linear programming problems using methods such as Lagrange multiplier, Karush-Kuhn-Tucker conditions, and various optimization algorithms.

**CO4** apply interior point methods, including Karmarkar's algorithm and Barrier algorithm, to solve optimization problems.

**CO5** acquire the ability to model and solve multi-stage decision problems using dynamic programming principles, including sub-optimization and backward/forward recursion.

**Board of Studies (BoS) :**
19$^{th}$BoS conducted on 29.08.2023

**Academic Council:**
21$^{st}$ Academic Council held on 20.12.2023

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

**SDG 4:Quality education**

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

The syllabus contributes to providing quality education by teaching optimization techniques and problem-solving methods.

**SDG 9 : Industry, innovation and infrastructure**

Statement:Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

The syllabus covers advanced methods in optimization, which can contribute to innovative solutions in various industries and infrastructure development.

**SDG 11: Sustainable Cities and Communities**

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

Optimization techniques taught in the syllabus can be applied to urban planning and resource allocation, supporting the development of sustainable cities.

| GEDX 221 | POLYMERS FOR DIFFERENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | TRANSPORTATION | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:**To introduce the changing structure of automotive industries towards usage of plastics, rubbers, composites, sealants and adhesives.

**COB2:**To impart knowledge of polymers used in interior applications.

**COB3:**To develop knowledge of polymers used in exterior applications.

**COB4:**To provide knowledge of composite materials for automotive applications.

**COB5:**To illustrate the usage of automobile rubber components.

**MODULE I INCLINATION OF AUTOMOTIVE COMPONENTS TOWARDS POLYMERS** 9

Quest for a lightweight vehicle - Need for plastics – advantages and limitations of plastics – designing with plastics –the decisive properties – materials selection – requirements for different application areas – light weight nanocomposites – uses of adhesives in automobile and aerospace – phenolics, epoxies, acrylics, anaerobics, cyanoacrylates.

**MODULE II POLYMERS FOR AUTOMOBILE INTERIORS** 9

Interiors – dominance of plastic – fashion and function – plastics surfaces: texture and fogging – emissions and interior air quality - plastic structure and panel application: sandwich concept, instrumental panel, other sensitive panels – structural and mechanical components: seating, door and window furniture, steering wheel, airbags, seat belts, pedals, instrumental and others.

**MODULE III POLYMERS FOR AUTOMOBILE EXTERIORS** 9

Exteriors: Body panels and structure – Painting problems – Bumpers – Other exteriors: Grills, Spoilers, Mirrors, Door handles, Wheel trim, Road wheels, Sunroof components, Windscreen wiper assemblies.

**MODULE IV COMPOSITE MATERIALS FOR ELECTRIC VEHIVLES** 9

Low-cost carbon fibers – lightweight automotive materials - Barriers to Carbon Fibre Adoption in the Automotive Industry - Low-Cost Carbon Fibre - Precursor Materials - PAN-Based - Lignin-Based - Polyolefin-Based - Advanced Processing Techniques - Advanced Surface Treatment and Sizing - Application of Composite Materials in the Automotive Industry -

Composite Driveshaft and Spring - Recent Developments in Automotive thermoplastic composites

**MODULE V RUBBER COMPONENTS IN AUTOMOBILES 9**

Rubber mounts – Spring design – Comparison with metallic springs –Seals for static and dynamic applications –tyres and tubes – timing belt – rubber – metal bonding

**L – 45 ; TOTAL HOURS –45**

**TEXTBOOKS:**

1. James Maxwell, “Plastics in the Automotive Industry”, SAE internationals, woodhead Publication, England, 1994.
2. Omar Faruk, Jimi Tjong, Mohini Sain, “Lightweight and Sustainable Materials for Automotive Applications”, CRC Press, 2017.
3. Ahmed Elmarakbi, “Advanced Composite Materials for Automotive Applications”, Wiley, 2014.

**REFERENCES:**

1. Kalyan Sehanobish, “Engineering Plastics and Plastic composites in Automotive Applications”, SAE internationals, Warrendale, 2009.
2. Automotive Plastics and Composites, Reinforced Plastic Magazine, Elsevier Advanced Technology, 1999.

**COURSE OUTCOMES:**

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

**CO1:** demonstrate the the changing structure of automotive industries towards usage of plastics

**CO2:** explain the plastics used in automotive interior applications

**CO3:** appreciate the plastics usage in automotive exterior applications

**CO4:** suggest composite materials for automotive parts

**CO5:** appreciate the usage of rubbers for various automotive applications

**Board of Studies (BoS):**
BoS of PE held on 07.02.2023

**Academic Council:**
20th Academic Council held on 13.04.2023

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

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO5** | L | | | | | | | | | | | L | | | H | |

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

SDG 8: Work opportunities for automobile and mechanical engineers in polymer and automotive part manufacturing industries

Effective learning of this course will lead the other department students to appreciate the usage of polymer materials in automobile applications which in turn leads to work opportunities

| GEDX 222 | PROGRAMMING LANGUAGE PRINCIPLES | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1**:To learn syntax and semantics of programming languages

**COB2:** To comprehend data, data types, and basic statements

**COB3:** To explore call-return architecture and ways of implementing them

**COB4:** To gain knowledge about object-orientation, concurrency and even handling in programming languages

**COB5:** To write programs in non-procedural programming paradigms

**MODULE I SYNTAX AND SEMANTICS 09**

Evolution of programming languages – describing syntax – context-free grammars– attribute grammars – describing semantics – lexical analysis – parsing – recursive-decent – bottom-up parsing.

**MODULE II DATA, DATA TYPES AND BASIC STATEMENTS 09**

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types– record types –union types – pointers and references – Arithmetic expressions – overloaded operators –type conversions – relational and Boolean expressions – assignment statements – control structures – selection – iterations – branching – guarded statements.

**MODULE III SUBPROGRAMS AND IMPLEMENTATIONS 09**

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return–implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping.

**MODULE IV OBJECT-ORIENTATION, CONCURRENCY, AND EVENT ANDLING 09**

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads –statement level concurrency – exception handling – even handling.

**MODULE V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 09**

Introduction to lambda calculus – fundamentals of functional programming languages –Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages.

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Robert W. Sebesta, “Concepts of Programming Languages”, Tenth Edition, Addison Wesley, ISBN:9789332518872, 9332518874, 2014.
2. Michael L. Scott, “Programming Language Pragmatics”, Third Edition, Morgan Kaufmann,ISBN:9780124104778, 0124104770, 2015.

**REFERENCES:**

1. R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, MIT Press,ISBN:9780262512985, 026251298, 2009.
2. Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Prentice Hall, ISBN:9780137903870, 0137903871, 1998.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:**Identify syntax and semantics of programming languages

**CO2:**Define data, data types, and basic statements of programming languages

**CO3:** Design and implement subprogram constructs

**CO4:**Apply object-oriented, concurrency, and event handling programming constructs

**CO5:** Develop programs in Scheme, ML, and Prolog

**Board of Studies (BoS) :**
19th BoS of CSE held on 28.12.2021

**Academic Council:**
18th Academic Council Meeting held on 24.02.2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | H | | | | | | | | | | |
| CO2 | H | | | | | | | | | | | | | |
| CO3 | H | | | L | | | | | | | | | | |
| CO4 | H | H | | H | | H | M | | | | | | H | |
| CO5 | H | H | | H | H | H | H | | | | | | H | H |

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

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

Statement::By learning the Programming Language Principles, the student will be able to create robust real time applications.

| GEDX 224 | PYTHON PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| SDG - 8 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

The students will

COB1: understand basics of Python programming.

COB2: gain the knowledge in control structures, loops, functions and modules.

COB3: represent the data using lists, tuples and dictionaries.

COB4: acquire knowledge about the fundamental principles of Object-Oriented Programming.

COB5: discover the use of file and exception handling techniques

**MODULE I INTRODUCTION TO PYTHON 10+10**

Basic introduction to Python-Python Interpreter- variables and simple data types-strings-string formatting-Numbers-comments-Operators- Operator Precedence-Control flow-Conditional statements-Nested conditionals-Loops-Loop control statements.

**MODULE II DATA COLLECTION AND FUNCTIONS 10+10**

Data collection- Processing data with List, Tuples, Dictionaries -Function Definitions –Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions –Passing a List- Storing your functions in module.

**MODULE III CLASSES, FILE HANDLING AND EXCEPTION HANDLING 10+10**

Classes and objects – Inheritance - Multiple level of Inheritance– Encapsulation and Information Hiding- Python Standard Libraries–Packages-File handling- File Open-Read, Write, Delete-Exceptions - Exception handling

**L – 30; P – 30 ;TOTAL HOURS - 60**

**LIST OF EXPERIMENTS**

Students should develop and practice simple Python programs using the following concepts.

1. Data Types and variables
2. String formatting
3. Operators
4. Conditional branching

5. Loops
6. Collection and processing with Lists
7. Collection and processing with Tuples
8. Collection and processing with Dictionaries
9. Functions
10. Recursion
11. Modules
12. Classes & Objects
13. Inheritance
14. File handling
15. Exception handling
16. Mini Python project such as
    - Simple Quiz using python
    - Random Number guessing Game
    - Rock paper scissor
    - Countdown timer

**TEXT BOOK:**

1. Eric Matthes," Python Crash Course: A Hands-On, Project-Based Introduction to Programming" ,3rdedition, No starch Press, 2023.

**REFERENCES:**

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python 3, Shroff /O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Python Cookbook,Third edition by David Beazley, Brian K. Jones
3. Paul J. Deitel and Harvey Deitel, Python for Programmers, First edition, Pearson Education, ISBN-10 : 9353947987, 2020.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

CO1: Write simple Python programs using data types, variables, operators and string.

CO2 : Interpret the use of conditional statements, loops and function calls to navigate program control flow effectively.

CO3: Implement data structures in Python.

CO4: Apply fundamental OOP principles for creation of Python programs through effective class creation, object utilization, and inheritance.

CO5: Discover the functionality of the file system in Python and handle exceptions effectively.

**Board of Studies (BoS) :** 16th BoS of IT held on 18.08.2022

**Academic Council:** 19th AC held on 29.09.2022

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

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

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

Students can be equipped with valuable Python programming skills crucial for successful employment. Also students will be empowered to make significant contributions across various sectors.

| GEDX 226 | SMART SENSORS IN HEALTHCARE APPLICATIONS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4,9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:**To understand the basics of biosensors and its instrumentation

**COB2:**Provide knowledge on the various enzyme sensors in healthcare applications

**COB3:** To provide information to the students on application of bio sensors.

**MODULE I INTRODUCTION TO BIO SENSORS 8**

Introduction to Bio sensors, Classification of Biosensors- Based on Type of Transduction, Based on Biological Element, Instrumentation, Future Directions in Biosensors (Micro and Nano Technologies), Designing a Simple Biosensor

**MODULE II ENZYME SENSORS 10**

Enzyme Sensors: Principles of Operation, Theoretical Aspects, Transient response, Stability, Sensor Calibration. Potentiometric Enzyme Electrodes: Potentiometric Glucose Electrodes, Potentiometric Amino Acid Electrodes, Comparison of Potentiometric Enzyme Electrodes.

**MODULE III SEMICONDUCTOR ENZYME SENSORS 10**

Semiconductor Enzyme Sensor: MOSFET Sensors, ISFET Sensors, ENFET Sensors

**MODULE IV OPTICAL AND THERMAL SENSORS 7**

Optical Enzyme Sensors: Principles of Operation, Optical Sensors Based on Absorption- based on Fluorescence- Bio/Chemi-luminescence, Optical Fibers, Thermal Enzyme Sensors: Determination of Glucose, Determination of Urea, Piezoelectric Enzyme Sensors.

**MODULE V SMART SENSOR APPLICATIONS** 10

Electronic Tongue- Applications and Challenges, Electronic Nose- Applications and Challenges. Biosensors for Neurological Disease.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Hamida Hallil, HadiHeidari,Smart Sensors for Environmental and Medical Applications, ISBN: 978-1-119-58734-7 May 2020 Wiley-IEEE Press
2. Tran Minh Canh , Biosensors , , Chapman & Hall Publication 1993 edition, 2013

**REFERENCES:**

1. Bansi d. Malhotra and Anthony r. F. Turner, “Advances in Biosensors”edited , , JAI Press INC (Imprint of Elsevier Science)
2. Robert S. Marks, Christopher R. Lowe, David C. Cullen, Howard H. Weetall,Handbook of Biosensors and Biochips (2 Volume set), Wiley (2007)

**COURSE OUTCOMES:**

**CO1**: Able to find design simple bio sensors

**CO2**: Able to identify sensors for bio medical applicationsanalyze the stability of nonlinear systems

**CO3**: Apply the principles of semi conducting properties in bio sensors

**CO4**: Identify the optical and thermal sensors used for various biomedical applications

**CO5**: Able to apply the smart sensor technology in electronic bio sensors

**Board of Studies (BoS) :**

18th Board of Studies of EIE held on 12.07.2022

**Academic Council:**

19th Academic Council Meeting held on 29.09.2022

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 4,9: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all and help in developing technological capabilities

Students will be able to apply the recent advancements in technology in the field of biomedical applications

| GEDX 227 | TOTAL QUALITY MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To learn the basics of TQM.

**COB2:** To acquire knowledge on the principles of TQM

**COB3:** To familiarize with the various TQM tools and techniques

**COB4:** To gain knowledge about Lean six sigma

**COB5:** To be conversant with Quality management system.

**MODULE I INTRODUCTION L:9**

Definition of quality- Evolution of quality- TQM framework- Basic concepts of TQM- Dimensions of manufacturing and service quality- Principles of TQM- Contributions of Deming, Juran and Crosby- Barriers to TQM Implementation.

**MODULE II TQM PRINCIPLES L:8**

Customer focus – Customer satisfaction - Customer retention – Costs of quality - Leadership – Strategic quality planning - Quality Councils - Quality circles - Recognition and Reward - Performance appraisal – Supplier partnership – Partnering -Supplier selection - Supplier Rating.

**MODULE III TQM TOOLS AND TECHNIQUES L:9**

The seven traditional tools of quality– New management tools – Benchmarking - Continuous process improvement: PDCA cycle, 5S, Kaizen, Benchmarking Process, Quality Function Deployment (QFD) - Process – Benefits- Taguchi Quality Loss Function - Total Productive Maintenance (TPM) – Concept- Improvement Needs- FMEA – Stages of FMEA.

**MODULE IV LEAN SIX SIGMA L:11**

Concept of Six Sigma - Definition - Identifying project of importance from service and manufacturing sector- Developing project charter - Measure - Finalizing critical to quality (CTQ) characteristics – MSA - Analyse - Identification and confirmation of potential critical factors - Improve - Generation and evaluation of solutions to critical root causes - selection and optimization of best solution - Pilot implementation and validation of solution- Control - control plan.

**MODULE V QUALITY MANAGEMENT SYSTEMS L:8**

Need for ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System– Elements - Implementation of Quality System – Documentation -Quality Auditing - TS 16949. ISO 14000 – Concept, Requirements and Benefits - ISO 22301:2019- Business continuity management systems.

**L – 45; TOTAL HOURS – 45**

**TEXTBOOKS:**

1. Total Quality Management(TQM) 5th Ed byPearson Education– October 2018. ByBesterfield Dale H. & BesterfieldCarol.
2. Total Quality Control 4th edition Subsequent Edition 2004 - Armand V. Feigenbaum.

**REFERENCES:**

1. “The Management and Control of Quality”, James R.Evans& William M.Lidsay, 5th Edition, South-Western (Thomson Learning), 2002.
2. “Total Quality Management”, Oakland.J.S., Butterworth HcinemannLtd.,Oxford, 2002.
3. Total Quality Management: Key Concepts and Case Studies, D.R. Kiran, October 2016.
4. “Total Quality Management (TQM): Principles, Methods, and Applications”, AshishAgarwal, Dixit Garg, Sachin K. Mangla, Sunil Luthra, 2020.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1**. Explain fundamentals of Total Quality Management

**CO2:** Describe the principles of TQM.

**CO3:** Select the proper TQM tools for continuous quality improvement process

**CO4:** Illuminate the lean six sigma concepts

**CO5:** Explainthe Quality management system.

**Board of Studies (BoS):**
20th BOS of mechanical dept held on 08.08.2022

**Academic Council:**
19th Academic Council held on 29.09. 2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | M | L | | | | | | | M | M | M | L | | |
| **CO2** | M | L | | M | | | | | M | M | M | L | | |
| **CO3** | M | L | | | | | | | M | M | H | L | | |
| **CO4** | M | L | | L | | H | M | | M | M | L | L | | |
| **CO5** | M | L | | | | | | M | M | H | 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 comprehensive understanding of TQM principles and tools promote quality in process and products.

| GEDX 229 | WASTEWATER MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 6 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge on the generation , type and characteristics of domestic wastewater

**COB2:** To give an insight on the principle of domestic wastewater treatment

**COB3:** To familiarize the characteristics of industrial wastewater and its treatment methods

**COB4:** To provide exposure about the cycle of sanitation and stages of septage management

**COB5:** To impart knowledge on the advanced techniques in sewage treatment

**MODULE I WASTEWATER GENERATION 9**

Wastewater generation - Types of domestic wastewater - Types of sewerage system - Storm water management - Flow estimation - Sewage characteristics –Impact of untreated effluents on land and water - Pollution Control Rules and Environmental legislation.

**MODULE II DOMESTIC WASTEWATER TREATMENT 9**

Onsite and offsite challenges in wastewater treatment – Stages of wastewater treatment – Principles and Functions of treatment process - Working of Septic tanks - Onsite grey water treatment - wetland treatment - Capturing nutrients - Stages in Sludge management

**MODULE III INDUSTRIAL WASTEWATER TREATMENT 9**

Sources and characteristics of industrial wastewater - Effects of Industrial wastes on sewerage system - Sewage treatment plants and receiving water bodies -Standards related to industrial wastewater - Pre-treatment - Waste volume reduction, waste strength reduction, neutralization, equalization and proportioning, Removal of Organic and inorganic dissolved solids

**MODULE IV SEPTAGE TREATMENT 9**

Full cycle of sanitation - Sustainable practices in capture and containment - Septage treatment using Drying beds, Planted drying bed,

Anaerobic digestion - Disposal and resource recovery - Challenges in operation and maintenance of receiving and treatment facilities

**MODULE V ADVANCED TREATMENT METHODS AND REUSE 9**

Advances in sewage treatment – Microalgae based wastewater treatment technologies – Advances in membrane technology - Thermal hydrolysis technology for sludge treatment – Biogas generation - Wastewater Reuse and Recycle - Regulations Standards - Types of Reuse – Agriculture - Groundwater Recharge.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Mackenzie L. Davis,. “Water and Wastewater Engineering: Design Principles and Practice”, Second Edition (McGraw-Hill Education: New York, 2020.
2. Metcalf and Eddy, “Wastewater Engineering Treatment, Disposal and Reuse”, Tata McGraw Hill, 2007.
3. Narayana Rao M and Amal K. Datta “Wastewater Treatment, Rational methods of Design and Industrial practices”, Oxford and IBH Publications, Third Edition, New Delhi, Reprint 2009
4. Strande, L., Ronteltap, M., and Brdjanovic, D., Fecal Sludge Management: Systems Approach for Implementation and Operation, IWA Publishing, 2014.

**REFERENCES:**

1. Athar Hussain, Sirajuddin Ahmed. “Advanced Treatment Techniques for Industrial Wastewater”, IGI Global, USA, 2018.
2. Arceivala, S.J., “Wastewater Treatment for Pollution Control & Reuse”, McGraw-Hill, New Delhi, 3rd Edition, 2006.
3. NG Wun Jern. “Industrial Wastewater Treatment”. World Scientific, Imperial College Press, Singapore, 2020.
4. Patwardhan, A. D, “Industrial Wastewater Treatment”, PHI Learning (P) Ltd., New Delhi, 2017.
5. Operative Guidelines for Septage Management for Local Bodies in Tamil Nadu, Municipal Administration and Water Supply Department Government of Tamil Nadu, 2020.

**COURSE OUTCOMES:**

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

**CO1:**describe the types of wastewater, its generation and characteristics

**CO2:** explain the treatment of domestic wastewater.

**CO3:**identify and suggest the treatment methods relevant to the industrial wastewater

**CO4:**illustrate the current practices for septage management

**CO5:** describe the advanced treatment methods and recommend options for reuse

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic Council held on 13.04.2023

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

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

SDG No.6 :Ensure availability and sustainable management of water and sanitation for all

The knowledge on the Domestic and industrial wastewater management along with the sanitation would cater the development of infrastructure aiming to reduce pollution and safeguard the environment.

| GEDX 231 | ELECTRONICS FOR MECHANICAL | L | T | P | C |
|---|---|---|---|---|---|
| SDG 4 ,9 | SYSTEMS | 3 | 0 | 0 | 3 |

**COURSEOBJECTIVES:**

**COB 1** : To study the characteristics of semiconductor devices such as diodes, transistors and their applications.

**COB 2** : To study fundamentals of digital logic circuits.

**COB 3** : To study 8085 microprocessors and its interfacing with other peripheral devices.

**COB 4** : Classify sensors based on their operating principles.

**COB 5** : Recognize the significance of electronic sensors in modern technology.

**PREREQUISITE**:

**MODULE I SEMICONDUCTORS AND RECTIFIERS 9**

Classification of solids based on energy band theory-Intrinsic semiconductors Extrinsic semiconductors-P type and N type-PN junction and its application – HWR-FWR-BR-Zener diode. Bipolar junction transistor- Field effect transistor: Configuration and characteristic-SCR, DIAC, TRIAC, UJT.

**MODULE II DIGITAL ELECTRONICS 9**

Number systems- Binary Arithmetic Operations-Boolean Algebra-Logic gates Karnaugh map: SOP, POS.

**MODULE III COMBINATIONAL AND SEQUENTIAL CIRCUITS 9**

Combinational Circuits: Half and full adders- Magnitude Comparator- Multiplexer/ Demultiplexer- encoder / decoder Sequential circuits: Flip Flops: SR, JK, D and T FF- Truth tables and circuits-Shift Registers-Ripple Counters.

**MODULE IV 8085 MICROPROCESSOR AND APPLICATIONS OF MICROPROCESSOR 8**

Architecture of 8085-Pin configuration - Instruction set-Addressing modes- Simple programs using arithmetic and logical operations. Applications – printed boards Arduino / Raspberry Pi.

**MODULE V SENSORS FOR ENGINEERING 10**

**APPLICATIONS**

Overview of electronic sensors and their applications - Classification of sensors- Sensing principles- Sensor characteristics- Interfacing analog and digital sensors with Arduino / Raspberry Pi board- applications.

**L- 45;TOTAL HOURS- 45**

**TEXT BOOKS:**

1. Ramesh Goankar, "Microprocessor Architecture", Programming and Applications with 8085, Wiley Eastern, 1998.
2. Mehta V.K, "Principles of Electronics", S. Chand and Company Ltd, 1994

**REFERENCES:**

1. Malvino and Leach, "Digital Principles and Applications", Tata McGraw- Hill,1996.
2. Mehta V.K, "Principles of Electronics", S. Chand and Company Ltd, 1994
3. DouglesV.Hall, "Microprocessor and Interfacing", Programming and Hardware, Tata McGraw-Hill, 1999.
4. Salivahanan S, Suresh Kumar N, Vallavaraj A, "Electronic Devices and Circuits" First Edition, Tata McGraw-Hill, 1999.

**COURSE OUTCOMES:**

Students who complete this course will be able to

CO1 : Working principles and characteristics of various semiconductor devices.

CO2 : Different digital logic circuits: Combinational and sequential circuits. Architecture of 8085, its features and programming for specific application

CO3 : Architecture of 8085, its features and programming for specific application

CO4 : Evaluate and compare sensor selection .in engineering applications

CO5 : Identify various applications where electronic sensors are used.

**Board of Studies (BoS):**
25th BOS of ECE held on 20.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | M | M | L | - | - | L | M | L | M | L | H | L | H |
| **CO2** | H | H | H | M | L | - | - | L | M | L | M | L | H | L | H |
| **CO3** | H | H | H | M | L | - | - | L | M | L | M | L | H | L | H |
| **CO4** | H | H | L | L | L | - | - | L | M | H | H | L | M | L | M |
| **CO5** | H | H | M | L | L | - | - | L | M | H | H | L | H | L | H |

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

SDG 4: Quality Education

Statement: A fundamental concept of electronics properties and its characteristic provides a global impact on quality education.

SDG 9: Industry, Innovation and Infrastructure

Statement: This course plays a major role in electronic sensing and analyzing for IoT technology which modernize industry operations.

## OPEN ELECTIVE COURSES – VII SEMESER

| GEDX 101 | ADVANCED ENTREPRENEURSHIP | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** Realize the skills required to be an entrepreneur

**COB2:** Acquaint the students with challenges of starting new ventures

**COB3:** Enable them to investigate, comprehend and internalize the process of setting up a business by identifying the business opportunity

**COB4:** Identify the right sources of fund for starting a new business

**COB5:** Locate a business which contributes to the society at large

**MODULE I INTRODUCTION TO ENTREPRENEURSHIP 10**

Entrepreneurship: knowledge and skills requirement - characteristic of successful entrepreneurs - entrepreneurship process, factors impacting emergence of entrepreneurship - managerial vs. Entrepreneurial approach - National Policy on Skill Development and Entrepreneurship 2015 - Digital India and Make in India flagship programme of Government of India.

**MODULE II STARTING THE VENTURE 10**

Generating business idea – sources of new ideas, methods of generating ideas - creative problem solving, opportunity recognition - environmental scanning – competitor and industry analysis - Forms of ownership - procedure for registration in small industry - Overview of Government of India start up India Scheme – Journey of Sachin Bansal : From Flipkart to Navi's IPO

**MODULE III FUNDAMENTALS OF MANAGEMENT 10**

Overview of Marketing - Human resources, finance and Operation requirement for new venture - sources of funds – overview of venture capital and angel investment. Overview of project management. The role and Functions of Business Incubators and Accelerators in entrepreneurship Development – The secret sause of Nykaa : Story of FalguniNayar

**MODULE IV BUSINESS PLAN REPORT PREPARATION 7**

Understanding the value of a business plan - Developing an investor presentation - Preliminary Project Report - students' business plan presentation

**MODULE V IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETY** 8

Social Entrepreneurship: Definition, Types, and Issues, Static Impact of social Entrepreneurship, Impact of For- Profit companies Vs social entrepreneurship - case studies on social entrepreneurs.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Hisrich, Robert D., Michael Peters and Dean Shepherded, Entrepreneurship, Tata McGraw Hill,2014.
2. Rashmibansal, Arise awake: the inspiring stories of young entrepreneur who graduated from college into A Business of their own, westland books private Ltd,2015.

**REFERENCES:**

1. Barringer, Brace R., and R., Duane Ireland, Entrepreneurship, Pearson Prentice Hall, New Jersy (USA), 2012.
2. Kishore Biyani&DipayanBaishya, It happened in India: The story of pantaloons, Big Bazaar, Central and the great Indian consumer, Rupa& co, 2011
3. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning. 2012
4. Rashmi Bansal: Take me Home: The Inspiring story of 20 Entrepreneurs from small town India with Big Time Dream, Westland, 2014
5. Moloy K. Bannerjee, SiddharthBannerjee, P. RanganathSastry Start-up City: Ten Tales of Exceptional Entrepreneurship from Bangalore's Software Miracle, Collins Business, 2014
6. The Portfolio Book of Great Indian Business Stories: Riveting Tales of Business Leaders and Their Times, portfolio, 2015

**COURSE OUTCOMES:**

**CO1:** Turn out to be an expert to recognize a business opportunity that fits the individual

**CO2:** Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial career

**CO3:** Construct an appropriate business model

**CO4:** Develop a well-presented business plan

**CO5:** Start socially relevant new ventures

**Board of Studies (BoS) :**
15th BoS of CSB held on 15.09.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

| GEDX 102 | ARTIFICIAL INTELLIGENCE AND | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | MACHINE LEARNING APPLICATIONS | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1**:To learn the problem solving methods and learning design of intelligent systems.

**COB2:** To comprehend the concepts of machine learning

**COB3:** To explore supervised and unsupervised learning and their applications

**COB4:** To build systems that learns and adapts using real-world applications.

**COB5:**To implement learning algorithms that can be applied to real-world.

**MODULE I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 06**

Computerized reasoning - Artificial Intelligence (AI) - characteristics of an AI problem - Problem representation in AI - State space representation - problem reduction-Concept of small talk programming

**MODULE II SEARCH PROCESS 10**

AI and search process - Brute force search techniques, Depth first, Breadth first search techniques, Hill climbing, Best first search, AND/OR graphs, A* algorithm - Constraint satisfaction - Knowledge Representation: Logic - Rules of inference - Resolution - Unification algorithm - Production rules - Semantic networks - Frames – Scripts - Conceptual dependency

**MODULE III SUPERVISED LEARNING 10**

Basic concepts and types of Machine Learning - Supervised Learning**:** Linear Models for Classification: Discriminant Functions - Probabilistic Generative Models - Probabilistic Discriminative Models - Bayesian Logistic Regression. Neural Networks: Feed forward Network Functions - Error Backpropagation – Regularization in Neural Networks - Mixture Density Networks - Bayesian Neural Networks - Kernel Methods - Ensemble learning: Boosting - Bagging.

**MODULE IV UNSUPERVISED LEARNING 10**

Clustering - K-means - Mixtures of Gaussians - The EM Algorithm in General – Model Selection for Latent Variable Models - High-Dimensional Spaces. Dimensionality Reduction: Factor analysis - Principal Component Analysis - Probabilistic PCA - Independent components analysis.

**MODULE V APPLICATION 09**

Linear Models for Regression - Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear Regression - Bayesian Model Comparison – Applications: Radar for target detection, Deep Learning Automated ECG Noise Detection and Classification, ML in Network for routing, traffic prediction and classification, ML in Cognitive Radio Network (CRN).

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Stuart Russel and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Prentice Hall,ISBN:9781292153964, 1292153962, 2016.
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, “Artificial Intelligence”, Tata McGraw Hill, ISBN:9780070087705, 0070087709, 2019.

**REFERENCES:**

1. Patrick Henry Winston, “Artificial Intelligence”, Addison Wesley, ISBN:9780201533774, 0201533774, 2000.
2. Luger George F and Stubblefield William A, “Artificial Intelligence: Structures and Strategies for Complex Problem Solving”, Pearson Education, ISBN:9780201648669, 0201648660, 2002.
3. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, ISBN:9780387310732, 0387310738, 2007.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:**Use appropriate search algorithms for any AI problem

**CO2:**Represent a problem using first order and predicate logic

**CO3**: Identify the apt agent strategy to solve a given problem

**CO4:**Design software agents to solve a problem

**CO5:** Implement applications for NLP that use Artificial Intelligence

**Board of Studies (BoS) :**
19th BoS of CSE held on 28.12.2021

**Academic Council:**
18th Academic Council Meeting held on 24.02.2022

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

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

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

Statement: The implementation of technologies such as deep learning in the industry contributes to improving productivity, manufacturing efficiency and allows faster, more flexible and more efficient processes.

| GEDX 103 | AUTOMOTIVE | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | TECHNOLOGY | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To understand the engineering principles that underpins the technology of an automotive vehicle.

**COB2:** Recognize the future direction of the sensors used within the automotive vehicle.

**COB3:** To gather knowledge about the role and use of advanced systems in automobile.

**COB4:** To learn in a vehicle accident reconstruction and deformation behavior of a vehicle.

**COB5:** To gain knowledge of the vehicle case study and in E-Mobility business.

**MODULE I VEHICLE TECHNOLOGY 9**

Introduction - Electric and Hybrid Vehicle technology- LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles, types - series and parallel hybrid, layouts, comparison, Power systems and control systems, Different modes of operation for best usage. Electric/hybrid vehicle features and system requirements, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV),Comparison of Electric vehicles with different energy sources

**MODULE II SENSOR TECHNOLOGY 9**

Connectivity Fundamentals- Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Wireless Security Overview. Basics of Radar Technology and Systems -Ultrasonic Sonar Systems - LIDAR Sensor Technology and Systems -Camera Technology-Night Vision Technology, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems.

**MODULE III ADVANCED SYSTEMS 9**

ADAS- Introduction to ADAS- Concept of Advanced Driver Assistance Electronic Systems, NHTSA-consideration, next generation of mobile-connected devices accuracy. Modem electronic and micro control systems in automobiles: Electronically controlled concealed headlight systems, Electro chromic mirrors, automatic review mirrors, Day time running lamps (DRL), Head up display, Travel information systems, On

board navigation system, Electronic climate control, Electronic cruise control, Antilock braking system, Electronically controlled sunroof,Anti-theft systems, Automatic door locks (ADL).

**MODULE IV VEHICLE RECONSTRCTION TECHNIQUES 9**

Safety and accident reconstruction- crash test techniques, offset frontal collision test and lateral collision test, Bharat NCAP, Euro NCAP, US NCAP,NCAP rating, vehicle crash Reconstruction - Principles and Technology- Reconstruction and Analysis of Motorcycle and passenger car Crashes- Reconstruction and Analysis of Rollover Crashes of Light Vehicles.

**MODULE V E-MOBILITY 9**

E-mobility business, electrification challenges, Connected Mobility and Autonomous Mobility- case study E-mobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs, case studies- Emerging Technologies for Electric Vehicle Drives, Case Studies of Two Wheeler, Three-Wheeler, and Four-Wheeler Electric Vehicles.

**L-45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. John Wiley, Advanced Driver Assistance Systems (ADAS) Professional Engineering Publishing, 2020.
2. Robert Bosch GmbH Safety, Comfort and Convenience Systems, 2016.
3. Donald J Van Kirk, Vehicular Accident Investigation and Reconstruction 1st Edition, 2021.

**REFERENCES:**

1. The Center for Auto Safety, “Newly Developed Roof Crush Test Proves Existence of Safer Vehicles that can Withstand Rollover Crashes". Archived from the original on 2007.
2. SAE, Electric and Hybrid Electric Vehicles and Fuel Cell Technology, 2020.

**COURSE OUTCOMES:**

On completion of the course the students should be able to

**CO1:** Describe the characteristics and importance of energy sources in automotive design technology.

**CO2:** Identify relevant automotive sensor technology for the specified vehicles.

**CO3:** Design a vehicle advanced system based on automotive design standards.

**CO4**: Analyze the various crash techniques and reconstruction systems in an automobile.

**CO5:** Analyze vehicle E-mobility challenges and techniques for futuristic requirements.

**Board of Studies (BoS) :**
14th Board of Studies held on 22.08.2022

**Academic Council:**
19th Academic Council held on 29.09. 2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | L | L | L | L | L | L | M | M | M | H | H | H |
| CO2 | H | H | L | L | L | L | L | L | M | M | M | H | H | H |
| CO3 | H | H | L | L | L | L | L | L | M | M | M | H | H | H |
| CO4 | H | H | L | L | L | L | L | L | M | M | M | H | H | H |
| CO5 | H | H | L | L | L | L | L | L | M | M | M | H | H | H |

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

SDG 9: The subject will cover the fundamental understanding of how automobile technology has evolved.

Statement: Effective comprehension of cutting-edge systems, vehicle reconstruction, and e-mobility issues.

| GEDX 105 | BUILDING REPAIR SOLUTIONS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The objective of the course is to impart adequate knowledge on

**COB1:** materials commonly used in building construction including type of buildings

**COB2:** cement mortar and cement concrete manufacturing methods including quality control aspects

**COB3:** physical and chemical deterioration mechanisms acting on buildings in the real time conditions

**COB4:** materials used for building repair works

**COB5:** techniques for rehabilitating common distress in buildings

**MODULE I MATERIALS FOR CONSTRUCTION AND TYPES OF BUILDINGS 9**

Introduction – types of cement, sand and stone chips (coarse aggregate) – basic properties – water for construction – types of steel reinforcement rods & its basic properties – bricks – formation of wall with bricks and solid blocks – types of buildings – classification.

**MODULE II MANUFACTURE OF CEMENT MORTAR AND CEMENT CONCRETE 9**

Cement mortar – ingredients - mix ratio – manufacturing – application areas, cement concrete – ingredients – design of concrete mix – manufacturing methods – applications areas - quality control procedures, cement mortar and concrete – microstructure – influencing parameters.

**MODULE III MAJOR CAUSES FOR BUILDING DISTRESS 9**

Durable buildings - definition and significance in the current context, causes for building repairs - physical mechanisms - shrinkage, creep, thermal incompatibility, frost action, erosion, abrasion and fire exposure, chemical mechanisms - carbonation, chloride attack, sulphate attack, acid attack - mechanism of corrosion of steel reinforcement rods in concrete.

**MODULE IV BUILDING REPAIR MATERIALS 9**

Repair materials - factors influencing selection of repair materials – various stages of concrete repair - importance of surface preparation - bond coat - rust convertors - rust removers - protective coating to steel rebars -

superplasticizers - corrosion inhibitor admixed concrete - micro concrete - polymer modified mortar / concrete - crack sealing compounds - concrete coatings.

**MODULE V BUILDING REPAIR TECHNIQUES 9**

Overview of repair techniques - techniques for arresting cracks – grouting – guniting and shotcrete – concrete / steel jacketing technique, procedure for arresting leakage and dampness in terrace, washroom and wall areas – case study.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Duggal, S. K., “Building Materials”, 4th Edition, New Age International, 2012
2. Gambhir, M.L., “Concrete Technology”, 5th Edition, Tata McGraw Hill Education, 2013

**REFERENCES:**

1. Santha Kumar, A.R., “Concrete Technology”, Oxford University Press, New Delhi, 2007.
2. Shetty, M.S., and A.K., Jain “Concrete Technology (Theory and Practice)”, S. Chand and Company Ltd., 2010.
3. Brooks, J.J. and Neville, A.M., “Concrete Technology”, Pearson, 2019.
4. Kumar Mehta. P. and Paulo J.M. Monteiro., “Concrete: Microstructure, Properties, and Materials” 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.
5. Gambhir, M. L., and Neha Jamwal, Building Materials: Products, Properties and Systems, Tata McGgraw Hill, 2017.
6. Raj, P. Purushothama, Building construction materials and techniques, Pearson Education India, 2017.
7. Gahlot, P. S. and Sanjay Sharma, Building repair and maintenance management, CBS Publishers and Distributors, 2019.

**COURSE OUTCOMES:**

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

**CO1:** understand the various materials used for building construction, its properties and significance.

**CO2:** understand and visualize the manufacture of cement mortar and concrete used in building construction, and relevant quality control aspects.

**CO3:** recognize the physical and chemical deteriorating mechanisms detrimental to the buildings.

**CO4:** suggest materials for different repair works in a building.

**CO5:** identify the suitable repair techniques for rehabilitation of common distress buildings.

**Board of Studies (BoS):**
18th BoS of CSE held on 05.04.2023

**Academic Council:**
20th Academic Council held on 13.04.2023

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

| GEDX 110 | DEEP LEARNING ESSENTIALS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1**:To learn the machine learning basics

**COB2:**To estimate the deep learning networks

**COB3:**To describe the deep networks.

**COB4:**To expose the students to sequence modeling

**COB5:**To summarize the practical methodology and applications of deep learning.

**MODULE I MACHINE LEARNING BASICS FOR DEEP LEARNING** **09**

Learning Algorithms - Capacity, Overfitting and Underfitting -Hyper parameters and Validation Sets - Estimators, Bias and Variance - Maximum Likelihood Estimation - Bayesian Statistics - Stochastic Gradient Descent - Building a Machine Learning Algorithm - Challenges Motivating Deep Learning.

**MODULE II DEEP LEARNING NETWORKS** **09**

Introduction – Historical context of Deep Learning – Classes of Deep Learning Network – Deep Networks for Unsupervised learning – Deep Networks for Supervised learning – Hybrid Deep Networks.

**MODULE III DEEP NETWORKS: MODERN PRACTICES** **09**

Deep Feedforward Networks - Architecture Design - Back-Propagation and Other Differentiation Algorithms - Regularization for Deep Learning - Regularization and Under- Constrained Problems - Optimization for Training Deep Models - Optimization Strategies and Meta-Algorithms – Convolutional Network.

**MODULE IV SEQUENCE MODELING: RECURRENT AND RECURSIVE NETS** **09**

Unfolding Computational Graphs - Recurrent Neural Networks - Deep Recurrent Networks - The Challenge of Long-Term Dependencies - Echo State Networks - The Long Short-Term Memory and Other Gated RNNs - Optimization for Long-Term Dependencies.

**MODULE V PRACTICAL METHODOLOGY AND APPLICATION** 09

Performance Metrics - Default Baseline Models - Selecting Hyperparameters - Debugging Strategies - Example: Multi-Digit Number Recognition – Applications - Computer Vision, Speech Recognition and Natural Language Processing – Other Applications.

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Li Deng and Dong Yu, “Deep Learning Methods and Applications”, NowPublisher, 1st Edition, ISBN: 1932-8346, 2014.
2. Josh Patterson, Adam Gibson, “Deep Learning”, O'Reilly Media, 1st Edition, ISBN: 978-1491914250, 2017

**REFERENCES:**

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning (Adaptive Computation and Machine Learning Series)”, MIT Press, 1st Edition,ISBN: 978-0262035613, 2017.
2. Tom M. Mitchell, Machine Learning, McGraw Hill Education, 1stEdition,ISBN: 978-1259096952, 2013.
3. LaureneFausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Pearson, 1st Edition, ISBN- 978-8131700532, 2004.

**COURSE OUTCOMES**

**:**After completion of the course, students should be able to

**CO1:**Illustrate the machine language applications in deep learning

**CO2:**Identify the various deep learning algorithms and its application

**CO3**:Evaluate the role of sequence modeling

**CO4:**Compare the various deep learning network algorithms

**CO5:**Apply the deep learning algorithms to solve real time problems.

**Board of Studies (BoS) :**
19th BoS of CSE held on 28.12.2021

**Academic Council:**
18th Academic Council Meeting held on 24.02.2022

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

Statement: The implementation of technologies such as deep learning in the industry contributes to improving productivity, manufacturing efficiency and allows faster, more flexible and more efficient processes.

1. Development of sustainable infrastructure by understanding the physical and chemical deteriorating mechanisms during its life time.
2. Make the human settlements safe and resilient by implementing proactive measures for enhancing durability in new construction, and adopting suitable repair materials and techniques for rehabilitation of existing buildings.

**GEDX 111 DRONE TECHNOLOGY L T P C**

**SDG: 9 2 0 2 3**

**COURSE OBJECTIVES:**

**COB1:** To give basic knowledge about the design and analysis of the controlled flights

**COB2:** To provide knowledge on the assembly of a designed controlled flight.

**MODULE I INTRODUCTION TO UAV/MAV 10**

History of UAV –classification –basic terminology- models and prototypes – applications.

**MODULE II BASICS OF AIRFRAME 10**

Airframe –dynamics –modeling- structures –wing design- engines types-equipment maintenance and management-control surfaces-specifications. Autopilot – AGL pressure sensors-servos –accelerometer – gyros – actuators - power supply processor, integration, installation, configuration, and testing.

**MODULE III COMMUNICATION PAYLOADS AND PATH PLANNING 10**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range – Waypoints navigation-ground control software-Recent trends in UAV-Case Studies.

**PRACTICALS 30**

1. Introduction to various types of RPV/RC- Controlled flights
2. Introduction to various multi-copter configurations.
3. Wing Analysis using XFLR analysis
4. Weight estimation and components selection for drones.
5. Assembling of drone and inspection of various components.
6. Calibration of ESC and motors.
7. Binding of Receiver and Transmitter.
8. Introduction to various Flight controllers
9. Basic connection of flight controller and its calibration
10. Mission planner Introduction and calibration procedures
11. Machine-in-loop autonomous flight mission planning
12. Simulator training for drone flying
13. Test Flight and Ground flight.

**L- 30; P- 30; TOTAL HOURS: 60**

**TEXT BOOKS:**

5. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
6. Skafidas, “Microcontroller Systems for a UAV”, KTH, TRITA-FYS 2002:51 ISSN 0280-31634, 2002.

**REFERENCES:**

3. Jane’s Unmanned Aerial Vehicles and Targets, Jane’s Information Group; ASIN: 0710612575, 1999.
4. R. Said and H. Chayeb, “Power supply system for UAV”, KTH, 2002.

**COURSE OUTCOMES:**

Students will be able to

**CO1:** To design and do the analysis for a controlled flight.

**CO2:** construct a drone and have a basic experience of flying the controlled flight.

**Board of Studies (BoS):**
18th BoS held on 24.11.2023

**Academic Council:**
21th AC held on 20th December 2023

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | L | L | | | | | | | | H | H |
| CO2 | H | H | H | L | L | | | | | | | | H | 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 : Holistic understanding of fluid mechanics in various filed of everyday life

| GEDX 112 | ELECTRIC VEHICLE | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 8,9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB 1:** To study the concept of electric vehicles (EV)

**COB2:** To get familiarized with electric vehicle energy storage systems

**COB3:** To learn the basics of charging in EV's

**COB4:** To study about electric vehicle modelling

**COB5:** To understand about electric vehicle's ancillary system and its design

**MODULE I INTRODUCTION TO ELECTRIC VEHICLE (EV) 9**

A Brief History -Technology, benefits and challenges in comparison with IC engine –EV's and hybrid electric vehicle (HEV) – costs and emissions – autonomous cars – general and hybrid electric vehicle layout – working principle of an HEV drive train – concept of electric, hybrid electric and plug-in HEV – HEV drive train topologies – plug-in HEV drive train topologies – Case studies on recent EV's.

**MODULE II ENERGY STORAGE SYSTEMS FOR EV 9**

Battery parameters - Types of Battery : Lithium – Nickel – Sodium – Zinc – Lead Acid - Coin cell - Rechargeable – Battery sealing – Ideal model, Linear model, Thevenin model – Battery Cell Voltage Equalization – Onboard power electronics battery management – Equalizer chaining method. Electrical Modeling of Ultra capacitors, Flywheel Energy Storage Systems and Renewable Fuel Cell Power Sources.

**MODULE III EV CHARGING SYSTEMS 10**

Introduction to charging systems – Charging time – cost – Standardization – Methods – Modes of operation – Types of charging plugs – Vehicle to grid technology – wireless power transfer – Case studies.

**MODULE IV ELECTRIC VEHICLE MODELLING AND DESIGN CONSIDERATIONS 10**

Tractive Effort - Modeling Vehicle Acceleration - Modelling Electric Vehicle Range - Aerodynamic Considerations - Transmission Efficiency - Electric Vehicle Chassis and Body Design - General Issues in Design.

**MODULE V DESIGN OF ANCILLARY SYSTEMS 7**

Heating and Cooling Systems - Design of the Controls - Power Steering - Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks - Electric Vehicle Recharging and Refueling Systems.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Tom Denton, “Electric and Hybrid Vehicles” Routledge Publishers, 1st edition, March 2020.
2. James Larminie and John Lowry, “Electric Vehicle Technology Explained”,John Wiley &Sons Ltd, 2nd edition, 2015.
3. M. Ehsani, Y. Gao, Stefano Lango, K.M.Ebrahimi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 3rd Edition,2018.

**REFERENCES:**

1. Tariq Muneer and Irene IllescasGarcía, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press, 2016.

**COURSE OUTCOMES:**

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

**CO1:**realize the importance of electric transportation systems.

**CO2:** model battery system for any EV

**CO3:** design and choose a suitable charging system for EV

**CO4:** develop a model of EV considering design constraints

**CO5:** identify the opportunities and challenges in ancillary system design

**Board of Studies (BoS) :**
19thBoS of EEE conducted on 29.08.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

SDG 8: Decent work and economic growth

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

SDG No. 9 Industry, innovation and infrastructure

Statement: The development of zero emission electric vehicles will meet out the desired needs such as new innovative systems for industry and establishing advanced infrastructure.

| GEDX 113 | EMERGING TECHNOLOGIES IN MOBILE NETWORKS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To list the various technologies involved in mobile networks.

**COB2:** To describe the importance and research aspects of SDN

**COB3:** To apply the D2D, M2M, IoT and Vehicular networks in mobile networks

**COB4:** To differentiate LTE networks and Advanced LTE

**COB5:** To explain the concept of 5G technology in mobile networks

**MODULE I INTRODUCTION TO MOBILE NETWORKS 9**

Mobile Network Architecture, Basics of IP Networks, IPv6 Address, Format and types of Addresses and IPv6 Messages, Stateless Auto configuration, DNS, IPv6 Packet Headers , Base IPv6 Header ,Extension Headers, Migration to IPv6

**MODULE II SOFTWARE-DEFINED NETWORKING 9**

Need of Software Defined Networking, Conventional Routing, Computational Workload of Routers , Decoupling Control and Data Planes ,Architectural , SDN in Research, Programmable Networks , Global Environment for Networking Investigation , OpenFlow Protocol, OpenFlow Network Architecture, OpenFlow Operation.

**MODULE III OPPORTUNISTIC NETWORKING 9**

Opportunity in Networking, Opportunistic Channel Access, Cognitive Radio Networks , Channel Sharing: D2D, M2M and IoT, Mobile Relay, Vehicular Relays, Opportunistic Vehicular Communication, 802.11-Based Vehicular Networks, Challenges in Opportunistic Vehicular Networks .

**MODULE IV LTE NETWORKS 9**

LTE Network Architecture, Protocol Stack, Resource Grid, Frame, LTE Configurations, LTE-Advanced Networks, Coordinated Multipoint (CoMP), Carrier Aggregation.

**MODULE V 5G COMMUNICATION TECHNOLOGY 9**

5G Expectations and Limitations, UE , Device-to-Device , Modes of Operation, Other D2D Technologies: Wi-Fi Direct, D2D Communication Underlying LTE-A ,Transmit Power Control, Resource Allocation.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Hasan, Syed Faraz. Emerging trends in communication networks. Springer International Publishing, 2014.
2. Hu, Wen-Chen, ed. Emergent trends in personal, mobile, and handheld computing Technologies. IGI Global, 2012.

**REFERENCES:**

1. Rodriguez, Jonathan. *Fundamentals of 5G mobile networks*. John Wiley & Sons, 2015.
2. Jan, Mian Ahmad, Fazlullah Khan, and Muhammad Alam, eds. Recent trends and advances in wireless and IoT-enabled networks. Berlin/Heidelberg, Germany: Springer, 2019.

**COURSE OUTCOMES:**

students will be able to,

**CO1:** Discuss various technologies of mobile networks

**CO2:** Summarize the necessity of IPv6, cognitive radio, IoT, LTe and 5G in mobile networks

**CO3:** Compare the various trends in mobile networks

**CO4:** Adapt the various network architectures.

**CO5:** Differentiate the networks based on the applications

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

**Academic Council:**
19th Academic Council held on 29.09. 2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | M | H | M | – | – | – | – | – | – | – | – | H | H | M |
| CO2 | H | H | M | H | H | – | – | – | – | – | – | – | H | M | M |
| CO3 | M | M | M | H | H | – | – | – | – | – | – | – | H | H | M |
| CO4 | H | H | H | M | H | – | – | – | – | – | – | – | H | H | M |
| CO5 | H | H | H | M | H | M | – | – | – | – | – | - | M | H | 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: Able to apply the theoretical concepts for the various application of image processing

| GEDX 114 | FUNDAMENTALS OF DATA SCIENCE AND MACHINE LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To understand fundamentals of statistical concepts

**COB2:** To learn unsupervised learning algorithms

**COB3:** To acquire knowledge in regression models

**COB4:** To explain various classification algorithms

**COB5:** To understand deep learning concepts

**MODULE I FUNDAMENTALS OF DATA 9**

Importing – Summarizing - Visualizing Data - Statistical Learning - Monte Carlo Sampling - Monte Carlo Estimation - Monte Carlo for Optimization.

**MODULE II UNSUPERVISED LEARNING 9**

Introduction - Risk and Loss in Unsupervised Learning - Expectation–Maximization (EM) Algorithm - Empirical Distribution and Density Estimation - Clustering via Mixture Models - Mixture Models - EM Algorithm for Mixture Models - Clustering via Vector Quantization - K-Means - Clustering via Continuous Multiextremal Optimization - Hierarchical Clustering - Principal Component Analysis (PCA) - Motivation: Principal Axes of an Ellipsoid - PCA and Singular Value Decomposition.

**MODULE III REGRESSION 9**

Linear Regression - Analysis via Linear Models - Inference for Normal Linear Models - Nonlinear Regression Models - Linear Models in Python - Regularization and Kernel Methods.

**MODULE IV CLASSIFICATION 9**

Introduction - Classification Metrics - Classification via Bayes' Rule - Linear and Quadratic Discriminant Analysis - Logistic Regression and Softmax Classification - K-nearest Neighbors Classification - Support Vector Machine - Classification with Scikit-Learn - Decision Trees and Ensemble Methods.

**MODULE V DEEP LEARNING 9**

Introduction to ANN – ANN with 1 Input and 1 Output – Working with Any Number of Input – Working with Hidden Layer.

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Dirk P. Kroese, Zdravko Botev, Thomas Taimre, Radislav Vaisman, "Data Science and Machine Learning Mathematical and Statistical Methods", CRC Press, 2020.
2. Ahmed Fawzy Gad, Fatima Ezzahra Jarmouni, "Introduction to Deep Learning and Neural Networks with Python: A Practical Guide", Academic Press, 2021.

**REFERENCES:**

1. Taweh Beysolow II, "Introduction to Deep Learning Using R", Academic Press, 2017.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning, MIT Press, 2016.
3. Sandro Skansi, "Introduction to Deep Learning", Springer International Publishing, 2018.

**COURSE OUTCOMES:**

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

**CO1:** recognize the fundamentals of statistical concepts

**CO2:** explain unsupervised learning algorithms

**CO3:** apply regression models to solve data science problems

**CO4:** apply the classification algorithms for the given problem

**CO5:** explain deep learning concepts

**CO6:** analyze complex data using machine learning algorithms

**Board of Studies (BoS) :**
16th BoS of IT held on 18.08.2022

**Academic Council:**
19th Academic Council Meeting held on 29.09.2022

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | | | | | | | | | | | | M | |
| CO2 | M | | | | | | | | | | | | M | |
| CO3 | | | M | M | | | | | | | | | M | |
| CO4 | | | | M | | | | | | | | | M | |
| CO5 | | | | M | | | | | | | | | M | |
| CO6 | | | | 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: It provides deep knowledge on unsupervised learning, regression analysis, classification and deep learning concepts, which can add to productive employment.

| GEDX 116 | GREEN DESIGN AND SUSTAINABILITY | L | T | P | C |
|---|---|---|---|---|---|
| SDG 11 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**The objectives of the course are**

- To impart knowledge on the concepts of sustainable development and fundamentals of socio economic systems.
- To understand the basics of green building and frame work for the attainment of sustainability.
- To enhance the student's interest in the design of green building and energy efficient measures in a buildings.
-

**MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 9**

Objectives of Sustainable Development - Need for sustainable development - Environment and development linkages - Globalization and environment - Population, poverty and pollution- global, regional and local environment issues-Greenhouse gases and climate change.

**MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 9**

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth-Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

**MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY 9**

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

**MODULE IV GREEN BUILDINGS 9**

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency - Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

**MODULE V ENERGY CONSERVATION AND EFFICIENCY 9**

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation-Energy conservation measures for buildings- Energy wastage- impact to the environment.

**Total Hours –45**

**TEXT BOOKS:**

1. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 5th Edition, John Wiley and sons, 2022.
2. Peter P Rogers, Kazi F Jalal and John A Boyd “An Introduction to Sustainable Development” Earthscan, 2017
3. Kirby, J., Okeefe, P., and Timber lake, “Sustainable Development”, Earthscan Publication, London, 2007.
4. Moncef Krarti, “Energy Audit of Building Systems: an Engineering approach” CRC Press, LLC, Florida 2020.

**REFERENCES:**

*1.* Handbook of Green Building Design and Construction: LEED, BREEAM,
*2.* Green Building Handbook: Volume 2: A Guide to Building Products and their Impact on the Environment Paperback 2000

**COURSE OUTCOMES:**

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

- Explain the objective, need for the sustainability and the link between the globalization and environment.
- Address the economic, environmental, and social concerns in the sustainable development.
- Acquire knowledge on the performance indicators, constraints and barrier for sustainability.
- Explain the relationship between sustainability and emergence of green building practices.
- Conduct the energy audit on green building design and suggest ideas for attainting sustainability in building.

**Board of Studies (BoS) :**
18th BoS of CE held on 05.04.2023

**Academic Council:**
20th Academic Council held on 13.04.2023

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | H | H | | | | H | H | | | | M | M | H | L | M |
| **CO2** | M | H | H | M | H | H | H | | M | H | | M | H | L | M |
| **CO3** | H | H | M | L | | H | H | | L | M | H | | H | L | M |
| **CO4** | L | H | | | H | H | H | | H | | H | M | H | L | M |
| **CO5** | H | H | H | M | H | H | H | H | H | H | H | M | H | L | M |

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : Green building and design with sustainable indicator will enhance the sustainable development.

| GEDX 117 | IMAGE PROCESSING AND ITS APPLICATIONS | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 4,9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

- **COB1 :** To apply the fundamentals of digital image processing
- **COB2 :** To analyze the performance parameters of image processing.
- **COB3 :** To discuss the image enhancement techniques for remote sensing
- **COB4 :** To adapt the image processing techniques in medical applications
- **COB5 :** To adapt the image processing techniques for industrial applications.

**PREREQUISITES:**

Fundamental concepts of transforms.

**MODULE I DIGITAL IMAGE FUNDAMENTALS 9**

Elements of Image Processing System, Fundamental steps in Digital Image Processing, Image Sampling & Quantization, Spatial and Gray level resolution. Fundamentals of Color Image Processing, Color models-RGB,CMY,HIS

**MODULE II IMAGE ENHANCEMENT AND TRANSFORMS 9**

Image Enhancement-Basic Gray level transformations, Histogram Processing, Spatial filtering, Image transforms- 2D DFT , DCT, Hadamard and Haar transform.

**MODULE III IMAGE SEGMENTATION AND RESTORATION 9**

Segmentation: Point, Line and Edge detection methods, Image segmentation and its types, Restoration: Noise model, Inverse filter and Wiener filter. Unconstrained and constrained restoration.

**MODULE IV MEDICAL IMAGE APPLICATIONS 9**

Multimodal medical image processing applications -Ultrasound image processing application, Dental X-ray image analysis- Content-based image retrieval-Detection of parasites using image processing

**MODULE V REMOTE SENSING AND INDUSTRIAL APPLICATIONS** **9**

Satellite image classification, Satellite image restoration- Industrial applications– Fault detection in automotive systems, Cereal grain inspection.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Gonzalez and Woods, "Digital Image Processing", 4th E dition, Pearson Education, 2018.
2. Robert Shcowebgerdt, Remote sensing models & methods for image processing, 2nd edition, 2012
3. Geoff Dougherty, "Digital Image Processing for Medical Applications", 1st Edition, Cambridge University Press, 2009.

**REFERENCES:**

1. E.R.Davies ,“Image Processing for the Food Industry”,World Scientific Publishing Co Pvt Ltd, 2000
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.

**COURSE OUTCOMES:**

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

**CO1 :** Explain the fundamental concepts of digital image processing

**CO2 :** Summarize the image enhancement techniques and transforms

**CO3 :** Apply suitable image segmentation and restoration techniques

**CO4 :** Select appropriate image processing techniques for medical applications

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

**Academic Council:**
19th Academic Council held on 29.09. 2022

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

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

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

Statement: This course enables the student to understand basic image processing techniques and helps for lifelong learning.

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

Statement: Able to apply the theoretical concepts for the various application of image processing

| GEDX 118 | INDUSTRIAL AUTOMATION AND | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | CONTROL | 3 | 0 | 0 | 3 |

**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 buses used in automation industries.

**MODULE I PROGRAMMABLE LOGIC CONTROLLERS 9**

Evolution of PLCs - Hard Relay Logic - Programmable logic controllers - Organisation - 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

**L – 45; TOTAL HOURS – 45**

**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”, Mc Graw 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, identify the requirements of communications networks in PLC and analyze issues related to PLC applications in installation and trouble shooting.

**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:** Distinguish between low level and high level operator interfaces in DCS and select DCS for specific applications.

**CO6:** Able to select and use most appropriate networking technologies and standards for a given application

| **Board of Studies (BoS) :** | **Academic Council:** |
|---|---|
| 18th BoS of EIE held on 12.07.2022 | 19th Academic Council Meeting held on 29.09.2022 |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | 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 |

**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

| GEDX 119 | INDUSTRIAL SAFETY | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To learn the modern safety concepts

**COB2:**Tofamiliarize with the safety in manufacturing industries

**COB3:** To acquire knowledge in construction and electrical safety systems

**COB4**: Tobe conversant with safety performance monitoring

**COB5:** To gain knowledge in safety education and training

**MODULE I INTRODUCTION TO SAFETY L:7**

Evolution of modern safety concept- Safety policy - Safety Organization - Line and staff functions for safety- Safety Committee- budgeting for safety - Safety education and training.

**MODULE II SAFETY IN MANUFACTURING L:10**

Safety in metal Working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing – Regulations - Safety consideration in material handling devices: Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

**MODULE III CONSTRUCTIONAL AND ELECTRICAL SAFETY L:10**

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

**MODULE IV SAFETY PERFORMANCE MONITORING L:9**

Permanent, partial and temporary disabilities - Calculation of accident indices: frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – Problems.

**MODULE V SAFETY EDUCATION AND TRAINING L:9**

Importance of training - Identification of training needs - Training methods: programme, seminars, conferences, competitions - Method of promoting safe practice - Motivation – Communication - Role of government agencies and private consulting agencies in safety training: Creating awareness, awards, celebrations, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic safety and training.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Nasser Elahi, “Industrial Safety Management”, Kalpaz Publications, 2006.
2. Jain.R.K., Sunil S.Rao. “Industrial Safety, Health and Environment Management Systems” Khanna Publishers, 2000.
3. Accident Prevention Manual, NSC, Chicago, 14th Edition, 2015.

**REFERENCES:**

1. Fulman, J.B., Construction Safety, Security, and Loss Prevention, John Wiley and Sons, 1979.
2. John Ridley, “Safety at Work”, Butterworth & Co., London, 1983.
3. Alexandrov, M.P., Material Handling Equipment, Mir Publishers, Moscow, 1981.
4. Fordham Cooper W., Electrical Safety Engineering, Butterworths, London, 1986.
5. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York,1980.
6. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** Describe the modern safety concepts

**CO2**: Discuss the safety in manufacturing industries

**CO3:** Elucidate the electrical and construction safety systems

**CO4:** Illuminate safety performance monitoring

**CO5:** Explain the safety education and training

| **Board of Studies (BoS):** | **Academic Council:** |
|---|---|
| 20th BOS held on 08.08.2022 | 19th Academic Council held on 29.09. 2022 |

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

Holistic understanding of Industrial safety fundamental norms enhances the safety of men and machines in industries.

| GEDX 120 | INDUSTRY 4.0 | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:**To gain knowledge about the need of industry 4.0

**COB2:** To familiarize with various technologies involved in Industry 4.0

**COB3:**To be conversant with the systems supporting Industry 4.0

**COB4:**To acquire knowledge in data and information handling in Industry 4.0

**COB5:**To learn about the maturity and readiness levels for Industry 4.0

**MODULE I INTRODUCTION TO INDUSTRY 4.0 L:9**

Various Industrial revolutions- Developments in USA, Europe, China and other countries- Digitalisation and the Networked Economy- Drivers, Enablers, Compelling Forces for Industry 4.0- Comparison of Industry 4.0 factory and conventional factory- Benefits.

**MODULE II TECHNOLOGIES OF INDUSTRY 4.0 L:9**

Internet of Things (IoT) - Industrial Internet of Things (IIoT) - Internet of Services- Smart Manufacturing- Smart Devices and Products- Smart Logistics - Smart Cities - Predictive Analytics.

**MODULE III SYSTEMS SUPPORTING INDUSTRY 4.0 L:9**

Cyber physical systems- Robotic automation and collaborative robots- Mobile computing - Cyber security.

**MODULE IV DATA AND INFORMATION HANDLING IN INDUSTRY 4.0 L:9**

Resource-based view of a firm- Data as a new resource for organizations- Harnessing and sharing knowledge in organizations- Cloud computing basics- Cloud computing and Industry 4.0

**MODULE V MATURITY AND READINESS FOR INDUSTRY 4.0 L:9**

Challenges – Gaps- Maturity levels- Readiness assessment – Opportunities- Future Trends - Case studies.

**L – 45; TOTAL HOURS – 45**

**REFERENCES:**

1. Christoph Jan Bartodziej, “The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics”, Springer Gabler, 2017.
2. Alp Ustundag and EmreCevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer International Publishing, 2018.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** Explain the need of Industry 4.0

**CO2:** Elucidate the various technologies involved in Industry 4.0

**CO3:** Discuss the systems supporting Industry 4.0

**CO4:** Describe the data and information handling in Industry 4.0

**CO5:** Assess the readiness level of particular industry towards Industry 4.0

**Board of Studies (BoS):**
20th BOS 0f Mechanical dept held on 08.08.2022

**Academic Council:**
19th Academic Council held on 29.09. 2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | M | | L | | | L | L | L |
| CO2 | M | L | | | M | | | | L | | | L | L | L |
| CO3 | M | L | | | M | | | | L | | | L | L | L |
| CO4 | M | L | M | M | M | | | | L | | | L | L | L |
| CO5 | M | L | H | | | | M | | L | | | L | 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 knowledge of various technologies and systems of Industry 4.0 will help in the development innovative industry setups.

| GEDX 121 | INTRODUCTION TO ARTIFICIAL | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 1 | INTELLIGENCE | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** Familiarize students with Artificial Intelligence principles and techniques.

**COB2:** Identify appropriate AI methods to solve a complex problem.

**COB3:** Formalize a given problem in the language/framework of different AI methods

**COB4:** To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems

**COB5:** Implement appropriate searching strategies for few real world environments

**MODULE I INTRODUCTION 9**

Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment, , Intelligent Agents, Different types of agents, Problem-Solving Process – Formulating Problems-Problem Types and Characteristics- Problem Analysis and Representation, Performance Measuring-Problem Space and Search-Toy Problems- Real-world problems-Problem Reduction Methods.

**MODULE II PROBLEM SOLVING 9**

General Search algorithm – Uniformed Search Methods – BFS, Uniform Cost Search, Depth First search , Depth Limited search (DLS), Iterative Deepening, Informed Search-Introduction- Generate and Test, BFS, A* Search, Memory Bounded Heuristic Search, Local Search Algorithms and Optimization Problems – Hill climbing and Simulated Annealing.

**MODULE III KNOWLEDGE AND REASONING 9**

Knowledge Representation-Knowledge based Agents-The Wumpus World, Logic-Propositional Logic-Predicate Logic-Unification and Lifting, Representing Knowledge using Rules-Semantic Networks Frame Systems, Definition of uncertainty, Bayes Rule – Inference, Belief Network.

**MODULE IV PLANNING 9**

Planning Problem – Simple Planning agent –Blocks world, Goal Stack Planning-Means Ends Analysis- Planning as a Statespace Search, Partial Order Planning-Planning Graphs-Hierarchical Planning Non- linear Planning -Conditional Planning-Reactive Planning, Knowledge based Planning-Using Temporal Logic – Execution Monitoring and Re-planning-Continuous Planning-Multi-agent Planning-Job shop Scheduling Problem. NLP-Introduction-Levels of NLP-Syntactic and Semantic analysis Discourse and Pragmatic Processing-Information Retrieval Information Extraction-Machine Translation-NLP and its Application.

**MODULE V GAME PLAYING 9**

Introduction-Important Concepts of Game Theory, Game Playing and Knowledge Structure-Game as a Search Problem, Alpha-beta Pruning-Game Theory Problems Game Theory, Expert System-Architecture-Knowledge acquisition-Rule based Expert System-Frame based and Fuzzy based expert system- Case study in AI Applications.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.

**REFERENCES:**

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill, 2003.
2. Parag Kulkarni, Prachi Joshi, “Artificial Intelligence –Building Intelligent Systems ”PHI learning private Ltd, 2015
3. Akshar Bharati, Vineet Chaitanya, Rajeev Sangal, “Natural Language Processing: A Paninian Perspective”, Prentice Hall India Ltd.,New Delhi, 1996

**COURSE OUTCOMES:**

**CO1:** Evaluate Artificial Intelligence (AI) methods and describe their foundations.

**CO2:** Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.

**CO3:** Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.

**CO4:** Analyze and illustrate how search algorithms play vital role in problem solving

**CO5:** Ability to apply knowledge representation, reasoning, to real-world problems.
**CO6:** Discuss current scope and limitations of AI and societal implications.

**Board of Studies (BoS) :**
16th BoS of IT held on 18.08.2022

**Academic Council:**
19th Academic Council held on 29.09.2022

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

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

SDG 1 : End poverty in all its forms everywhere.

Statement : AI Sector will produce new employment to peoples, thus providing them with salary and ending poverty.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **GEDX 122** | **INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND EVOLUTIONARY COMPUTING** | **3** | **0** | **0** | **3** |
| **SDG: 4,8 &9** | | | | | |

**COURSE OBJECTIVES:**

**COB1:**To introduce students to the fundamental concepts, principles, and techniques in Artificial Intelligence (AI) and Evolutionary Computing.

**COB2:** To familiarize students with various AI algorithms, including evolutionary computing, machine learning, and natural language processing.

**COB3:** To provide students with a comprehensive understanding of problem-solving techniques and search algorithms in AI.

**COB4:** To explore the applications of AI and Evolutionary Computing in various domains such as robotics, computer vision, healthcare, and finance.

**COB5:** To foster an awareness of ethical considerations and societal impact associated with AI and Evolutionary Computing.

**MODULE I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9**

Introduction to the course and its objectives- History and evolution of artificial intelligence - Fundamental concepts in AI - Problem-solving techniques and search algorithms.

**MODULE II EVOLUTIONARY COMPUTING 10**

Introduction to evolutionary computing - Genetic algorithms - Genetic programming - Evolutionary strategies - Swarm intelligence.

**MODULE III MACHINE LEARNING 10**

Introduction to machine learning - Supervised learning algorithms (e.g., perceptron, feed forward neural networks) - Unsupervised learning algorithms (e.g., clustering, self-organizing maps) - Deep learning and neural networks - Reinforcement learning- Machine learning case studies using python.

**MODULE IV NATURAL LANGUAGE PROCESSING 9**

Introduction to natural language processing - Syntax and semantic analysis - Language models and text classification - Named entity recognition and sentiment analysis - Machine translation and language generation.

**MODULE V ADVANCED TOPICS IN ARTIFICIAL INTELLIGENCE** **7**

Computer vision and image recognition - Robotics and autonomous systems - Ethical considerations in AI - AI in healthcare and finance - Future trends in AI-Generative AI and Prompt Engineering.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.Pearson, 4th edition (2020)
2. "Artificial Intelligence: Foundations of Computational Agents" by David L. Poole and Alan K. Mackworth, Cambridge University Press, 2nd edition (2017)

**REFERENCES:**

1. "Introduction to Evolutionary Computing" by Agoston E. Eiben and J. E. Smith, Springer, 3rd edition (2015)
2. "Evolutionary Algorithms: The Role of Mutation and Recombination" by David E. Goldberg, Springer, 1st edition (1989)
3. "Pattern Recognition and Machine Learning" by Christopher M. Bishop, Springer, 1st edition (2006)
4. "Deep Learning" by Ian Goodfellow, YoshuaBengio, and Aaron Courville, The MIT Press, 1st edition (2016)
5. "Speech and Language Processing" by Daniel Jurafsky and James H. Martin, Pearson, 3rd edition (2019)
6. "Foundations of Statistical Natural Language Processing" by Christopher D. Manning and HinrichSchütze, The MIT Press, 1st edition (1999)
7. "Computer Vision: Algorithms and Applications" by Richard Szeliski, Springer, 1st edition (2010)
8. "Robotics, Vision and Control: Fundamental Algorithms in MATLAB" by Peter Corke, Springer, 1st edition (2011).
9. "Ethics of Artificial Intelligence and Robotics" edited by Vincent C. Müller, Routledge, 1st edition (2020).

**COURSE OUTCOMES:**

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

**CO1:**apply the key concepts of Artificial Intelligence and Evolutionary Computing.

**CO2:**apply problem-solving techniques and search algorithms to solve AI-related problems.

**CO3:** implement and analyze different machine learning algorithms for classification, clustering, and regression tasks.

**CO4:** utilize evolutionary computing techniques, such as genetic algorithms, genetic programming, and evolutionary strategies, to optimization and design problems.

**CO5:** analyze the ethical implications of implementing AI technologies in various domains

**Board of Studies (BoS) :**
19th BoS of EEE conducted on 29.08.2023

**Academic Council:**
21st Academic Council held on 20.12.2023

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

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

**SDG 4: Quality Education**

The course contributes to quality education by providing knowledge and understanding of artificial intelligence and evolutionary computing, enabling students to acquire the skills and competencies needed in the field.

**SDG 8: Decent Work and Economic Growth**

The course prepares students for the growing field of artificial intelligence and evolutionary computing, which has the potential to drive economic growth and create new job opportunities.

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

The course focuses on innovative technologies and computational techniques that are essential for advancing industries and improving infrastructure.

| GEDX 123 | MOTOR VEHICLE ACTS AND LOSS ASSESSMENT | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To understand the structures and function of transport authorities

**COB2:** To gain knowledge in penalty for offenses

**COB3:** To gain knowledge in vehicle insurance and policy

**COB4:** To understand the vehicle impact

**COB5:** To study the surveying procedure for insurance

**MODULE I INTRODUCTION TO TRANSPORTATION AND TRANSPORT AUTHORITIES** **9**

Functions of Transport Authorities - Key terms used in Motor Vehicle Act- Classification and anatomy of different classes of vehicle - Importance of Permit - Provisions regarding permit - Special Provisions for State Transport Undertakings (STUs)

**MODULE II CONSTRUCTION, MAINTENANCE OFFENCES AND PENALTY FOR MOTOR VEHICLES** **9**

Provisions regarding construction and maintenance of motor vehicles - Preparing rules for various mandatory components to be fitted in a vehicle. Manipulate the maximum limit for speed and weight - Reconstructing provisions for vehicles with left-handed driving vehicles - Planning the rules for driving motor vehicle keeping safety of passengers and occupants a public places - Outlining the punishments for law-breakings.

**MODULE III VEHICLE INSURANCE** **9**

Purpose and need of Insurance- Role in economic development of the country - Insurance legislation and IRDA act - Market Structure - GIC Reinsurance company/ Tariff Advisory Committee - Principle of general insurance - Types of motor vehicle insurance - Types of motor vehicle policies - Zero Depreciation Policy -Terms and Conditions for motor vehicle insurance.

**MODULE IV ANALYZING VEHICLE IMPACT** **9**

Reasons of occurring of accidents - Effect on vehicle during impact from: Any One Side, Head on Collision, Vehicle Topple – underwriting an insurance form – risk assessment in given circumstances.

**MODULE V SURVEYING AND INVESTIGATING MOTOR VEHICLE CLAIM** **9**

Surveyor - Licensing authority and controller of insurance - Role of surveyor and loss adjustor - Empanelment of surveyor- Intimation - Site visit - Garage visit – Photography - Estimate and claim form - Passing of estimate - Cost of parts - Cost of repairing – Labour - Checking of documents (Paper pertaining to vehicle) - Important aspects of survey - Various types of loss assessment - Preparation of survey reports and submission - Fraud claims - Connected to Packet Policy- MACT

**L 45 ; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. R H Prajapati, Motor Vehicle Acts and Loss Assessment", Atul Prakashan Publications, 1st edition, 2016.

**REFERENCES:**

1. Hucho.W.H, "The Motor Vehicles Act, 1988 ", Universal/LexisNexis publications, 2021 edition.
2. G.S.Karkaras, "Assessment of Compensation in Accidents under Motor Vehicles Act", Delhi Law House publications, 2nd edition, 2013. (ISBN-13 :978-8186976708)
3. "The motor vehicles act, 1988", Asia law house Publishing, 17th edition, 2020. (ISBN-13 : 978-8186976708)
4. Janak Raj jai., "Motor accident claims law and procedure", Universal law publishing, 6th Edition, India, 2016.(ISBN-13 : 978-8186976708)
5. Kannan, Vijayaragavan, "Motor vehicle laws", 16th edition, 2019. (ISBN:0768082536)

**COURSE OUTCOMES:**

**Students should able to**

CO1: Paraphrase Motor Vehicle Acts.

CO2: Examine of Motor Vehicles for Safety and Pollution Control Engineering.

CO 3: Analyze the Penalties related with the Offences and their Procedures.

CO 4: Recognize the types of Motor Vehicle Insurance.

CO 5: Extrapolate the Duties and Responsibilities of Surveyor and Loss Assessor.

**Board of Studies (BoS) :**

14th Board of Studies of auto held on 22.08.2022

**Academic Council:**

19th Academic Council held on 29.09. 2022

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | L | L | L | L | | | | | | L | H | H | H |
| CO2 | H | L | L | L | L | | | | | | L | H | H | H |
| CO3 | H | L | L | L | L | | | | | | L | H | H | H |
| CO4 | H | L | L | L | L | | | | | | L | H | H | H |
| CO5 | H | L | L | L | L | | | | | | L | H | H | H |

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

**SDG No: 9**

The motor vehicle act and the insurance policies are the topics that everyone must be aware of.

**Statement:** Better understanding of the insurance claim process is made accessible by having a thorough understanding of motor vehicle act and claim procedure.

**GEDX 127 SOFT COMPUTING TECHNIQUES L T P C**

**SDG: 9 3 0 0 3**

**COURSE OBJECTIVES:**

**COB1:** To learn the basic concepts of Soft Computing

**COB2:** To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems

**COB3:** To apply soft computing techniques to solve problems.

**COB4:**To learn the basic concepts of genetic algorithms

**COB5:**To integrate soft computing techniques for complex problems.

**MODULE I INTRODUCTION TO SOFT COMPUTING 9**

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

**MODULE II ARTIFICIAL NEURAL NETWORKS 9**

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

**MODULE III FUZZY SYSTEMS 9**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

**MODULE IV GENETIC ALGORITHMS 9**

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

**MODULE V HYBRID SYSTEMS 9**

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

**REFERENCES:**

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani," Neuro-Fuzzy and Soft Computing", Prentice-Hall of India,ISBN-978-0132610667 2021.
2. Kwang H.Lee,-First course on Fuzzy Theory and Applications, Springer,
ISBN-3-540-22988-42020,2021.
3. Sujatha Dash," Advanced Soft Computing Techniques in Data Science,
IoT and Cloud Computing",Springer Nature- ISBN 3030756572,2021
4. Deepti Moyi Sahoo, Nisha Rani Mahato, and Snehashish Chakraverty "Concepts of Soft Computing: Fuzzy and ANN with Programming- Springer; ISBN-B07R6Z66LT,2020.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:**Apply suitable soft computing techniques for various applications.

**CO2:**Integrate various soft computing techniques for complex problems.

**CO3:** Analyze various genetic and hybrid systems.

**CO4:** Compare different Fuzzy and Neural algorithms

**CO5:**To design various Neuron model systems.

**Board of Studies (BoS) :**
19th BoS of CSE held on 28.12.2021

**Academic Council:**
18th Academic Council Meeting held on 24.02.2022

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

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

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

Statement : By learning “Soft Computing” the students are able to develop methods to collaborate with fuzzy and Neural systems for various real time applications which leads to sustainable economic growth in turn providing productive employment.

| GEDX 128 | VALUE ANALYSIS AND ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:**To learn the basics of value engineering

**COB2:**To gain knowledge in value engineering job plan and process

**COB3:**To be conversant with orientation and information phases

**COB4:**To familiarize with the function analysis and creative phases

**COB5:**To acquire knowledge on evaluation and investigation

**MODULE I VALUE ENGINEERING BASICS L: 12**

Origin of value engineering - Definition of value engineering and value analysis - Benefits of value engineering– Problem recognition –Level of value engineering in organization –Value engineering activity - Difference between value engineering and value analysis - Types of value function - Basic and secondary functions - Creativity aspects in value engineering and analysis.

**MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS L: 7**

Seven phases of job plan - FAST diagram - Behavioural and organizational aspects of value engineering - Principles of value analysis - Requirement of value engineering - Role of value analysis in engineering applications.

**MODULE III ORIENTATION AND INFORMATION PHASES L:8**

Launch of value engineering project works – Selection and evaluation of value engineering projects - Objectives and targets – Value engineering project work- Time-bound programme – Projects scheduling and teams - Time schedule - Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality and reliability related information - Manufacturing data.

**MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES L:11**

Objectives - Function definition –Anatomy of the function – Approach and evaluation of function - Classification of functions - Higher level functions –Value gap - Value index - Cost Modelling -Progress in creativity - Promotion of creativity skills in firm- Obstacles in creativity - Mental road blocks - Creativity killer phrases - Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

**MODULE V EVALUATION AND INVESTIGATION L:7**

Paired comparison and evaluation matrix techniques - Unique and quantitative evaluation of ideas - Criteria for comparison - Function analysis system technique - Criteria for selection of value engineering solutions - Design – Materials – Quality – Marketing – Manufacturing - Preview sessions.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Mudge, Arthu E, Value engineering – A systematic approach, Mc Graw Hill, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), Value Engineering, Narosa publishing, 2005.

**REFERENCES:**

1. Park R J, Value Engineering: A plan for invention, St. Lucie press, 1999.
2. Heller D E, Value management, value engineering and cost reduction, Addison Wesley, 1988.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** Describe the basics of value engineering

**CO2:** Elucidate value engineering job plan and process

**CO3:** Explain the orientation and information phases

**CO4:**Illuminate function analysis and creative phases

**CO5:** Discuss the investigation and evaluation reports

**Board of Studies (BoS):**
20th BOS of Mech held on 08.08.2022

**Academic Council:**
19th Academic Council held on 29.09. 2022

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

Holistic understanding of value engineering helps to identify and eliminate unwanted costs and improve function and quality.

| GEDX 129 | VEHICLE MAINTENANCE | L | T | P | C |
|---|---|---|---|---|---|
| SDG: 9 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**COB1:** To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.

**COB2:** The student able to impart knowledge in maintaining of engine components and subsystems.

**COB3:** The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.

**COB4:** The student able to impart knowledge in maintaining of steering, suspension, braking and wheels.

**COB5:** The student able to impart carefully maintaining their vehicle wiring and air conditioning systems.

**MODULE I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS** 8

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual – vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

**MODULE II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE** 8

General Engine service- Dismantling of Engine components- Engine repair-working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

**MODULE III TRANSMISSION AND DRIVELINE MAINTENANCE** 8

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings-servicing differential assemblies- fault diagnosis.

**MODULE IV STEERING, SUSPENSION, BRAKE AND WHEEL MAINTENANCE** **12**

Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, and power steering system.

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

**MODULE V AUTO ELECTRICAL AND AIR CONDITIONING MAINTENANCE** **9**

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Panchal, Dhruv U., et al. Vehicle Maintenance and Garage Practice. India, PHI Learning, 2014.
2. Denton, Tom. Advanced Automotive Fault Diagnosis. N.p., Taylor & Francis, 2006.

**REFERENCES:**

1. Bonnick, Allan, and Newbold, Derek. A Practical Approach to Motor Vehicle Engineering and Maintenance. United States, CRC Press, 2011.
2. VanGelder, Kirk T. Automotive Engine Repair. United States, Jones & Bartlett Learning, 2017.

**COURSE OUTCOMES:**

students can able to

**CO1:** Prepare maintenance schedules and procedures with appropriate tools.

**CO2:** Demonstrate the procedure and methods to repair and calibrate the engine.

**CO3:** Analyse the causes and remedies for fault in transmission and drive line systems.

**CO4:** Analyse the causes and remedies of steering, suspension systems, brake and wheel.

**CO5:** Demonstrate the procedure for maintenance in wiring and air conditioning systems.

**Board of Studies (BoS) :**
14th BOS of Auto held on 22.08.2022

**Academic Council:**
19th Academic Council held on 29.09. 2022

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO11 | PO 12 | PSO 1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | H | H | H | | | | | | | H | | H | H | H |
| CO2 H | H | H | H | | | | | | | H | | H | H | H |
| CO3 | H | H | H | | | | | | | H | | H | H | H |
| CO4 | H | H | H | | | | | | | H | | H | H | H |
| CO5 | H | H | H | | | | | | | H | | H | H | H |

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

SDG No. 9 : Sustainable development in the transport

Statement: Improve the durability and maintenance of vehicles.