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

Regulations 2022
Curriculum and Syllabi
(Updated upto December 2023, as per 21st Academic Council)

M.Tech.
(Construction Engineering & Project Management)

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

REGULATIONS 2022

CURRICULUM AND SYLLABI
(Updated upto December 2023, as per 21st Academic Council)

M.TECH.
CONSTRUCTION ENGINEERING & PROJECT MANAGEMENT

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 school 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 nurture Civil Engineers into ethically strong and responsible leaders to address Global challenges through Quality Education, Application oriented research, innovation, inspiration, motivation and sustainable growth.

- To enrich and enhance knowledge for the best practices in various disciplines of Civil Engineering through Collaborations with Global Institutions of Excellence, Industries and Research Organizations.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.TECH CONSTRUCTION ENGINEERING & PROJECT MANAGEMENT

PROGRAMME EDUCATIONAL OBJECTIVES

- To educate graduates the concepts and practices of management in the construction industry.
- To impart organizational and leadership qualities for effective management of construction projects with ethical responsibility.
- To equip the graduates with knowledge, research and practical skills in modern construction practices and techniques giving importance to sustainable development.
- To provide necessary knowledge and skills in accounting, financing, risk analysis and contracting.
- To train the graduates in the use of relevant software packages for planning, scheduling, executing and controlling of construction projects and inculcate an urge for life long learning.
- To function effectively with individual capabilities as well as with a collective strength as a professional team with good communication skills.

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 modelling to complex engineering activities with an understanding of the limitations.
- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES

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

- To formulate, plan, schedule, execute and deliver construction projects using construction technology and project management skills.
- To apply modern concept and tools to analyze and solve the problems on construction engineering and project management.
- To conceptualize the problems in the industry and to provide technical and economically feasible solutions.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI – 600 048.

REGULATIONS 2022

M.Tech. / MCA / M.Sc. / M.Com. / M.A. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means post graduate degree programme (M.Tech. / MCA / M.Sc. / M.Com. / M.A.)

ii) **"Branch"** means specialization or discipline of programme like M.Tech. in Structural Engineering, Food Biotechnology etc., M.Sc. in Physics, Chemistry, Actuarial Science, Biotechnology etc.

iii) **"Course"** means a theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Advanced Concrete Technology, Electro Optic Systems, Financial Reporting and Accounting, Analytical Chemistry, 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 PROGRAMMES OFFERED AND ADMISSION REQUIREMENTS

2.1 Programmes Offered

The various programmes and their mode of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
MCA	
M.Sc.	
M.Com.	
M.A.	

2.2 ADMISSION REQUIREMENTS

2.2.1 Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination as specified in the clause 3.2 [Eligible entry qualifications for admission to programmes] of this Institution or any other University or authority accepted by this Institution.

2.2.2 The other conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by the Institution from time to time.

3.0 DURATION, ELIGIBILITY AND STRUCTURE OF THE PROGRAMME

3.1. The minimum and maximum period for completion of the programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech.	4	8
MCA	4	8
M.Sc.	4	8
M.Com.	4	8
M.A.	4	8

3.1.1 Each academic semester shall normally comprise of 90 working days. Semester end examinations shall follow within 10 days of the last Instructional day.

3.1.2 Medium of instruction, examinations and project report shall be in English.

3.2 ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO PROGRAMMES

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
1.	Aeronautical Engineering	M.Tech. (Avionics)	B.E. / B.Tech. in Aeronautical Engineering / Aerospace Engineering / Mechanical Engineering / Mechatronics / EEE / ECE / EIE / or Equivalent degree in relevant field.
2.	Civil Engineering	M.Tech. (Structural Engineering)	B.E. / B.Tech. in Civil Engineering / Structural Engineering or Equivalent degree in relevant field.
		M. Tech. (Construction Engineering and Project Management)	B.E. / B.Tech. in Civil Engineering / Structural Engineering / B.Arch. or Equivalent degree in relevant field.
3.	Mechanical Engineering	M.Tech. (CAD/CAM)	B.E. / B.Tech. in Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace / Aeronautical / Material Science / Polymer / Plastics / Marine Engineering or Equivalent degree in relevant field.
4.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engineering)	B.E. / B.Tech. in EEE / ECE / EIE / ICE / Electronics / Instrumentation Engineering or Equivalent degree in relevant field.
5.	Electronics and Communication	M.Tech. (VLSI and Embedded Systems)	B.E. / B.Tech. in ECE / EIE / ICE / EEE / IT or Equivalent degree in relevant field.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
	Engineering		
6.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
		M.Tech. (Artificial Intelligence and Data Science)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
7.	Information Technology	M.Tech. (Information Technology)	B.E. / B.Tech. in IT / CSE / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
8.	Computer Applications	MCA	BCA / B.Sc. Computer Science / B.E. / B.Tech. / B.Sc. Mathematics, B.Sc. Physics / Chemistry / B.Com. / BBA / B.A. with Mathematics at graduation level or at 10 + 2level or equivalent degree in relevant field.
9.	Mathematics	M.Sc. (Actuarial Science)	Any under graduate degree with Mathematics / Statistics as one of the subjects of study at 10 + 2 level.
10.	Physics	M.Sc.(Physics)	B.Sc. in Physics / Applied Science / Electronics /Electronics Science / Electronics & Instrumentation or Equivalent degree in relevant field.
11.	Chemistry	M.Sc.(Chemistry)	B.Sc. in Chemistry / Applied Science or Equivalent degree in relevant field.
12.	Life Sciences	M.Sc. Biochemistry & Molecular Biology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
		M.Sc. Biotechnology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Sc. Microbiology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Tech. Biotechnology	B.Tech. / B.E. in Biotechnology or Equivalent degree in relevant field.
		M.Tech. Food Biotechnology	B.E. / B.Tech. in Biotechnology / Food Biotechnology / Chemical Engineering / Biochemical Engineering / Industrial Biotechnology or Equivalent degree in relevant field.
13.	Commerce	M.Com	B.Com. / BBA
14.	Arabic and Islamic Studies	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or) Any under graduate degree with Part 1 Arabic (or)Any under graduate degree with AalimSanad / Diploma / Certificate in Arabic or Islamic Studies.

3.3. STRUCTURE OF THE PROGRAMME

3.3.1 The PG. programmes consist of the following components as prescribed in the respective curriculum:

i. Core courses
ii. Elective courses
iii. Laboratory integrated theory courses
iv. Project work
v. Laboratory courses
vi. Open elective courses
vii. Seminar

viii. Mini Project
ix. Industry Internship
x. MOOC courses (NPTEL- Swayam, Coursera etc.)
xi. Value added courses

3.3.2 The curriculum and syllabi of all programmes shall be approved by the Academic Council of this Institution.

3.3.3 For the award of the degree, the student has to earn a minimum total credits specified in the curriculum of the respective specialization of the programme.

3.3.4 The curriculum of programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Range of credits
M.Tech.	76 - 80
MCA	86
M.Sc.	77 - 85
M.Com.	88
M.A.	72

3.3.5 Credits will be assigned to the courses for all programmes as given below:

- ❖ One credit for one lecture period per week or 15 periods of lecture per semester.
- ❖ One credit for one tutorial period per week or 15 periods per semester.
- ❖ One credit each for seminar/practical session/project of two or three periods per week or 30 periods per semester.
- ❖ One credit for 160 hours of industry internship per semester for all programmes (except M.Com.)
- ❖ Four credits for 160 hours of industry internship per semester for M.Com.

3.3.6 The number of credits the student shall enroll in a non-project semester and project semester is as specified below to facilitate implementation of Choice Based Credit System.

Programme	Non-project semester	Project semester
M.Tech.	9 to 32	18 to 26

MCA	9 to 32	18 to 26
M.Sc.	9 to 32	10 to 26
M.Com.	9 to 32	16 to 28
M.A.	9 to 32	NA

3.3.7 The student may choose a course prescribed in the curriculum from any department offering that course without affecting regular class schedule. The attendance will be maintained course wise only.

3.3.8 The students shall choose the electives from the curriculum with the approval of the Head of the Department / Dean of School.

3.3.9 Apart from the various elective courses listed in the curriculum for each specialization of programme, the student can choose a maximum of two electives from any other similar programmes across departments, aliter to open electives, during the entire period of study, with approval of Head of the department offering the course and parent department.

3.4. ONLINE COURSES

3.4.1 Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester (in case of M.Tech. M.Sc. & MCA programmes) 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 shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

3.4.2 Students shall undergo project related online course on their own with the mentoring of the project supervisor.

3.5 PROJECT WORK

3.5.1 Project work shall be carried out by the student under the supervision of a faculty member in the department with similar specialization.

3.5.2 A student may however, in certain cases, be permitted to work for the project in an Industry / Research organization, with the

approval of the Head of the Department/ Dean of School. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist / Competent authority from the organization and the student shall be instructed to meet the faculty periodically and to attend the review meetings for evaluating the progress.

3.5.3 The timeline for submission of final project report / dissertation is within 30 calendar days from the last instructional day of the semester in which project is done.

3.5.4 If a student does not comply with the submission of project report / dissertation on or before the specified timeline he / she is deemed to have not completed the project work and shall re-register in the subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 CLASS ADVISOR

A faculty member shall be nominated by the HOD/ Dean of School as Class Advisor for the class throughout their period of study.

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.

4.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department / Dean of School 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.

5.0 COURSE COMMITTEE

5.1 Each common theory / laboratory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers handling the common course with one of them

nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers handling the common course belong to a single department or from several departments. The Course Committee shall meet as often as possible to prepare a common question paper, scheme of evaluation and ensure uniform evaluation of the assessment tests and semester end examination.

6.0 CLASS COMMITTEE

6.1 A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman will be constituted in every semester:

6.2 The composition of the class committee will be 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) Faculty members of all courses of the semester
iii) All the students of the class
iv) Faculty advisor and class advisor
v) Head of the Department – Ex officio member

6.3 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 nature 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.

6.4 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 of courses.

6.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the

semester end examination to analyze 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 concerned course coordinator.

7.0 REGISTRATION AND ENROLLMENT

7.1 The students of first semester shall register and enroll 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.

7.2 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.

7.3 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.

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

8.0 BREAK OF STUDY FROM PROGRAMME

8.1 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:

8.1.1 Medical or other valid grounds

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

8.1.3 Debarred due to any act of indiscipline

8.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

8.3 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).

8.4 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.

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT WORK

9.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum no. of credits to be earned to enroll for project semester
M.Tech.	18
MCA	22
M.Sc.	18
M.Com	NA
M.A.	NA

9.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

10.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

10.1 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.

10.2 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.

10.3 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.

10.4 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. However, he / she is permitted to redo the courses awarded with 'I' grade / arrear in previous semesters. They shall also be permitted to write arrear examinations by paying the prescribed fee.

10.5 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.

10.6 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.

10.7 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.

11.0 REDO COURSES

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

11.2 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.

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	Weightage of Marks
Continuous Assessment 1	25%
Continuous Assessment 2	25%
Semester End Examination	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 75% weightage for continuous assessments and 25% 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 The assessment of seminar course including its component and its weightage shall be decided by a committee of faculty members constituted by the Head of the Department. This committee shall ensure the conduct of assessment of components and award marks accordingly.

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 School for that purpose. However, there is no substitute examination for semester end examination.

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

14.0 SUPPLEMENTARY EXAMINATION

14.1 Final Year 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 credit 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 both odd and even semesters.

15. PASSING, DECLARATION OF RESULTS AND GRADE SHEET

15.1 All assessments of a course shall be made on absolute marks basis. However, the Class Committee without the student members shall preferably meet within 5 days after the semester end examination and analyze the performance of students in all assessments of a course and award letter grades. 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
I	0

"I" denotes inadequate attendance and hence prevented from appearing for semester end examination

"U" denotes unsuccessful performance in the course.

15.2 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.

15.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of School and it shall be declared by the Controller of Examinations.

15.4 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 fees tothe Controller of Examinations. Subsequently the Head of the Department/ Dean of 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 knowledgeable in that course as members. The committee shall meet within a week to re-evaluate the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

15.5 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 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" grade is excluded for calculating GPA.

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

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

Percentage Equivalent of Marks = CGPA X 10

15.6 After successful completion of the programme, the Degree shall be awarded upon fulfillment of curriculum requirements and classification based on CGPA as follows:

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the minimum prescribed period.
First Class	6.50 and above and completing the programme within a minimum prescribed period plus two semesters.
Second Class	Others

15.6.1 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 PG programme within the minimum prescribed period of study (except clause 8.1.1)

15.6.2 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 8.1.1)

15.6.3 The students who do not satisfy clause 15.6.1 and clause 15.6.2 shall be classified as second class.

15.6.4 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.

16.0 DISCIPLINE

16.1 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.

16.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

17.0 ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

17.1 A student shall be declared to be eligible for the award of the Master's Degree, if he/she has:

i. Successfully acquired the required credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
ii. No disciplinary action is pending against him/her.
iii. Enrolled and completed at least one value added course.
iv. Enrollment in at least one MOOC / SWAYAM course (non-credit) before the final semester.

17.2 The award of the degree must have been approved by the Institute.

18.0 POWER TO MODIFY

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

****

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

CURRICULUM & SYLLABI FOR

M. Tech. (Construction Engineering & Project Management)

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MAE 6183	Probability and Statistics	3	1	0	4
2.	CEE 6121	Construction Economics, Finance and Risk Management	3	0	0	3
3.	CEE 6122	Project Management in Construction	3	0	0	3
4.	CEE 6123	Contract Laws and Regulations	3	0	0	3
5.	CEE 6124	Construction Equipment Management	2	0	0	2
6.	CEE 6125	Statistics Laboratory	0	0	2	1
7.	CEE 6104	Destructive and Non-Destructive Testing of Concrete	0	0	2	1
8.	ENE 6181	English for Career Development	1	1	0	2
9.		Professional Elective	3	0	0	3
		Credits				**22**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1.	GEE 6201	Research Methodology and IPR	2	0	0	2
2.	CEE 6221	Advanced Construction Planning, Scheduling and Control	3	0	0	3
3.	CEE 6222	Lean Construction Management	2	0	0	2
4.	CEE 6223	Construction Quality and Safety Management	3	0	0	3
5.	CEE 6224	Building Information Modeling	0	0	2	1
6.	CEE 6225	Construction Management Laboratory	0	0	2	1
7.		Professional Elective				9
		Credits				**21**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1.		Professional Elective				6
2.		Open Elective	3	0	0	3
3.	CEE 7121	Project Work (Phase I)	0	0	18	6#
4.	CEE 7122	Internship*				2
5.		MOOC **				0
		Credits				**11**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEE 7121	Project Work (Phase II)	0	0	36	18
		Credits				**6 + 18 = 24**

Total Credits – 78

* Industrial training will be undertaken during the summer vacation of first-year for 30 days. The credit will be awarded in the 3rd Semester.

Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester

** The students shall pursue a MOOC course related to the project in the third semester, and the progress in this regard shall be monitored during Project Phase – I reviews.

Enrollment in at least one value-added course is mandatory.

PROFESSIONAL ELECTIVES
ODD SEMESTER ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEEY 151	Infrastructure Planning and Management	3	0	0	3
2.	CEEY 152	Port Planning and Management	3	0	0	3
3.	CEEY 153	Integrated Building Management Services	3	0	0	3
4.	CEEY 154	Building Acoustics	2	0	0	2
5.	CEEY 155	Digital Technology in Construction	1	0	0	1
6.	CEEY 156	Advanced Construction Techniques	3	0	0	3
7.	CEEY 157	Logistics and Supply Chain Management	3	0	0	3
8.	CEEY 158	Condition Assessment and Rehabilitation of Structures	3	0	0	3
9.	CEEY 159	Tunnel Engineering	1	0	0	1
10.	CEEY 101	Advanced Concrete Technology	3	0	0	3
11.	CEEY 109	Pre fabricated Structures	2	0	0	2
12.	CEEY 181	Climate change in Water Resources	3	0	0	3
13.	CEEY 182	Hydrologic Analysis and Design	3	0	0	3

EVEN SEMESTER ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEEY 251	Modern Construction Materials	3	0	0	3
2.	CEEY 252	Planning, Legislation and Professional Practice	3	0	0	3
3.	CEEY 253	Rural Infrastructure Planning and Development	3	0	0	3

4.	CEEY 254	Characterization of Construction Materials	3	0	0	3
5.	CEEY 255	Sustainable Construction	3	0	0	3
6.	CEEY 256	Shoring, Scaffolding and formwork	3	0	0	3
7.	CEEY 257	Resource Management in Construction	3	0	0	3
8.	CEEY 258	Energy Conservation Techniques in Building Construction	3	0	0	3
9.	CEEY 259	Value Engineering	3	0	0	3
10.	CEEY 260	Construction Demolition and Waste Management	3	0	0	3
11.	CEEY 261	Automation in construction	3	0	0	3

LIST OF OPEN ELECTIVE COURSES – III SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department / School
1.	OEEY 701	Analytical Techniques	3	0	0	3	Chemistry
2.	OEEY 702	Artificial Intelligence and IoT	3	0	0	3	CSE
3.	OEEY 703	Biomaterials	3	0	0	3	Physics
4.	OEEY 704	Biomedical Instrumentation	3	0	0	3	Physics
5.	OEEY 705	Biophotonics	3	0	0	3	Physics
6.	OEEY 706	Data Science and Machine Learning	3	0	0	3	IT
7.	OEEY 707	Electric Vehicle and Battery Storage Technology	3	0	0	3	EEE
8.	OEEY 708	Green Building and Energy Management	3	0	0	3	Civil Engineering
9.	OEEY 709	Industry 4.0 and Applications	3	0	0	3	ECE
10.	OEEY 710	Nanotechnology and Catalysis	3	0	0	3	Chemistry
11.	OEEY 711	Project Management	3	0	0	3	Mechanical
12.	OEEY 712	Real Time Embedded Systems	3	0	0	3	ECE

13.	OEEY 713	Robotic Technology	3	0	0	3	Mechanical
14.	OEEY 714	Soft Computing Techniques	3	0	0	3	EEE
15.	OEEY 715	Structural Interpretation of Materials	3	0	0	3	Chemistry

SEMESTER I

MAE 6183	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

SDG: 04

COURSE OBJECTIVES: The course will impart knowledge on

COB1: the theory of probability and random variables

COB2: the multidimensional random variables

COB3: techniques to carry out probability calculations and identify probability distributions

COB4: application of statistical inference in practical data analysis

COB 5: knowledge of Analysis of variances(ANOVA)

MODULE I PROBABILITY AND RANDOM VARIABLE 9+3

Axioms of probability – Addition and Multiplication theorem – conditional probability –Total Probability – Baye's theorem - Random variable – Probability mass function – Probability density functions – Properties – Expectation - Moments – Moments generating functions and their properties.

MODULE II STANDARD DISTRIBUTIONS 9+3

Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, weibull and Normal distributions.

MODULE III MULTIDIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression - Partial, Multiple correlations and regressions

.

MODULE IV TESTING OF HYPOTHESIS 9+3

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, F and Chi-square distributions – Test for independence of attributes and Goodness of fit.

MODULE V DESIGN OF EXPERIMENTS 9+3

Analysis of variance – One way classification – CRD – Two way classification – RBD – Latin square.

L – 45 T- 15;TOTAL HOURS –60

TEXT BOOKS:

1. Sheldon M. Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Fifth Edition, Elsevier 2016.
2. Selvamuthu Dharmaraja, Dipayan Das, “Introduction to Statistical Methods, Design of Experiments and Statistical Quality Control”, Springer, 2018.
3. T. Veerarajan, “Probability, Statistics and Random Processes”, 3rd edition, Tata McGraw-Hill Publishing Company Limited, 2008.

REFERENCES:

1. Miller, I., Miller, M.,Freund, J. E., “Mathematical Statistics”, 7th Edition, Prentice Hall International, 2014.
2. Douglas C. Montgomery, George C. Runger, “Applied Statistics and Probability for Engineers”, 7th Edition, Wiley publication, 2020.
3. Richard A. Johnson, “Probability and Statistics for Engineers”, 8th Edition, Pearson Education, 2017.
4. Jay L. Devore, “Probability and Statistics for Engineering and the Sciences”, 9th Edition, Cengage Learning India, 2016.
5. S.P.Gupta, “Fundamentals of Applied Statistics”, Sultan Chand & Sons, 2019.
6. S.C.Gupta and V.K.Kapoor, “Fundamentals of Mathematical Statistics”, 12th Edition, Sultan Chand and Sons, 2014.
7. Arora and Arora, “Comprehensive Statistical Methods”, S. Chand, 2021.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: do basic problems on probability

CO2: solve the probability problems using appropriate distributions.

CO3: derive the probability mass / density function of a random variable and multiple correlations and regressions.

CO4: apply large sample tests and small sample tests.

CO5: apply Analysis of Variances (ANOVA) in testing of hypothesis.

Board of Studies (BoS) :
14th BOS of Mathematics & AS held on 30.06.2022

Academic Council:
19th AC held on 29.09.2022

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

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

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

Learning of probability, distributions and hypothesis tests will lead to knowledge of applications in Construction Engineering and Project Management.

CEE 6121	CONSTRUCTION ECONOMICS, FINANCE AND RISK MANAGEMENT	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: resources in construction

COB2: economic studies considering the time value of money

COB3: the demonstration of different methods for the comparison of alternatives

COB4: financial management of construction projects

COB 5: Risk management in projects.

MODULE I CONSTRUCTION ECONOMICS 9

Economic resources: land; capital and finance; labour; entrepreneurialism

Land: types; factors affecting price; factors affecting availability; location; brownfield; greenfield Capital and finance: definition; specific capital; share capital; capital goods; finance; mortgages; venture capital; bank loans; directors' loan accounts; lottery funding; retained profits

Labour: demographics of the working population; factors affecting availability; mobility of labour; factors affecting labour efficiency; the quality of labour; skills; incentives Infation – Taxes

MODULE II TIME VALUE OF MONEY 9

Introduction – Time value of money - quantifying alternatives for decision making - Cash flow diagrams - Equivalence- various interest factors - Arithmetic gradient - Geometric gradient – Present, future and annual worth method of comparing alternatives

MODULE III RATE OF RETURN ANALYSIS 9

Rate of return - incremental rate of return - break-even comparisons - capitalized cost analysis - benefit-cost analysis – tutorial problems

MODULE IV FINANCIAL MANAGEMENT 9

Financial Management –- Cost Reporting vs. Cost Control – General Ledger – Job cost Ledger – Equipment Ledger - Method of accounting – Balance Sheet – Income Statement – Over billing – Under Billings – Financial Ratios

Equipment – Cost of Ownership – Operating and Maintenance Cost – Own – Lease Rent – Replacement Analysis

MODULE V RISK MANAGEMENT 9

Definitions of risk - elements of risk management - causes of risk –Identifying risk, preparing for risk identification, risk categories, referring to historical information – perspectives of risk – risk analysis: sensitivity analysis - scenario analysis - breakeven analysis - simulation analysis - decision tree analysis – Selection of a Project and Risk Analysis in Practice managing/mitigating risk

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Bose, D. C., “Fundamentals of Financial management”, 2nd ed., New Delhi, PHI, 2010.
2. Gould, F. E., “Managing the Construction Process”, 2nd ed., Upper Saddle River, New Jersey, Prentice Hall,2002.
3. Gransberg, D. G., Popescu, C. M. and Ryan, R. C., “Construction Equipment Management for Engineers, Estimators, and Owners, Boca Raton, CRC/Taylor & Francis, 2006.

REFERENCES:

1. Harris, F., McCaffer, R. and Edum-Fotwe, F., “Modern Construction Management”, 6th ed., Blackwell Publishing, 2021.
2. Peterson, S. J., “Construction Accounting and Financial Management”, Upper Saddle River, New Jersey, Pearson Education, 2019
3. Prasanna Chandra, “Projects: Planning, Analysis, Financing, Implementation and Review”, New Delhi, Tata McGraw-Hill Publishing Company Ltd.,2019.
4. Sullivan, W. G., Bontadelli, J. A. and Wicks, E. M., “Engineering Economy”, 11th ed., Upper Saddle River, New Jersey, Prentice Hall, 2001.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: appreciate the economic resources required to complete a typical construction project

CO2: describe the construction economics relating to time value of money

CO3: analyze the various methods of alternatives based on present, future, and annual worth of project / equipment.

CO4: provide an overview of the financial and accounting management including financial statements

CO5: interpret and apply various risk analysis methods to manage/ mitigate risk.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

The holistic understanding of construction finance and value of money can lead to proper selection of equipment and resources leading to a sustainable environment

CEE 6122	PROJECT MANAGEMENT IN CONSTRUCTION	L	T	P	C
		3	0	0	3

SDG: 9

COURSE OBJECTIVES: The course will impart knowledge on

COB1: life cycle of the project

COB2: inception and feasibility study of the projects.

COB3: stages of the project delivery

COB4: construction phase and the process of execution

COB 5: the process involved during the closeout of the project.

MODULE I INTRODUCTION 8

Project - Relationships Among Portfolios, Programs, and Projects -Project Management - Role of the Project Manager – Organizational structure - Project Stakeholders and Governance - Project Team - Project Life Cycle - Project Management Processes

MODULE II PROJECT FEASIBILITY & INCEPTION 9

Introduction, Significance in feasibility report- Technical analysis, Financial analysis, Economic analysis, Ecological analysis, Flow diagram for a feasibility study of a project. Design, Budget and Cost Estimation - Work Plan - Contract Documents - Managing Scope, Project Team Meetings, Weekly Monthly Reports Drawing and - Design Team Management - Evaluation of Design Effectiveness - Constructability Post Design Review

MODULE III PROJECT DELIVERY 10

Selection of Professional Services - Contract Pricing Formats - Design Bid Build Method of Project Delivery – Design-Build Method of Project Delivery - Construction Management Method of Project Delivery - Bridging Project Delivery Method - Fast-Track Projects - Turn-Key Projects - Design Development and Performance Specifications - Key Decisions for Project Delivery - Terms of Payment - Prospective Bidders and Bidding Qualification Based Selection (QBS) Check List for Bidding - Keys to a Successful Project

MODULE IV PROJECT EXECUTION MANAGEMENT 9

Project Planning – Activity Relationship – Activity Duration - CPM - labor productivity - factors affecting job - site productivity - labor relations in construction - collective bargaining - materials management - materials procurement and delivery -

MODULE V PROJECT - CLOSE OUT 9

System Testing and Start-Up - Final Inspection Guarantee and Warranties - Lien Releases Record and As-Built Drawings - Check List of Duties -

Disposition of Project Files - Post Project Critique - Owner Feed-Back – Stake Holder's Feedback.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

- "Project Management Body Of Knowledge (PMBOK®) Guide" PMBOK, 5th Edition, 2013
- Garold D. Oberlender, Project Management For Engineering And Construction, Second Edition, Mc Graw Hill, 2000

REFERENCES:

- Chitkara, K.K. "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 2014.
- Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders", Pittsburgh, Prentice Hall, 2000.
- Frank Harris & Ronald McCaffer with Francis Edum – Fotwe, "Modern Construction Management", Eighth Edition, Blackwell Publishing, 2021.

COURSE OUTCOMES: On completion of the course, students will be able to

CO 1 : define project life cycle and functions of project management

CO 2: demonstrate and explain the various design and construction process involved in a project

CO 3 : outline the different delivery methods and its advantages

CO 4: apply the relevant process in execution.

CO 5: summarize and resolve the issues in closure of project.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

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

The holistic understanding of construction project management and execution techniques.

CEE 6123 CONTRACT LAWS AND REGULATIONS

L	T	P	C
3	0	0	3

SDG: 09

COURSE OBJECTIVES: The course will impart knowledge on

COB1: various elements and features of contract

COB2: process of bidding and tendering procedures

COB3: the concept of contract breach, claims and settlement

COB4: process of arbitration in construction projects

COB 5: procedures and conditions of International Contracts

MODULE I INTRODUCTION TO CONTRACTS 9

Definitions, Essentials for a legally valid contract, Salient features of a contract, Discharging of a contract, Documents for an Engineering Contract; Types of contracts: Classification Based on − Tendering Process, Economic Consideration, Tasks Involved; Main and Sub Contracts, Features, Merits, Demerits, Applicability of the various types of contracts.

MODULE II TENDERING PROCESS 9

Definitions, List of Documents, EMD, SD, Preparation of Enquiry Documents, Invitation for Tenders and sale of Documents, Preparation of Tender Documents and its submission, Receipt of Tender Documents and its opening, Evaluation of Tender and Award of contract – Letter of Award, Letter of Intent, Issues in tendering process: Pre - Registration, Pre – Qualification, Nominated Tendering, Rejection of Tenders, Repeat Orders, Revocation of Tenders, Unbalanced Bidding, Cartel or Collusion in Tendering.

MODULE III PERFORMANCE OF CONTRACT & CLAIMS 9

Responsibilities (Duties and Liabilities) of Principal & Contractor, Monitoring and Quality control/assurance, Settlement of claims − Advances, Bills, Extension for time, Extras & Variations, Cost Escalations. Security Deposit, Retention Money, Performance Bond, Liquidated Damages, Penalties, Statutory Requirements, Labor Welfare, Legislation – Laws relating to Wages Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages, Quantum Meruit, Force Majeure

MODULE IV ARBITRATION 9

General - Methods for dispute resolution − Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation. Conciliation −

Appointment of Conciliator, Role of Conciliator, Special Features of Conciliation Dispute Resolution Boards (DRB) − Constitution Of DRB, Functioning of DRB, Procedure for Hearings, Status of Award. Arbitration – Arbitration Agreement, Arbitrators Powers, Types of Awards, Interventions by Courts, Setting Aside of Award, Revocation of Arbitrator − Misconduct of Arbitrator.

MODULE V INTERNATIONAL CONTRACTS 9

International Competitive Bidding, Domestic Preference, FIDIC Documents, Conditions, Currency of Bid and Payment, Escalation in Foreign Currency, Financing of projects, Applicable Law and Settlement of Disputes, International Arbitration.

L – 45; TOTAL HOURS –45

TEXTBOOKS:

1. Gajaria G.T., “Laws Relating to Building and Engineering Contracts in India”, M.M.Tripathi Private Ltd., Bombay, 2000.
2. Jimmie Hinze, Construction Contracts, McGraw Hill, 2001.
3. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, 2000.

REFERENCES:

1. Pollock & Mulla, “The Indian Contracts Act 1872”, Lexis Nexis Publications, 2022.
2. Dr. S.C. Tripathi, “Arbitration and Conciliation Act 1996”, Central Law Publications, 2012.
3. Patil. B.S, “Civil Engineering Contracts and Estimates”, Universities Press Private Limited, India, 2015

COURSE OUTCOMES: On completion of the course, students will be able to

CO 1: explain the various elements, types, and laws related to a constructiocontractsct.

CO 2: describe the various processes involved in tendering.

CO 3: analyze the performance of a contract.

CO 4: elaborate on the process involved in construction arbitration.

CO 5: draft an international contract agreement.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

The holistic understanding of making and working of construction contracts.

CEE 6124	CONSTRUCTION EQUIPMENT MANAGEMENT	L	T	P	C
		2	0	0	2

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: planning of equipment

COB2: estimation of cost of equipment.

COB3: working of earth moving and excavation equipment

COB4: types of pile driving, cranes and concrete mixing equipment

MODULE I INTRODUCTION 7

Planning process of equipment - Factors affecting equipment selection, Planning equipment utilization, Equipment utilization chart. Equipment Management in Projects – Maintenance Management – Replacement - Cost Control of Equipment – Depreciation Analysis, Methods of calculation of depreciation- Safety Management.

MODULE II ESTIMATION OF COST OF EQUIPMENT 8

Estimation of Ownership cost (Average Annual Investment method) - Estimation of Ownership cost (Time value method) – Use of compounding factors in Equipment cost estimation based on time value method - Operating cost of Equipment – Operating cost components, Illustrations on estimation of operating cost Equipment cost estimation – Caterpillar & Peurifoy method – Illustrations on use of Caterpillar method and Peurifoy method for estimation of total equipment cost.

MODULE III EARTHMOVING AND EXCAVATING EQUIPMENT 7

Engineering Fundamentals of Moving Earth - Machine Performance-Required power, Available power, Usable power, Rolling resistance, tractive force, co-efficient of traction, Effect of grade on tractive effort, Effect of altitude on performance of IC engines, Performance chart, ways to define payload of equipment. Bull Dozers - Types of dozer blades, blade adjustments, Blade performance, production estimation.

Scrapers, Scraper operation, types of scraper, Components of production cycle of scraper and pusher – Illustrations on production estimation of scraper and balancing interdependent machines.

Front End loaders - loader attachments, productivity estimation.

Excavators-Front shovels and backhoes, operation, factors affecting selection, production estimation.

Trucks – Production cycle, cycle time estimation, Productivity of trucks, balancing interdependent machines.

MODULE IV PILE DRIVING , CRANES, AND MIXER MACHINES 8

Piles and Pile driving equipment - Pile types: Driven piles- pile hammers, principle of pile hammer, factors affecting pile hammer selection.– Types of pile hammer: Drop hammer, Single acting and double acting steam hammers, Diesel hammers, Vibratory pile drivers.

Cranes, Crane motions, Principles of lifting mechanism of crane, types of cranes-lattice boom crawler crane, lattice boom truck mounted cranes, telescopic boom crane. Types of cranes-Tower cranes, Factors affecting lifting capacity of crane, Range diagram.

Concreting equipment - Steps in concrete making process, types of concrete mixer machines. – Methods of handling and transporting concrete, Consolidation of concrete, Methods of finishing and curing of concrete.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Peurifoy, R., Schexnayder, C., Shapira, A., & Schmitt, R., “Construction Planning, Equipment, and Methods” (8th ed.), McGraw-Hill, 2011.

2. Gransberg, D. D., Popescu, C. M., & Ryan, R. C., “Construction equipment management for engineers, estimators, and owners”, 2nd ed., CRC Press, 2006.

REFERENCES:

1. Robert Peurifoy , Clifford J. Schexnayder .,”Construction planning, Equipment and Methods” Gram Hill, 2018

2. S.C. Sharma, “Construction Equipment and its Management “, Khanna Publishers ,2008

3. Nunnally, S. W., “Construction methods and management”, (8th ed.), Prentice Hall, 2011.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: select the equipment for construction projects

CO2: estimate the cost of equipments.

CO3: analyse and select earth moving and excavating equipments.

CO4: choose pile driving, mixer machine and crane for various applications

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

The holistic understanding of equipment management leads responsible usage of resources leading to development of sustainable buildings

CEE 6125	STATISTICS LABORATORY	L	T	P	C
		0	0	2	1

SDG: 04

COURSE OBJECTIVES: The course will impart knowledge on

COB1: the basic concept of statistics and statistical tools

COB2: various database concepts and operations

COB3: efficient algorithms for solving a problem.

LIST OF EXPERIMENTS:

1. Measurements - Nominal, ordinal and Internal Scale of Measurements
2. Graphical and Diagrammatic representation of the data- Bar diagram, Histogram
3. Measure of central tendency – Arithmetic Mean, Median, Mode, and Geometric mean
4. Sampling distributions - Small and large samples -Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions
5. Testing and Hypothesis- Type-I and Type – II errors- Z test, T test, X – Test , F- Test
6. Analysis of r x c tables – Goodness of fit.
7. Multiple and partial correlations – Method of least squares – Plane of regression – Properties of residuals – Coefficient of multiple correlation
8. Analysis of variance – One-way and two-way classifications

P – 30;TOTAL HOURS –30

TEXT BOOKS:

1. Gupta.S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, 11th Edition, 2002.
2. Jay L. Devore, “Probability and statistics for Engineering and the Sciences”, 8th Edition, Cengage Learning, 2014.

REFERENCES:

1. Johnson, R.A. and Wichern, D. W. “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, 6th Edition, 2012.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. Rice, J.A. "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.

COURSE OUTCOMES: On completion of the course, students will be able to
CO1: use statistical tests in testing hypotheses on data.

CO2: apply the concept of linear regression and correlation, in engineering applications.
CO3: List the guidelines for designing experiments and recognize the key historical figures in the Design of Experiments.
CO4: Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, and testing for multivariate normality.

Board of Studies (BoS) : **Academic Council:**
17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	L	L	L	L					L	L	L	L	L	L
CO2	L	L	L	M	L					L	L	L	L	M	L
CO3	L	M	L	L	L					L	L	L	L	L	L
CO4	L	L	L	L	L					L	L	M	L	L	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 statistical techniques will lead to knowledge of applications in Engineering problems

CEE6104	DESTRUCTIVE AND NON-DESTRUCTIVE TESTING OF CONCRETE	L	T	P	C
		0	0	2	1

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1 : fundamentals of concrete mix design by various codal provisions and tests on fresh concrete properties

COB 2 : strength and durability tests on concrete members

COB 3 : Non-Destructive Testing of Concrete

COB 4 : flexural behaviour of RC Beams

MODULE I MIX DESIGN OF CONCRETE & FRESH CONCRETE PROPERTIES 5

Mix design of normal strength grade and high strength grade concrete using IS & ACI Codal Provisions - Fresh Concrete Properties (Conventional) – Self-Compacting concrete

MODULE II STRENGTH & DURABILITY TESTS ON CONCRETE 10

Correlation between cube strength, cylinder strength, splitting tensile strength and modulus of rupture - Study of stress-strain curve for concrete & steel - Determination of Young's modulus - Durability Tests on Concrete – RCPT, sorptivity test, permeability test.

MODULE III NON-DESTRUCTIVE TESTS ON CONCRETE ELEMENTS 7

Rebound Hammer method – Ultrasonic pulse velocity method

MODULE IV TESTING OF REINFORCED CONCRETE BEAMS 8

The behavior of Reinforced Concrete Beams under flexure loading using Data logger, LVDT, Strain gauges and load cell

P – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Lea, "Chemistry of Cement and Concrete", Butterworth-Heinemann Ltd, 5e, 2017
2. Mehta and Monteiro, "Concrete-Micro structure, Properties and Materials", McGraw Hill Professional, 2017
3. Neville A. M. and Brooks J. J.," Concrete Technology", Pearson Education, 2019
4. Neville A.M., "Properties of Concrete", Trans-Atlantic Publications, Inc.;

5e, 2016
5. Santhakumar R., “Concrete Technology‟, Oxford Universities Press, 2018
6. Shetty M. S., Concrete Technology‟, S. Chand & Co., 2018

COURSE OUTCOMES: On completion of the course, students will be able to

CO 1 : perform the mix design of normal & high strength grade concrete and investigate the fresh concrete properties

CO 2 : assess the various properties of hardened concrete by conducting the strength and durability tests

CO 3 : conduct non-destructive testing on concrete elements

CO 4 : apply the engineering techniques to study the behaviour of structural members

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

ENE 6181	ENGLISH FOR CAREER DEVELOPMENT	L	T	P	C
SDG: 4 , 8		1	1	0	2

COURSE OBJECTIVES:

COB1: To enable students to learn about the job search, application, and interview process

COB2: To give them an opportunity to explore their global career path, build vocabulary and improve language skills to achieve professional goals

COB3: To produce a professional-looking resume

COB4: To understand networking and interview skills

COB5: To understand the key skills and behaviors required to facilitate a group discussion

MODULE I ENTERING THE JOB MARKET 3+2

Introduction to the Career Development -Job Search Overview-Identifying Your Interests and Skills

Language Focus: Vocabulary and Word Forms Related to Jobs-Choosing the Job that's the Best Fit

Language Focus: Verb Tenses (Present vs. Present Progressive) Understanding Job Descriptions: Reading a Job Advertisement

Language Focus: Phrases to Compare Similarities

Online Learning Opportunities to Extend Your Skills

MODULE II RESUMES 3+2

What is a resume? Why do you need one?

Parts of a Resume-Writing a Resume, Part 1: Name and Contact Information

Listening: Connecting Employers with Job Seekers in Today's Economy

Language Focus: Key Words

Writing a Resume, Part 2: Headline and Summary

Writing a Resume, Part 3: Work Experience

Writing a Resume, Part 4: Education

Language Focus: Action Verbs

Writing a Resume, Part 5: Complete your Resume

MODULE III WRITING A COVER LETTER 3+2

What is a Cover Letter?

Professional Writing: Letter Format

Cover Letter: Paragraph 1- Introducing Yourself

Cover Letter: Paragraph 2- Highlighting Your Skills in the Cover letter
Cover Letter: Paragraph 3- Closing
Language Focus – Present Perfect vs. Past Tense
Professional Writing: Level of Formality
Language Focus: Using Modal Verbs to Write politely
Writing a Cover Letter for a Specific Job

MODULE IV INTERVIEWING FOR A JOB 3+5

Overview of the Job Interview: Answering Typical Interview Questions
Language Focus: Asking for Clarification in an Interview-
Sample Interview: Do's and Don'ts Part 1
Sample Interview: Do's and Don'ts Part 2
Sample Video: Responding to an Interview Question

MODULE V GROUP DISCUSSION 3+4

Introduction to Group Discussion - Participating in group discussions – understanding group dynamics - brainstorming the topic - questioning and clarifying - GD strategies- activities to improve GD skills

L - 15, T - 15; TOTAL HOURS - 30

REFERENCES:

1. R. Byrne, D. Teaching Oral Skill. London: Longman. 1975.
2. Byrne, D.Teaching Writing, London: Longman. 1975.
3. Rani Asoka, DeviVimala. English for Career development: ACourse in Functional English. Orient Longman Pvt. Ltd., India,2004.
4. Anderson, K., Maclean, J. & Lynch, T. Study speaking: A Course in Spoken
5. English for Academic Purposes. Cambridge University Press, UK, 2004.
6. Withrow, J., Brookes, G.& Cummings, M.C.Inspired to write. Reading and Tasks to Develop Writing Skills. Cambridge University Press, U.K., 2004.
7. Shinde, Maithry etal.Life Skills & Personality Development, Cambridge University Press India Pvt. Ltd, New Delhi
8. Fernandez, Agna Generic Skills for Employability, Cambridge University Press India Pvt. Ltd, New Delhi

COURSE OUTCOMES:

CO1: Identify the steps in the job search process

CO2: Describe themselves and their experiences in a résumé

CO3: Build their job-related vocabulary

CO4: Write a clear cover letter that tells employers why they are the right person for the job

CO5: Take part in Group discussion confidently.

Board of Studies (BoS) :
15thBoS of the Department of English held on 14.6.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1									H	H		H	L	L	L
CO2									H	H		H	L	L	L
CO3									H	H		H	L	L	L
CO4									H	H		H	L	L	L
CO5									H	H		H	L	L	L

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

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

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

Statement: This course ensures that the students acquire quality education and are also made eligible to obtain productive and decent employment.

GEE 6201	RESEARCH METHODOLOGY AND IPR	L	T	P	C
SDG: 4, 8, 9		2	0	0	2

COURSE OBJECTIVES:

COB1: To apply a perspective on research

COB2: To analyze the research design, information retrieval and problem formulation techniques.

COB3: To select the appropriate statistical techniques for hypothesis construction and methods of data analysis and interpretation

COB4: To execute the effective communications of research findings and apply the ethics in research.

COB5: To describe the research findings as research reports, publications, copyrights Patenting and Intellectual Property Rights.

PREREQUISITES:

- Basics of core engineering, probability and statistics.
- Basics of flowchart and algorithm techniques.

MODULE I RESEARCH PROBLEM FORMULATION AND RESEARCH DESIGN **6**

Research - objectives – types - Research process, solving engineering problems -Identification of research topic - Formulation of research problem, literature survey and review. Research design - meaning and need - basic concepts - Different research designs, Experimental design - principle, Design of experimental setup, Mathematical modeling - Simulation, validation and experimentation.

MODULE II DATA COLLECTION, ANALYSIS AND INTERPRETATION OF DATA **8**

Sources of Data, Use of Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision –limitations, Application of Computer in Research- Spreadsheet tool - Basic principles of Statistical Computation. Importance of statistics in research - Concept of probability - Popular distributions - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE III OPTIMIZATION TECHNIQUES **8**

Use of optimization techniques - Traditional methods – Evolutionary Optimization Techniques. Multivariate analysis Techniques, Classifications, Characteristics, Applications - correlation and regression, Curve fitting.

MODULE IV INTELLECTUAL PROPERTY RIGHTS 8

The Research Report - Purpose of written report - Synopsis writing - preparing papers for International Journals, Software for paper formatting like LaTeX/MS Office, Reference Management Software, Software for detection of Plagiarism – Thesis writing, - Organization of contents - style of writing- graphs, charts and Presentation tool - Referencing, Oral presentation and defense - Ethics in research - Patenting, Intellectual Property Rights - Patents, Industrial Designs, Copyrights, Trade Marks, Geographical Indications-Validity of IPR, Method of Patenting, procedures, Patent Search.

L – 30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Ganesan R., “Research Methodology for Engineers”, MJP Publishers, Chennai, 2011.
2. George E. Dieter., “Engineering Design”, McGraw Hill – International edition, 2020.
3. Kothari C.R., “Research Methodology” – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2020.
4. Kalyanmoy Deb., “Genetic Algorithms for optimization”, Kangal report, No.2001002.
5. Rajkumar S. Adukia, “Handbook on Intellectual Property Rights in India”, TMH Publishers, 2020.
6. Prabhuddha Ganguli. ”Intellectual Property Rights”. 1st Edition, TMH Publishers, 2012.

REFERENCES:

1. Holeman, J.P., ”Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2017.
2. Govt. of India, ”Intellectual Property Laws; Acts, Rules & Regulations”, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2020.
3. R Radha Krishnan & S Balasubramanian, ”Intellectual Property Rights”. 1st Edition, Excel Books, 2012.
4. Derek Bosworth and Elizabeth Webster. ”The Management of Intellectual Property”, Edward Elgar Publishing Ltd., 2013.

COURSE OUTCOMES:

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

CO1: Formulate the research problem

CO2: Design and Analyze the research methodology

CO3: Apply statistical techniques for hypothesis construction

CO4: Analyze and interpret the data to construct and optimize the research hypothesis

CO5: Report the research findings as publications, copyright, trademarks and IPR

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

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

SDG 4: Analysis and design of core field design promotes engineering skills and quality education.
Statement: This course enables the student to analyze the existing technology for further solution and its qualitative measures in terms of societal requirements.

SDG 8: Development of new technologies with core field design provides sustainable economic growth and productive employment.
Statement: To apply the hybrid techniques and concepts for different applications provides sustainable economic growth and productive employment.

SDG 9: Creative and curiosity of core field design fosters innovation and sustainable industrialization.
Statement: This course plays major roles through innovative ideas in industry towards modern infrastructures and sustainability.

CEE 6221	ADVANCED CONSTRUCTION PLANNING, SCHEDULING AND CONTROL	L	T	P	C
		3	0	0	3

SDG: 9, 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: planning construction projects using various methods.

COB2: scheduling the activities using network diagrams

COB3: advanced scheduling techniques like DSM, BDM

COB4: allocation and leveling of resources for construction projects.

COB 5: controlling the cash flow and updating the schedule of the project

MODULE I CONSTRUCTION PLANNING 9

Basic concepts in the development of construction plans - choice of technology and construction method – project planning – functions of planning– objectives and policies- types and stages of planning- Project scheduling levels - defining work tasks- work breakdown structure - coding systems – Organization Breakdown Structure - Responsibility Assignment Matrix Duration of activity - Development of project network - AOA and AON diagrams - defining precedence relationships among activities

MODULE II SCHEDULING TECHNIQUES 9

Tools for scheduling- – Gant Chart - critical path method - construction schedules – scheduling calculations - float - scheduling for activity-on-node – PERT - scheduling with uncertain durations (stochastic scheduling)– PERT problems using Excel Software

MODULE III ADVANCED SCHEDULING TECHNIQUES 9

Use of advanced scheduling techniques – PDM – PDM Problems with continuous and Non Continuous duration – LOB (Line of Balance) - BDM (Beeline Diagramming Method) - Applications in construction projects - network analysis for interdependent activities - Information driven scheduling - DSM (Dependency Structure Matrix) modeling in projects

MODULE IV RESOURCE PLANNING 9

Resource Definition – Resource management – Resource allocation - Resource Aggregation (Loading) - Resource Leveling (Smoothing) - Method of Moments for Resource Smoothing- Heuristic Procedure for Resource Smoothing- Scheduling

with Limited Resource – Monte Carlo schedule simulation- Queuing problems- Case Study

MODULE V PROJECT CONTROL 9

Project monitoring Levels and process - Schedule Updating - Project control process - Problems that may Arise during Construction - Earned Value analysis - crashing and time/cost tradeoffs - Project Costs – S curve - Cash Flow – Cost Control - Project Budget

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, 2014.
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, 2015.

REFERENCES:

1. Eppinger. S.D & T.R. Browning, “Design Structure Matrix Methods and Applications”, MIT Press, 2012.
2. 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:

On completion of the course, students will be able to

CO1: plan the construction projects with coding and work breakdown structure.

CO2: create a schedule for the project using network diagrams.

CO3: resolve scheduling constraints using advanced techniques.

CO4: resolve resource over-allocation problems

CO5: control the cost and update the schedule of construction projects.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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.

CEE 6222	LEAN CONSTRUCTION MANAGEMENT	L	T	P	C
		2	0	0	2

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: drawbacks in traditional practices, principles, tools and

COB2: lean methods

COB3: lean tools like VSP, work sampling, last planner system

COB4: activities for implementation in the construction industry.

MODULE I LEAN PHILOSOPHY, CONCEPTS & PRINCIPLES 7

Problems with current construction management techniques - Toyota's management principle - History of How Lean originated - History of Lean Construction - 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 II METHODS 8

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 III LEAN CONSTRUCTION TOOLS 7

Set Based Design - Choosing By Advantages - Value Stream Mapping - Last Planner System - Big Room - PDCA - A3 Reporting - FishBone Diagram - Paretto Analysis - 5S 11. Poka Yoke

MODULE IV LEAN ACTIVITIES 8

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 – 30; TOTAL HOURS –30

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: apply the lean methods to the construction industry.

CO3: apply the different tools in the construction industry to achieve better productivity.

CO 4: implement various activities in construction site.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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

SDG 11 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The holistic understanding of improving the productivity to save time and resources used in construction.

CEE 6223	CONSTRUCTION QUALITY AND SAFETY MANAGEMENT	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: the quality management systems and guidelines

COB2: quality planning, assurance, and improvement techniques

COB3: statistical control and ISO standards in the construction industry.

COB4: safety aspects involved in the construction industry.

COB5: policies followed and awareness in the construction industry

MODULE I INTRODUCTION TO QUALITY MANAGEMENT 9

Introduction – definitions, and objectives – factors influencing construction quality - responsibilities and authority - quality plan - quality management guidelines – quality circles.– requirements – preparing quality system documents – quality-related training – implementing a quality system – TQM – Tools - third-party certification

MODULE II QUALITY PLANNING ASSURANCE AND CONTROL 9

Quality policy, objectives, and methods in the construction industry - Taguchi's concept of quality – codes and standards – documents –– inspection procedures - Total QA / QC programme and cost implication- techniques and needs of QA/QC - different aspects of quality – appraisals- critical, major failure aspects and failure mode analysis.

MODULE III QUALITY IMPROVEMENT TECHNIQUES & ISO 9

Quality improvement - selection of new materials - influence of drawings, detailing, specification, standardization - bid preparation - quality checklist in sites - qualification of staff in organization - purpose of inspection: inspection of various components of construction; reports and records

MODULE IV SAFETY IN CONSTRUCTION 9

Construction Safety Management – OSHO - Role of various parties, duties and responsibilities of top management, site managers, supervisors etc. role of safety officers - Safety in construction operations – Safety of accidents on various construction sites - safety committee, safety monitoring. Writing safety manuals, preparing safety checklists and inspection reports.

MODULE V SAFETY AWARENESS AND POLICY 9

Various safety equipment and gear used on site. First aid on site, Safety awareness program. Labor laws, legal requirement and cost aspects of accidents on site, Incentive for safety practices - Study of safety policies, methods, equipments – job safety analysis – job hazard analysis.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Abdul Razzak Rumane, Quality Management in Construction Projects, CRC Press, 2010
2. Arora.K.C., ISO 9000 to OHAS 18001, S.K. Kataria & Sons; Reprint 2012.
3. Tim Howarth, Paul Watson, Wiley-Blackwell, Construction Safety Management, Wiley-Blackwell publication, 2008.

REFERENCES:

1. Er. Basu Roy.S.C, Modern Concept of Total Quality Control and Management for Construction, Nabhi Publication, 2013.
2. Mark Mcguire Moran, Construction Safety Handbook, A Practical Guide to OSHA Compliance and Injury Prevention, Second edition, 2003.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: understand the basis of the quality management system.

CO2: analyze the quality standards and control methods.

CO3: apply techniques to improve the quality of construction.

CO4: define the roles and responsibilities of stakeholders in establishing safety in the project.

CO5: describe the safety practices to be followed during various construction operations.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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 quality and safety management leads to provide quality construction projects.

CEE 6224 BUILDING INFORMATION MODELING

L	T	P	C
0	0	2	1

SDG: 09

COURSE OBJECTIVES: The course will impart knowledge on

COB1: tools of Building Information Modeling.

COB2: architectural modeling of structure

COB3: structural analysis and design of architecturally modeled structure

COB4: Execution of the same structure at site.

MODULE I INTRODUCTION TO BIM TOOL 5

Introduction to Building Information Modeling (BIM), Discussions of the Roles and Impacts of BIM in the Design, Construction Engineering and Management, Infrastructure Engineering, and Facility Management.

MODULE II DESIGN A RESIDENTIAL BUILDING 5

Design a residential building and its components with provided knowledge about BIM 3D, 4D, 5D, 6D & 7D. Annotate the model with 2D drafting elements and access building information from the building model's database - Creating and editing architectural & structural floor, Creating new material, Developing ceiling plan, adding ceiling, hosted components, interior space planning, developing interior 3D image using camera & rendering.

MODULE III INTRODUCTION TO MEP 10

New MEP Project, Linking an Architect Revit file, Views, Controlling Visibility, Elevation, Section, Creating Callout, Ceiling Plans, View Template, Section Box, Scope box - Space and Zone , Room and Room Tag, Creating Spaces, Modifying Spaces, Area and Volume Calculation, Creating Zone, Systems Browser and Colour Scheme

MODULE IV INTEGRATING WITH STAAD PRO 5

Structural Modeling, Design and Analysis, importing the model into STAAD Pro and analyzing. Types of loads in building analysis. Self-Weight, Dead Load from beams, columns, walls. Frame analysis- Beam end forces, Shear force and bending moment diagram. Specifications for release and offset. Building frame analysis.

MODULE V INTEGRATING WITH MSP & PRIMAVERA 5

Revit model can be imported with a project schedule to review the progress of the Project – Clash Detection of services.

P – 30 TOTAL HOURS –30

TEXT BOOKS:

1. Hardin, B., & McCool, D, "BIM and construction management: proven tools, methods, and workflows".John Wiley & Sons, 2015
2. Issa, R. R., & Olbina, S., "Building Information Modeling: Applications and Practices", American Society of Civil Engineers,2015.
3. Eastman, C., Teicholz, P., Sacks, R., & Liston, C., "BIM handbook: A guide to building information",2011.

REFERENCES:

1. Krygiel, E., & Nies, B., "Green BIM: successful sustainable design with building information modeling", John Wiley & Sons,2008.
2. "Modeling for owners, managers, designers, engineers and contractors". John Wiley & Sons, 2018.

COURSE OUTCOMES: On completion of the course, students will be able to

CO 1 : describe concepts of Building Information Modeling.

CO 2 : design a building structure using software

CO 3 : create new MEP project and link it with BIM

CO 4 : analyze the structure and link it with BIM

CO 5: import the schedule done using MSP or Primavera

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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

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

The holistic understanding of construction software and its importance in the industries.

CED 6225	CONSTRUCTION MANAGEMENT LABORATORY	L	T	P	C
		0	0	2	1

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: The techniques of estimation using MS EXCEL / COSTX software

COB2: scheduling software like MS Project & Primavera

MODULE I ESTIMATION **10**

Quantity takeoff by using MS EXCEL / COSTX - Estimation of Quantities stage wise – Carryout the rate analysis and costing for different stages of work - Preparation and delivery of the bid or proposal of an engineering construction project

MODULE II MS PROJECT **10**

Preparation of Planning and Scheduling by using MS PROJECT - scheduling for a small construction project - Allocation of resource- Tracking of a Project- Update the project - Cost analysis- Reports preparation

MODULE III PRIMAVERA **10**

Preparation of Planning and Scheduling by using PRIMAVERA - scheduling for a small construction project - Allocation of resource –
Tracking of a Project – Cost Analysis - Reports preparation.

P – 30; TOTAL HOURS –30

REFERENCES:

1. Feigenbaum .L, “Construction Scheduling with Primavera Project Planner”, Prentice Hall Inc., 2009.
2. Paulson. B.R., “Computer Applications in Construction”, McGraw Hill, 2005.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: estimate construction projects using Excel/CostX.

CO2: schedule construction projects using MS project.

CO3: schedule and track the constructions projects using Primavera.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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 scheduling the project can improve the productivity and avoid wastage of resources.

CEE 7122	INTERNSHIP	L	T	P	C
		0	0	0	2

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge

COB1: To improve the professional competency, Industrial Exposure and research aptitude of students

COB2: To develop the work practice through design skills inside the industry for solving real life problems

GENERAL GUIDELINES:

1. The course carries two credits for four weeks of Internship with a minimum duration of 160 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.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: Select or utilize the appropriate component\technology to solve a given problem

CO2: Improve their presentation and documentation skills

Board of Studies (BoS) : 19th BoS of Civil held on 29.09.2023

Academic Council: 21st AC held on 20.12.2023

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

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

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

The practical training in construction sites will lead to the development of sustainable buildings

CEE 7121	PROJECT WORK (PHASE I)	L	T	P	C
		0	0	18	6

SDG: 11

COURSE OBJECTIVES: The course will

COB1: provide an opportunity for the students to exhibit their capacity in executing a project work

COB2: provide meaningful solution to a research or real world problem related to Construction Engineering and Project Management

GENERAL GUIDELINES:

At post-graduate level, project work shall be carried out by the student individually

- Student shall select a project topic of his/her interest relevant to Construction Engineering and Project Management and approach any faculty member of the department with expertise in that field and get his / her willingness to supervise the project.
- Students are permitted to carry out their project in an Industry / Research organization, with the approval of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the department and an Engineer / Scientist from the organization. Proper permission and approvals should be obtained from the industry and documented.
- The information relatedthe to proposed topic and the faculty member willing to act as guide shall be informed to the project co-coordinator within 15 days from the commencement of the semester.
- Supervisor identified by the student shall be approved by the Professor in-charge or Head of the Department considering the guidelines followed in the department to allot supervisor for student projects
- The project co-coordinator in consultation with Professor in-charge or Head of the Department shall give initial approval to start the project work.
- A project review team comprising of minimum two senior faculty members of the department preferably doctorates shall be appointed by the Head of the Department.
- Project review schedules, weightage for each review and rubrics for evaluation will be prepared by the project co-coordinator in line with the academic calendar and informed to the students in advance.
- A minimum of three reviews shall be conducted to evaluate the progress of the students. All the members of the review committee shall

evaluate the students individually and the mean value shall be taken for grading.

- Student should meet the supervisor periodically and attend the review committee meetings for evaluating the progress. Proper documents shall be maintained by the supervisor to ensure the attendance and progress of the students.
- In the project phase I, students are expected to identify a suitable topic, draw the need for present study and scope of the investigation, review at least 25 journal papers in the related field, formulate the experimental / analytical methodology and conduct preliminary studies.
- At the end of project work phase I, students should submit a report based on the preliminary studies and the future work to be carried out.

COURSE OUTCOMES: On completion of the course, students will be able to
CO1: apply their practical knowledge and skill in Civil Engineering with a specialization in to solve real time problems
CO2: prepare an appropriate documentation

Board of Studies (BoS) : **Academic Council:**
17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CO2										H					

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

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

The project work course will help the students to explore and innovate new sustainable ideas and materials for implementation in construction industry.

CEE 7121	PROJECT WORK (PHASE II)	L	T	P	C
		0	0	36	18

SDG: 11

COURSE OBJECTIVES: The course will

COB1: provide an opportunity for the students to exhibit their capacity in executing a project work

COB2: provide meaningful solution to a research or real world problem related to Construction Engineering and Project Management

GENERAL GUIDELINES: **9**

- Project work phase II is a continuation of phase I following the same guidelines.
- The project co-coordinator shall arrange to conduct three reviews to ascertain the progress of the work and award the marks based on the performance.
- Detailed experimental investigation / in-depth analytical study / Preparation of specimens/testing have to be performed in line with the scope of the investigation.
- The students are expected to analyze 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 the scope for further reseais rch also to be highlighted.
- The outcome of project work shall be published in journals/conference of National or International importance.
- At the end, students should submit a report covering the various aspects of the 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 deadline for submission of final Project Report / Thesis / Dissertation is within 30 calendar days from the last Instructional day of the semester.
- The project co-ordinator in consultation with head of the department and controller of examination shall arrange for an external expert member to conduct the final viva-voce examination to ascertain the overall performance of the students in Project work.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: apply their practical knowledge and skill in Civil Engineering with a specialization to solve real time problems

CO2: Prepare an appropriate documentation of research work.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CO2										H					

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

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

The project work course will help the students to explore and innovate new sustainable ideas and materials for implementation in construction industry.

ELECTIVES
ODD SEMESTER ELECTIVES

		L	T	P	C
CEEY 151	**INFRASTRUCTURE PLANNING AND MANAGEMENT**	**3**	**0**	**0**	**3**

SDG - 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: concepts of Infrastructure Planning and Management

COB2: private involvement in Infrastructure

COB3: the challenges in infrastructure planning and implementations

COB4: To frame the strategies for a successful infrastructure project

COB 5: sustainable development of infrastructure

MODULE I AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE **9**

Introduction to Infrastructure, an overview of the power sector in India., an overview of the water supply and sanitation sector in India., an overview of the Road, Rail, Air and Port Transportation sectors in India., an overview of the Telecommunications sector in India., an overview of the Urban Infrastructure in India, an overview of the Rural Infrastructure in India, an Introduction to Special Economic Zones, Organizations and layers in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle., an overview of Infrastructure Project Finance.

MODULE II PRIVATE INVOLVEMENT IN INFRASTRUCTURE **9**

A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Challenges in Privatization of water supply; A Case study, Challenges in Privatization of Power: Case Study, Privatization of Infrastructure in India: Case Study, Privatization of Road Transportation Infrastructure in India.

MODULE III CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION: **9**

Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks: The case study for Political Risks, Socio – Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.

MODULE IV STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION **9**

Risk Management Framework for Infrastructure Projects, shaping the planning phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects.

MODULE V INFRASTRUCTURE MANAGEMENT **9**

Information Technology and Systems for Successful Infrastructure Management, - Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques, Capacity Building and Improving the Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Prof.Ashish H. Makwana, Infrastructure Engineering and Management , Lambert Publication (2018)

REFERENCES:

1. Grigg, Neil, “Infrastructure engineering and Management”, Wiley ,2018.
2. Dr.Sridhar Mothe, “Infrastructure contracts and management”. Asia law house,2021.
3. Hudson, Haas, Uddin, “Infrastructure management : Integrating design, Construction, maintenance, rehabilitation, and renovation”, McGraw Hill, ,2007.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: explain the basic concepts related to Infrastructure Projects

CO2: explain the role of the private sector in infrastructure growth.

CO3: describe the strategies for successful Infrastructure project implementation.

CO4: develop Infrastructure modeling and Life Cycle Analysis Techniques

CO5: plan the Sustainable Infrastructure for the development

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

The holistic understanding of infrastructure planning leads to development of sustainable cities

CEEY 152	PORT PLANNING AND MANAGEMENT	L	T	P	C
SDG - 8		3	0	0	3

COURSE OBJECTIVES: The course will impart knowledge on

COB1: the fundamental functions of port structure.

COB2: the port operation and evaluations

COB3: technical knowledge of port development

COB4: the regulatory framework for ports

COB 5: port administration, ownership, and management

MODULE I PORT STRUCTURE AND FUNCTIONS 9

Definition – Types and Layout of the Ports – Organizational Structure – Fundamental observations. Main functions and features of ports: Infrastructure and Connectivity – Administrative functions - Operational functions. Main services: Services and facilities for ships - Administrative formalities Cargo transfer - Services and facilities for cargo - Additional “added value” service- Ports and their stakeholders like PHO, Immigration, Ship agents, Stevedores, CHA.

MODULE II PORT OPERATIONS 9

Berths and Terminals - Berth Facilities and Equipment - ship Operation - Pre-shipment planning, the stowage plan and on board stowage - cargo positioning and stowage on the terminal - Developments in cargo/container handling and terminal operation - Safety of cargo operations - Cargo security: Measuring and evaluating performance and productivity.

MODULE III : PORT DEVELOPMENT 9

Phases of port development - Growth in word trade - Changes in growth - Development in terminal operation. Shipping technology and port: Ship knowledge - Ship development and port development Port time and ship speed - Other technical development affecting port.

MODULE IV REGULATORY FRAMEWORK FOR PORTS 9

Global regulatory organizations ; Conventions and Reports, Environment regulation: Port environmental pollution- Environmental Management System – HAZMAT (Hazardous Materials) – BWM (Ballast Water Management) Port Security : ISM, ISPS, Occupation Safety and Health Administration – ISO1400

MODULE V PORT ADMINISTRATION OWNERSHIP AND MANAGEMENT 9

Port ownership structure- Types of port ownership and administration - Organizations concerning ports - Boards governing the ports - Port management development - Rise and fall of Ports - information technology in ports. Port ownership in Indian context: Acts governing the Ports in India - Port ownership structure in India. . Port reform: Framework for port reform - Evolution of ports in a competitive world - Alternative Port Management Structure and Ownership Models.

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Patrick M.Alderton., “Port Management and Operations. Informa Law Category”, U.K,2008.
2. Bindra S. P., “A course in docks and harbor Engineering, Dhonpat raipublication”, 2013
3. Rangwala, "Harbor Engineering", Charotar Publishing House, 2013.

REFERENCES:

1. World Bank 2007, “Port Reform Tool Kit”, World Bank, Washington
2. Maria G.Burns, 2014., “Port Management and Operations”, CRS Press, U.K
3. Alan E.Branch. 2008, “Elements of Shipping. Chapman and Hall”, Fairplay Publications, U.K.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: design the layout of ports

CO2: evaluate the port performance and productivity

CO3:.find the technical lag affecting the port

CO4: prepare the checklist for the port safety

CO5: design the port administration and management

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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

SDG 8 : Decent Work and Economic Growth

Statement :

The water transport system Promote sustained, inclusive and sustainable economic growth.

CEEY 153	INTEGRATED BUILDING MANAGEMENT SERVICES	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: concepts of ventilation systems

COB2: working principles of electrical and transportation systems

COB3: security and fire protection services

COB4: plumbing and sanitary services

COB 5: office automation systems and communication systems

MODULE I VENTILATION SYSTEMS 9

Introduction to Integrated Building Management Services - Basic types of services in a built environment - HVAC fundamentals - indoor environmental quality - Active and Passive cooling - different types of HVAC systems, energy efficient HVAC systems - under floor air distribution – chilled beams – Commissioning of services

MODULE II ELECTRICAL AND TRANSPORTATION SYSTEMS 9

Electrical equipment, wiring and raceways, - lighting systems - vertical transportation in buildings, - Escalators -– Installation and Commissioning of services

MODULE III SECURITY AND FIRE PROTECTION SERVICES 9

classification of fire, types of firefighting systems, various components and construction aspects of firefighting systems - smoke detection- automatic fire alarm detection - security systems. closed circuit television & surveillance systems; access control & management system - Installation and Commissioning of services

MODULE IV OTHER SERVICES 9

Water proofing systems, types of plumbing systems, sanitary works - internal and external sanitary systems – STP - Interiors in buildings automated car parking management

MODULE V INTELLIGENT BUILDINGS 9

Intelligent buildings-Building automation- High performance buildings Smart buildings- Building services in high rise buildings-Green buildings-Energy efficient buildings for various zones-Case studies of residence, office buildings

and other buildings in each zones. BMS and energy savings – BMS benefits smart home - smart office

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Fair G.M., Geyer J.C. and Okun .D, “Water and waste Engineering“, Vol. II, John Wiley & sons, Inc., New York. 2008.
2. Hopkinson . R.G and Kay .J .D, “The Lighting of buildings, Faber and Faber, London, 2009.
3. Handbook for Building Engineers in Metric systems, NBC, New Delhi, 2008..
4. Time-saver Standards for Architecture Design Data, Callendar JH, McGraw Hill, 2004.

REFERENCES:

1. Philips Lighting in Architecture Designs, McGraw Hill, New York, 2004.
2. William H. Severns and Julian R. Fellows, “Air conditioning and refrigeration”, John Wily and sons, London, 2008.
3. Derek Clements Croome, “Intelligent Building Design, Management and Operations”, 2nd edition, ICEP Publishers, London, 2013.
4. Ehrlich, C., “Intelligent Building Dictionary: Terminology for Smart, Integrated Green Building Design, Construction, and Management”, San Francisco, Hands-on-Guide, 2007.
5. Shengwei Wang, “Intelligent Buildings and Building Automation, Spon Press”, London, 2009.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: differentiate the functions of different ventilation systems

CO2: demonstrate and explain the various electrical and transportation Systems

CO3: demonstrate and explain the various Intelligent Safety Systems

CO4: execute the plumbing and interior services

CO5: analyze high-performance buildings based on energy efficiency

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L		L		L	L	M		L	L	L	H	H	L	L
CO2	L		L		L	L	M		L	L	L	H	H	L	L
CO3	L		L		L	L	M		L	L	L	H	H	L	L
CO4	L		L		L	L	M		L	L	L	H	H	L	L
CO5	L		L		L	L	M		L	L	L	H	H	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 holistic understanding of building management system will lead to sustainable buildings

CEEY 154	BUILDING ACOUSTICS	L	T	P	C
		2	0	0	2

SDG: 9

COURSE OBJECTIVES: The course will impart knowledge on

COB1: acoustics properties required for building.

COB2: basic room acoustic measurements

COB3: noise hazards and control measures

COB4: the various concept on sustainable design

MODULE I INTRODUCTION TO ACOUSTICS 8

Introduction to Acoustics – Sound - Decibel arithmetic - Describing sound sources - propagation, reflection, absorption, diffusion, velocity, characteristic intensity etc. Properties of sound, decibel, scale, directionality and sound sources, hearing noise effects, diffraction and reflection. Acoustic properties of materials - More detail on sound absorption.

MODULE II ROOM ACOUSTICS 6

Sound propagation in rooms - Types of surfaces - Reverberation time calculations - Reverberant sound level calculations - Room acoustic modeling- Behaviour of sound in an enclosed space-resonance, echo and reverberation. 3D room acoustic modeling software – Auralisations - Auralisation examples

.

MODULE III SOUND INSULATION & NOISE IMPACT 8

Sound absorption and sound insulation - Airborne and structure borne sound - Sound insulation performance parameters - Sound Insulation of partitions - Sound Insulation of glazing - Sound Insulation of composite partitions - Sound Insulating constructions - Impact noise generation and transmission through structures - Impact noise parameters and standards - Impact noise measurements - Impact noise reduction

MODULE IV ACOUSTICS FOR SUSTAINABLE DESIGN 8

Acoustic considerations for sustainable design (city and building scale) - Acoustic comfort in green building rating systems - Acoustics for open plan offices - Acoustic privacy in meeting rooms and offices - Natural ventilation and noise control - Dual vented window design - Naturally ventilated design of a library - Recycled materials with acoustic properties – Day lighting and acoustics.

L – 30; TOTAL HOURS – 30

TEXT BOOKS:

1. Marshall Long , “Architectural Acoustics”, Academic Press,1st edition, 2005.
2. Gary Steffy, “Architectural Lighting Design”,second Edition, Wiley & Sons, Inc. 2001.

REFERENCES:

- NBC, National Building Code of India, New Delhi, Second revision, 2005 (NBC 2005).

COURSE OUTCOMES: On completion of the course, students will be able to

CO 1 : explain the concept of acoustics properties required for buildings.

CO 2 : describe the nature of room acoustics

CO 3 : analyze the various techniques on sound insulation and noise impacts

CO 4 : explain the sustainable design factors for good acoustics.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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

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

The holistic understanding of acoustics designs and its impact in construction.

CEEY 155	DIGITAL TECHNOLOGY IN CONSTRUCTION	L	T	P	C
		1	0	0	1

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: different requirements of virtual reality and application in the construction industry

COB2: augmented reality.

MODULE I VIRTUAL REALITY IN CONSTRUCTION 8

The historical development of VR - Scientific landmarks Computer Graphics - Real-time computer graphics - Flight simulation- Virtual environments, Requirements for VR - benefits of Virtual reality – Applications in construction – case study

MODULE II AUGMENTED REALITY IN CONSTRUCTION 7

Basics of augmented reality - how and why it was developed - how it compares to and differs from its technological cousin, virtual reality - hardware needed to view AR content - benefits of Augmented reality – Applications in construction – case study

L – 15 TOTAL HOURS –15

TEXT BOOKS:

1. Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
2. Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience, India, 2003.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”, Addison Wesley, USA, 2005.

REFERENCES:

1. Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005.
2. Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Meging Real and Virtual Worlds”, 2005.

COURSE OUTCOMES

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

CO 1 : demonstrate and respond to the importance of virtual reality in construction management.

CO 2 : formulate a deep understanding of augmented reality and its application in industry.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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 virtual visualization can improve the work flow and reduce the delay in construction projects.

CEEY 156	ADVANCED CONSTRUCTION TECHNIQUES	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: modern construction practices related to sub structure construction

.COB2:advanced construction techniques related to super structure

COB3: the rehabilitation and strengthening technique in a challenging environment

COB4: different demolition technique for various purpose

COB5: techniques for the construction of special structures.

MODULE I SUBSTRUCTURE CONSTRUCTION 8

Box jacking - pipe jacking - underwater construction of diaphragm walls and basement - methods – stand-by plant equipment for underground open excavation. Underwater construction – problems, encountered. Underwater concreting – Sequence of construction activities for tunnels.

MODULE II SUPERSTRUCTURE CONSTRUCTION 8

Formwork& scaffolding – lift slab construction - drop slab construction - ready mix concrete - modes of transporting & continuous concrete placing in tall structure - erection techniques for tall structures, large span structures – launching techniques for heavy decks - Sequence of construction activities for bridges, tall Structures, sustainable structures and dams.

MODULE III REHABILITATION AND STRENGTHENING TECHNIQUES 8

Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.

MODULE IV DEMOLITION TECHNIQUES 6

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling

MODULE V SPECIAL STRUCTURES

Geometry control technique – Part Segmentation Construction - Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers, Steel bridges - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Varghese, P. C., "Maintenance, Repair & Rehabilitation And Minor Works Of Buildings". India: PHI Learning, 2014.
2. Arora S.P. and Bindra S.P., "A text book on Building Construction", Dhanpat Rai and Sons, 2010.
3. Sankar, S.K. and Saraswati, S., "Construction Technology", Oxford University Press, New Delhi, 2008

REFERENCES:

1. Sharma, S., Gahlot, P. S., "Building Repair and Maintenance Management", India, CBS Publishers & Distributors, 2019.
2. ChungKlatte, S., Hasselbach, R., Knaack, U., "Prefabricated Systems: Principles of Construction", Germany, De Gruyter, 2012.
3. Emmitt, S., Barry's "Advanced Construction of Buildings". United Kingdom: Wiley, 2018.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: choose the suitable technique to be adopted in sub-structure construction

CO2: identify the appropriate technique to be used in superstructure construction.

CO3: investigate in the rehabilitation and strengthening technique

CO4: extrapolate the demolition techniques used in the construction.

CO5: choose the techniques for the construction of special structures.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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 technologies leads to development of resilient infrastructure

CEEY 157	LOGISTICS AND SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: basics of supply chain management

COB2: logistic network design

COB3: product and supply chain design

COB 4: strategic alliances and inventory management

COB 5: technologies for supply chain management (SCM).

MODULE I INTRODUCTION **9**

Definition of logistics and supply chain management, decision phases in a supply chain, objectives of SCM, examples of supply chains, supply chain drivers, supply chain integration, supply chain performance measures. - Role of distribution in supply chain

MODULE II LOGISTICS NETWORK DESIGN **9**

distribution network design, factors influencing distribution network design, distribution networks in practice, network design in the supply chain, factors influencing the network design, framework for network design, models for facility location and capacity allocation, Impact of uncertainty on network design.

MODULE III COORDINATED PRODUCT AND SUPPLY CHAIN DESIGN **9**

General framework - Design for logistics - Standardization - Push-pull boundary - Supplier integration into New Product Development - Keys to effective supplier integration - Mass Customization - Meaning - Mass Customization and Supply Chain Management.

MODULE IV STRATEGIC ALLIANCES AND INVENTORY MANAGEMENT **9**

Framework for strategic alliances - Third Party Logistics - 3PL issues and requirements - Retailer - Supplier Partnerships - Issues in Retailer - Supplier Partnerships - Distributor Integration - Types and issues of Distributor Integration. Cycle inventory, economies of scale to exploit fixed costs, quantity discounts, example problems, multi-echelon inventory, safety inventory in supply chain, safety level estimation, supply uncertainty, data aggregation,

replenishment policies, managing safety inventory in practice, product availability, optimal level, affecting factors, supply chain contracts - Bull whip effect.

MODULE V TECHNOLOGIES FOR SCM 9

Information Technology (IT) - Infrastructure - Interface devices - System architecture - Electronic commerce - IT for supply chain excellence - Service oriented architecture - Radio Frequency Identification (RFID) - Impact of internet.

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Sadler I, “Logistics and Supply Chain Integration”, Sage Publishers, 2012.
2. Simchi - Levi Davi, Kaminsky Philip and Simchi-Levi Edith, “Designing and Managing the Supply Chain”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2012.
3. Sunil Chopra and Peter Meindl, “Supply Chain Management”, Prentice Hall, New Jersey, 2013.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: describe the concepts of Inventory management.

CO2: design a distribution network

CO3: design the network of supply chain Management,

CO4: coordinate product and supply chain design in logistics.

CO5: enumerate the various technologies used for supply chain management

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

The holistic understanding of supply chain management may reduce the transportation of resources leading to development of sustainable buildings

CEEY 158	CONDITION ASSESSMENT AND	L	T	P	C
SDG: 11	REHABILITATION OF STRUCTURES	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 PHYSICAL AND CHEMICAL DETERIORATING MECHANISMS **9**

Durability of concrete – influencing parameters. Life cycle cost and sustainability. Physical deteriorating mechanisms: shrinkage & creep - abrasion – erosion – cavitation - freeze and thaw – thermal incompatibility – high-temperature variations. Chemical deteriorating mechanisms: alkali-silica reaction – leaching - acid attack – sulphate attack – corrosion of steel rebar in RC (chloride penetration and carbonation) – microbial induced corrosion – effluent gases from industries.

MODULE II CONDITION ASSESSMENT OF RC STRUCTURES USING NDT **9**

Condition assessment: significance and objectives – various stages – preliminary inspection – planning – visual inspection – laboratory and field testing. Non-Destructive techniques for condition assessment: overview – Rebound hammer test, ultrasonic pulse velocity test, concrete resistivity, cover meter, concrete core test, half-cell potential test, tests for carbonation, chemical analysis (chloride and sulphate content), tests for assessing fire damage in concrete structures. 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 – carbon fiber sheets – grouting agents -

concrete coatings - sacrificial anodes.

MODULE IV TECHNIQUES FOR REHABILITATION OF RC ELEMENTS **9**

Rehabilitation techniques – overview, significance and selection methods – dry pack method – overlays – preplaced aggregate concrete - pressure grouting– RC jacketing technique – Plate bonding technique – FRP jacketing technique – prestressing technique - ferrocement – guniting and shotcrete – techniques for repairing cracks – sacrificial anode cathodic protection

MODULE V CASE STUDIES ON RETROFITTING AND REHABILITATION OF RC STRUCTURES **9**

Seismic retrofitting of G+4 building: analysis for higher seismic level – revised member dimensions and steel requirement – retrofitting strategy. Case study on rehabilitation of : dampness in buildings, leaky sunken slab, distressed roof slab, over head 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, 2019+.
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.
5. Hand Book on “Repair and Rehabilitation of RCC Buildings”, Central Public Works Department, Government of India, 2002.
6. Malhotra, V.M. and Carino, N.J., “Handbook on Non-destructive Testing of Concrete”, CRC Press, 2004.

7. John Broomfield, “Corrosion of Steel in Concrete – Understanding, Investigation and Repair”, CRC Press, London, 2003.
8. Yoshihiko Ohama, “Hand Book of Polymer Modified Concrete and Mortars”, Noyes Publications, U.K., 3rd Edition, 2013.
9. FEMA 273; NEHRP Guidelines for the Seismic Rehabilitation of Buildings, 2005.
10. ATC – 40: Seismic Evaluation and Retrofit of Concrete Buildings, Vol. 1 & 2, 2005.

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

CO1: understand the physical and chemical deteriorating mechanisms detrimental to the RC structures.

CO2: perform conditions 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 and retrofitting of RC structures.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th 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

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 during its life time.
2. Make the existing human settlements safe and resilient by performing condition assessment using NDT and by adopting suitable repair techniques for its rehabilitation including seismic retrofitting.

CEEY 159	TUNNEL ENGINEERING	L	T	P	C
SDG: 11		1	0	0	1

COURSE OBJECTIVES: The course will impart knowledge on

COB1: tunneling and types of tunneling

COB2: techniques used in the tunnelling

MODULE I INTRODUCTION **7**

Tunneling Methods: Types and purpose of tunnels; factors affecting the choice of excavation technique; Methods – soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered in tunneling and remedial measures.

MODULE II TUNNELING TECHNIQUES **8**

Tunneling by Drilling and Blasting: Unit operations in conventional tunneling; Drilling – drilling principles, drilling equipment, Blasting – explosives, initiators, blasting mechanics, blast hole nomenclature; Tunneling by Road headers and Impact Hammers: Cutting principles, method of excavation, selection, performance, limitations, and problems. Tunneling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations, and problems; TBM applications.

L – 15 TOTAL HOURS –15

TEXT BOOKS:

1. Driving Horizontal Workings and Tunnel, by Pokorovski, Mir Publishers, 1980.
2. Harbour, Dock and Tunneling Engineering by R. Srinivasan Published by R. C. Pattii, Chal'otar Book Stall, Station Road TulsiSada, Arland (W. Rly), India.

REFERENCES:

1. "Rock Mechanics and Design in Mining and Tunneling", Bieniawski, Z.T., Rotterdam A.A. Balkema, 1984.
2. "Drilling and Blasting of Rocks", by Carlos L Jimeno, A.A. Balkema/Rotterdam/Brookfield 1995.
3. Hoek, E., Brown, E, "Underground excavations in Rock", CRC Press, 1980.

4. Hoek, E. and Brady, J. D. Rock, “Slope Engineering”, Taylor and Francis, 1981
5. Nick Barton, “Tunnel Boring Machines”, 2000/

COURSE OUTCOMES: On completion of the course, students will be able to
CO1: evaluate tunnel excavation method from technical and production aspects
CO2: analyze cost and time for ordinary tunnels based on risks and construction management principles

Board of Studies (BoS) : **Academic Council:**
17th BoS of Civil held on 10.08.2022 **19th AC held on 24.02.2022**

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

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

SDG 11 : Make cities and human settlements inclusive, safe, resilient and sustainable
A holistic understanding of construction techniques leads to the development of sustainable buildings

CEEY101	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: polymer-modified concrete, fiber-reinforced concrete and pervious 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 : types, brief working mechanism and application areas. Influence of chemical admixtures on fresh concrete, hardened concrete, microstructure and durability properties of concrete.

MODULE III CORROSION OF STEEL REBARS IN REINFORCED 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 – concrete coatings : types and materials – corrosion inhibitors – types – working mechanism.

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 SPECIAL CONCRETES : POLYMER MODIFIED CONCRETE, FIBER-REINFORCED CONCRETE AND PERVIOUS CONCRETE **9**

Polymer modified mortar / concrete: Types of polymers – working mechanism in cementitious systems - influence on fresh mortar / concrete, hardened mortar / concrete, microstructure, transport mechanism and durability properties – applications areas. Fiber-reinforced concrete : types of fibers – working mechanism – influence on fresh, hardened and durability properties – application areas. Pervious concrete: significance, manufacturing, properties and application areas.

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 University Press, New Delhi, 2007.

REFERENCES:

1. Kumar Mehta. P. and Paulo J.M. Monteiro., “Concrete : Microstructure, Properties, and Materials” 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2014.
3. Shetty.M.S., and A.K. Jain “Concrete Technology (Theory and Practice)”, S. Chand and Company Ltd., 2010.
4. Gambhir.M.L., “Concrete Technology”, 5th Edition, Tata McGraw Hill Education, 2017
5. Nayak, N.V, and Jain, A.K, Handbook on Advanced Concrete Technology, Narosa Publishing House Pvt. Ltd., New Delhi, 2012.
6. Zongjin Li, “Advanced Concrete Technology”, John Wiley & Sons, 2011.
7. EFNARC (2002), “Specification and Guidelines for Self-compacting Concrete”, Surrey, UK.

8. John Broomfield, “Corrosion of Steel in Concrete – Understanding, Investigation and Repair”, CRC Press, London, 2003.
9. 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 the significance of the 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 the procedure the for manufacpolymer-modifiedmodified concrete, fiber-reinforced concrete and pervious concrete including its application areas.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1							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, high performance and sustainable reinforced concrete (i) by using mineral admixtures, chemical admixtures in concrete, (ii) by adopting specialised procedures and methods and (iii) by adopting corrosion

protection methods during construction; and make the human settlements safe, resilient and sustainable.

CEEY 109	PREFABRICATED STRUCTURES	L	T	P	C
SDG: 11		2	0	0	2

COURSE OBJECTIVES: The course will impart knowledge on

COB1: design principles of prefabricated structures

COB 2: behavior of prefabricated RC structures

COB 3: the concepts in the construction of prefabricated structural components

COB 4: design of elements for industrial buildings

MODULE I DESIGN PRINCIPLES 07

General civil engineering requirements, specific requirements for planning and layout of prefabrication plant. IS code specifications- modular co-ordination, standardization, disuniting of prefabricates, production, transportation, erection, stages of loading and code provisions, safety factors, material properties, deflection control, lateral load resistance, location and types of shear walls - long wall and cross-wall large panel buildings

MODULE II REINFORCED CONCRETE 08

One way and two way prefabricated slabs, framed buildings with partial and curtain walls - connections – beam to column and column to column. Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, description of joints, their behaviour and reinforcement requirements, deflection control for short term and long term loads, ultimate strength calculations in shear and flexure

MODULE III WALLS 07

Types of wall panels, blocks and large panels, curtain, partition and load bearing walls, load transfer from floor to wall panels, vertical loads, eccentricity and stability of wall panels, design curves, types of wall joints, their behaviour and design, leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

MODULE I V INDUSTRIAL BUILDINGS AND SHELL ROOFS 08

Components of single-storey industrial sheds with crane gantry systems, R.C.roof trusses, roof panels, corbels and columns, wind bracing design - cylindrical, folded plate and hyper-prefabricated shells, erection and jointing, joint design, hand book based design.

Total Hours :30

REFERENCES:

1. Koncz.T., “Manual of Precast Concrete Construction”, Vol.I II and III & IV Bauverlag, GMBH, 1971.
2. Laszlo Mokk, “Prefabricated Concrete for Industrial and Public Structures”, AkademiaiKiado, Budapest, 2007.
3. Lewicki.B, “Building with Large Prefabricates”, Elsevier Publishing Company, Amsterdam/ London/New York, 1998.
4. Structural Design Manual, “Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete”, Netherland BetorVerlag, 2009.
5. Warszawski, A., “Industrialization and Robotics in Building - A managerial approach”, Harper and Row, 1990.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: apply the design principles used to construct prefabricated structures.
CO2: create a panel and framed buildings with their connections of prefabricated RC structures.
CO3: classify the types of floors, stairs, and roofs and describe their behaviour of structures.
CO4: critically describe the various types of wall panels for prefabricated structures.
CO5: construct a prefabricated structural component for industrial buildings.

Board of Studies (BoS) :
17th BOS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1		PS O2	PSO3
CO1			H	H									H			
CO2			H	H									H			
CO3			H	H									H			
CO4			H	H									H			
CO5			H	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 holistic understanding of prefabricated structures is more essential to ensure safe and sustainable buildings

CEEY 181	CLIMATE CHANGE AND WATER RESOURCES	L	T	P	C
SDG: 13		3	0	0	3

COURSE OBJECTIVES: The objectives of the course are

COB1: To impart knowledge on the climate system

COB2: To expose knowledge on the impact of climate change on different sectors.

COB3: To provide exposure to the tools available for vulnerability assessment.

COB4: To acquire knowledge on the guidelines of adaptation and mitigation carried out during climatic changes.

COB5: To familiarize the computation using downscaling methods in water resources.

MODULE I GLOBAL CLIMATE SYSTEM 9

Climate - Drivers of Climate change - Components of Global Climate System: Atmosphere,
hydrosphere, Lithosphere, and biosphere, atmospheric circulation - redistribution of heat - Global Energy Balance - Greenhouse effect- Hydrological cycle - Reservoirs, flows (or Fluxes), Residence Times, Water Vapor.

MODULE II CLIMATE VARIABILITY AND CHANGE 9

Climate variability and change: Factors Responsible for Natural Climate Variability and Change: large scale variability - El Nino, La Nina – ENSO, Teleconnections, Sun-Moon-Earth interaction - Factors Responsible for Anthropogenic Climate Change, Detection and Attribution of Climate Change; Global and Indian Scenarios – Observed changes and projected changes of IPCC - Impacts on water resources – Scenarios: SRES and RCPs.

MODULE III TOOLS FOR VULNERABILITY ASSESSMENT 9

Need for vulnerability assessment - Approaches for assessment – Types of climate models, History of climate modelling, Sensitivity of climate models, parameterization of climate process, simulation. Box models - Zero-dimensional models - Radiative-convective models - Higher- dimension models
- EMICs (Earth-system models of intermediate complexity) - GCMs (global climate models or general circulation models) – Regional Models - Sectoral models - CMIP

MODULE IV ADAPTATION AND MITIGATION 9

Water-related adaptation to climate change in the fields of Ecosystems and biodiversity, - Agriculture and food security, land use and forestry, Human health, water supply and sanitation, infrastructure and Economy (insurance, tourism, industry and transportation) - Adaptation, vulnerability and sustainable development Sector-specific mitigation - Carbon dioxide capture and storage (CCS) , Bio-energy crops, Biomass electricity, Hydropower, Geothermal energy, Energy use in buildings, Land-use change and management, Cropland management, Afforestation and Reforestation.

MODULE V IMPACTS ON WATER RESOURCES 9

General Circulation Models – downscaling – statistical downscaling – dynamic downscaling. Case studies on impacts of climate change on Water resources assessment, water quality, groundwater, irrigation and agriculture.

L –45; TOTAL HOURS –45

TEXT BOOKS:

1. Sangam Shrestha, Mukand S. Babel and Vishnu Prasad Pandey,2014, Climate Change and Water Resources, CRC Press an imprint of the Taylor & Francis Group
2. McGuffie., K, and Henderson-Sellers.A, 2005, A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd .

REFERENCES:

1. John M. Wallace and Peter V. Hobbs,2006, Atmospheric Science: An Introductory Survey, Second Edition, Academic Press an imprint of Elsevier
2. David Neelin., J, 2011, Climate Change and Climate Modeling, University Press, Cambridge, United Kingdom.
3. Thomas T. Warner, 2011, Numerical Weather and Climate Prediction, Cambridge University Press, New York 6. Intergovernmental Panel on Climate Change: https://www.ipcc.ch.

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

CO1: describe the earth's climate system and the interaction among the subsystems of the earth components

CO2: illustrate the basics of climate variability and change including the observations and Projections

CO3: demonstrate the tools for vulnerability assessment at global and at regional scale

CO4: describe the options available for adaptation and mitigation for different sectors

CO5: comprehend the methodology for using appropriate dataset for impact assessment on water resources through case studies

Board of Studies (BoS) :
19th BOS of Civil held on 29.9.2023

Academic Council:
21st ACM held on 23.12.2023

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

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

SDG 13:Climate change is a global challenge that affects everyone and everywhere such as floods.

Climate change action is increasing the frequency and intensity of extreme weather events and causes water management problems, damaging critical infrastructure and interrupting the

CEEY 182	HYDROLOGIC ANALYSIS AND DESIGN	L	T	P	C
SDG: 13		3	0	0	3

COURSE OBJECTIVES: The objectives of the course are

COB1: To impart the knowledge on hydrological modeling approaches

COB2: To acquire knowledge on the hydrological time series analysis and its applications

COB3: To provide exposure to the hydrologic data analysis.

COB4: To acquire knowledge on the hydrologic design and simulation aspects

COB5: To familiarize the design flows estimation concept

MODULE I DETERMINISTIC HYDROLOGIC SIMULATION 9

Hydrologic cycle – System concept – Hydrologic system Model – Classification of Hydrologic

Models – Statistical, Stochastic and Deterministic Approaches – Types of Deterministic Model – Black Box, Conceptual and Physically based models - Models of IUH, Nash and Chow-Kulandaiswamy Models – Modeling Procedure, Calibration and Validation, Modeling Errors - HEC HMS, SWAT and MIKE SHE Models.

MODULE II HYDROLOGIC TIME SERIES ANALYSIS 9

Stochastic Process – Classification – Stationary and Non-Stationary Process – Time series – Classification – Component of Time series – Method of Investigation – Auto Correlation Analysis – Moving Average Process – Auto Regressive Process - Auto Regressive Moving Average Process- Auto Regressive Integrated Moving Average Process – Thomas Fiering Model – Box Jenkins Model – Model formulation – Parameter Estimation – Calibration and Validation – Application to hydrologic Forecasting.

MODULE III STATISTICAL HYDROLOGY 9

Random Variable - Statistical characteristics of Hydrological Data – Discrete and Continuous Probability distribution Functions - Frequency and Return Period of Hydrologic Variables Correlation Analysis – Developing Prediction Equation by Simple and Multiple Linear Regression – Reliability of the Model.

MODULE IV HYDROLOGIC DESIGN 9

Hydrologic Design Scale – Estimating Limiting Value – Hydrologic Design level – Design storms for Minor and Major structures - Hydrologic Design Data - Hydraulic structure Design methods – Hydrologic Design Standard and Criteria - Hydrologic Risk, Reliability and Safety Factor - Computation of Design Storm - IDF Relationship - Estimation of PMP.

MODULE V DESIGN FLOWS **9**

Estimation of Design Flows - Rational Method - Urban Storm Drainage Design – SWMM Model - Hydrologic Design of Dam Spillway, Culverts, Highway and Railway Bridges - Flood Control Reservoir Design – Water Supply Reservoir Design – Real Time Flood

L –45; TOTAL HOURS –45

TEXT BOOKS:

1. Viessman W and Lewis.G.L., Introduction to Hydrology (5th edition) Pearson Education, Inc.
2008.
2. Jayarami Reddy, P. “Hydrology”, Laxmi Publications (P) Ltd., New Delhi, 3rd Edition, 2016.
3. Patra.K.C, “Hydrology and Water Resources Engineering”, Narosa Publications,2nd Edition, New Delhi, 2015.
4. Raghunath, H.M., “Hydrology – Principles, Analysis and Design, New Age International (P) Ltd., New Delhi, 3rd Edition 2014.

REFERENCES:

1. Chow, V.T. “Hydrology for Engineers”, McGraw-Hill Inc. Ltd., NewYork, 2000.
2. Singh, V.P., “Hydrology”, McGraw-Hill Inc. Ltd., New York, 2000.
3. Bedient, P.B., Huber, W.C., Vieux, B.E., “Hydrology and Floodplain Analysis”, Pearson Education India, 5th Edition, 2012.
4. Singh, V. P. Hydrologic Systems, Prentice-Hall Englewood Cliffs, NJ 1989.

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

CO1: describe the classification of hydrologic models and the deterministic modeling approach of Hydrologic Simulation

CO2: evaluate the statistical characteristics, Carryout frequency analysis and develop
Prediction equation between hydrologic variables using regression.

CO3: apply the time series models for hydrologic forecasting

CO4: compute the design storm by knowing the design concepts and methods

CO5: estimate the design flows for minor, medium and major hydraulic structures.

Board of Studies (BoS) :
19th BOS of Civil held on 29.9.2023

Academic Council:
21st ACM held on 23.12.2024

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

SDG 13:Climate change is a global challenge that affects everyone and everywhere such as floods.

Climate change action is increasing the frequency and intensity of extreme weather events. The effect of climate change may affect the entire hydrological cycle process which may be lead to protect the atmosphere and save our environment.

EVEN SEMESTER ELECTIVES

CEEY 251	MODERN CONSTRUCTION MATERIALS	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: the properties of metals and non-structural materials used in construction

COB2:the application of smart and intelligent materials in construction

COB3: the types, advantage,s and applications of fibre composites and glass

COB4: the properties and applications of special cement and concrete

COB 5: the applications of polymers and timber in construction

MODULE I METALS AND NON STRUCTURAL MATERIALS 9

Different types of steel, aluminum and their products - other alloys - applications in civil engineering – Nonstructural materials - wwaterproofingcompounds-types – non-weathering materials - flooring - types - materials used for flooring - properties - facade materials - types - properties - selection - insulation materials

MODULE II SMART AND INTELLIGENT MATERIALS 9

Smart materials – shape memory alloys - application in construction - smart windows -types - intelligent materials - Nanomaterials - coatings & paints - Nano sensors-aerogels - phase changing materials - translucent concrete – sensitive - electrified wood – flexi comb -liquid granite

MODULE III FIBRE COMPOSITES AND GLASS 9

Types of fibre materials (glass, carbon, polymer), fibre length and orientation-fibre reinforced concrete matrix-Interfaces and bonding-Application of fibre composites in construction-Types of glass-Mechanical Properties- glass wall and structural glass assemblies-Disposal and recycling.

MODULE IV SPECIAL CONCRETES AND CEMENT 9

Properties and applications - No fines concrete , High strength concrete-sprayed concrete-self compacting concrete-under water concrete-aerated concrete-foamed concrete-light weight aggregate concrete-High density aggregate concrete-recycling of concrete after demolition **–**

Geopolymer cements- Alkali –activated cements –waste derived cements

MODULE V POLYMERS AND TIMBER 9

Thermosetting and Thermo plastic polymers-polymer properties- Application of polymers in construction –Elastomers-Geo textiles-Geomembranes-Geopolymers-Solid Timber-Wood based panels-Laminated timber-Preservatives and preservation of timber – Flame retardant coatings

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. "Construction Materials: Their Nature and Behaviour", Fifth Edition. (2017). United States: CRC Press.
2. Mamlouk, M.S. and Zaniewski J.P, "Materials for Civil and Construction Engineers", Prentice Hall Inc., 2011.
3. Ganapathy, C. "Modern Construction Materials", Eswar Press, 2015
4. Duggal, S.K, "Building Materials", New Age International Publishers Ltd., Delhi, 2008.

REFERENCES:

1. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001 .
2. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: choose the metal and non structural materials used for various applications in construction

CO2: explain the advantages of using smart material in construction

CO3: apply the fibre composites and glass in construction

CO4: identify the benefits of special cement and concrete

CO5: : explain the advantages of polymers and timber in construction

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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

CEEY 252	PLANNING LEGISLATION AND PROFESSIONAL PRACTICE	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: constitution and legislation in relation to spatial planning

COB2: implications of the existing legislations relating to planning and its importance and shortcomings

COB3: problems and prospects of urban and regional planning in terms of professional practice.

COB4: development regulations and building rules

COB 5: Professional practices in the development process of cities

MODULE I THE CONCEPT AND THE RELEVANCE OF THE CONSTITUTION AND PLANNING LEGISLATION 9

The national goals of the Constitution and its relevance to Planning — Transformation of Rights to property from a fundamental right to legal right - Concept of the Planning Law - Historical evolution of Planning Law in India and in the United Kingdom and their inter-relationship —Planning Legislation as a positive tool in preparation and implementation of urban and regional plans

MODULE II TOWN AND COUNTRY PLANNING LEGISLATIONS AND LAWS GOVERNING LOCAL BODIES 9

Town and Country Planning Acts and their Review - Urban Local Bodies Laws, Legislations for Panchayats, Municipalities, Municipal corporations, Interface between the Planning and Local Bodies Acts - Local bodies Finance, Revenue, Expenditure and Resource Mobilization - The Constitution (73rd and 74th Amendment) Act, 1992 and their implications on planning and development.

MODULE III LAWS INCIDENTAL TO PLANNING AND THEIR IMPLICATIONS 9

Urban Development Authorities Acts, Right to Fair Compensation and Transparency in Land Acquisition and Rehabilitation and Resettlement Act, 2013, Housing Acts including Slum Housing, Acts related to the Environment, Rent Control Acts, Law relating Water Supply and Sewerage, Electricity, Registration, Parks, Play Fields and Open Spaces, Places of Public Resorts.

MODULE IV DEVELOPMENT REGULATIONS AND BUILDING RULES AND THEIR ENFORCEMENT 9

Development Regulations — Zoning Laws, Layout and Building Rules in Municipal Corporations, Municipalities, Town and Village Panchayats — Legal Mechanism for enforcement, their coordination and the way forward – Case Studies – Regulations for Ribbon Development, Arbitration, Accommodation Reservation, Transfer of Development Rights, Land Pooling

MODULE V PROFESSIONAL PRACTICE, CODE OF CONDUCT 9

Multiple tasks of Planners in the planning and Development Process of Cities and regions in public and private sectors – Expression of interests, Terms of Reference for different practice and charges – career options and prospects – Professional ethics and code of conduct – Role of Professional Institutions at the National and international level in the promotion of the profession.

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Ministry of Rural Development, Government of India, 'Right to Fair Compensation and Transparency in Land Acquisition and Rehabilitation and Resettlement Act 2013.
2. The Government of India, The Electricity Act, 2003.

REFERENCES:

1. Development Regulations, 2013, Second Master Plan for Chennai Metropolitan Planning Area, Volume II, Chennai Metropolitan Development Authority.
2. Patsy Healey, Robert Upton, 'Crossing Borders: International Exchange and Planning Practices' Routledge,2014

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: acquire Knowledge in various Acts/Laws relating to spatial planning.

CO2: deal with urban and regional planning issues within the framework of human rights and environmental protection.

CO3: apply the law in Professional practices

CO4: acquire knowledge on zoning regulations and building rule

CO5: orient planning rules and regulations toward the growth of the town in an orderly manner

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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 planning rules and regulation will have sustainable cities.

CEEY 253	RURAL INFRASTRUCTURE PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: the scope and nature of rural planning

COB2: the design components of a various rural infrastructure.

COB3: the various types of rural development programmes

COB4: challenges in rural infrastructure

COB 5: the various rural development case studies

MODULE I INTRODUCTION 9

Decentralised planning in India – concept of panchayat raj and hierarchical arrangements - Gandhian and Nehruvian visions – top-down and bottom approaches – trickle down process - Recent amendments and decentralized governance - 73rd and 74th constitutional amendment acts – implication in regional and rural planning – status of local self-government bodies - Participative district planning - role of Planning Commission & Finance Commissions.

MODULE II CHALLENGES OF RURAL AREAS 9

Rural Poverty – factors and processes – social and economic dimensions Rural urban linkages – dichotomy or symbiosis- Rural urban divide in terms of infrastructure facilities- Challenges faced by rural areas –economic, social, environmental, fiscal.

MODULE III RURAL DEVELOPMENT PROGRAMMES 9

Five Year Plans and rural development – globalization and shifting emphasis of planning from rural-centric to urban-centric - various approaches and perspectives towards rural development and planning – village development plan - Programmes/Policies/Schemes for rural development, their coverage and outcomes – investments, revenue and expenditure – funding from various bodies like centre, state and district - Rural Infrastructure Development - Bharat Nirman – A business plan for rural infrastructure, Rural Building Centers, PMGSY, IAY, Rajiv Gandhi Technology Mission, Central Rural Sanitation Programme, PURA, Asha Programme for rural health, ICDS for rural and tribal health, etc - Rural Employment Schemes - Mahatma Gandhi National Rural Employment Guarantee Act 2005, Sampoorna Grameen Yojana, National Food for work programme, Swarna Jayanty Gram Swarozgaryojana, National Social Assistance Programme Command Area Programme, Drought Prone Area

Programme, Backward Area Development Programme, North Eastern Development Programme.

MODULE IV CHALLENGES OF INTEGRATED RURAL PLANNING 9

Rapid pace of urbanization and changing profile of rural and peri-urban areas – land transactions – loss of agricultural lands – changing work profile, loss of livelihoods and associated challenges - land conversions and its regulation/facilitation in peri-urban areas - Various Issue in integrated planning – nature of investments in rural areas – productive and nonproductive – market economy and status of agriculture – socio-cultural stratifications and issues of participatory governance – politics of resources and urban dichotomy – placements of rural areas vis-à-vis urban – exploitative regime

MODULE V RURAL DEVELOPMENT EXPERIENCES 9

Rural Development experiences of some Asian Countries – China, Malaysia, Sri Lanka, Bangladesh.

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Katar Singh “,Rural Development: Principles, Policies and Management” SAGE Texts,2008
2. Dr.V. Nath.”Rural Development And Planning In India”, Concept publishing company , 2010

REFERENCES:

1. J. Christopher and A. Thomas William, “Rural Development: Concept and Recent Approaches” Hardcover2011
2. Tahir Hussain , Mary Tahir , Riya Tahir , “Fundamentals of Rural development “ I.K. International publishing house2017.
3. Srijeet Banerjee, “ Issues on Rural Finance, Infrastructure and Rural Development”, Abhijeet Publications 2010.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: understand the concept of rural planning

CO2: examine interrelations and interdependencies between communities and micro-regions

CO3: know about the various rural development programmes

CO4: understand the challenges of integrated rural planning

CO5: execute the best practice of rural planning

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

The holistic understanding of rural development will have a sustainable rural development.

CEEY 254	CHARACTERIZATION OF CONSTRUCTION MATERIALS	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: Characterization of construction materials
COB2: X Ray diffraction technique.
COB3: Thermal analysis to study construction materials and surface area measurement
COB4: Optical and Scanning Microscopy
COB 5: Characterization techniques to assess composite binder with limestone-calcined clay

MODULE I INTRODUCTION **9**

An Introduction; Structure of Construction Materials: An Overview; Calorimetry: Introduction and types of Calorimeters, Calorimetry: Sample preparation, Practical note and Heat of hydration, Calorimetry: Applications of calorimetry.

MODULE II X RAY DIFFRACTION **9**

Introduction to X Rays and crystallography, X Ray diffraction: Crystal systems and History of XRD, X Ray diffraction: Diffractogram, X Ray diffraction: Diffractogram – Calculations; X Ray Diffraction: Qualitative Phase Analysis, X Ray Diffraction: Sample Preparation and Application in study of cements

MODULE III THERMAL ANALYSIS, APPLICATION OF THERMAL ANALYSIS TO STUDY CONSTRUCTION MATERIALS, SURFACE AREA MEASUREMENT: **9**

Sampling and particle size distribution, Surface Area Measurement: Different techniques, Surface Area Measurement: calculation and applications, Porosity and pore structure - Introduction, significance of pore distribution, Porosity and pore structure - Working of mercury intrusion porosimeter.

MODULE IV OPTICAL AND SCANNING MICROSCOPY **9**

Introduction and specimen preparation, Optical and Scanning Microscopy- Features and functions, Types of optical microscopy, scanning electron microscope Part 1- Parts and Functioning; Scanning electron microscope Part 2- Working Principles; Scanning electron microscope Part 3 - Analysis of cementitious systems

MODULE V APPLICATION OF CHARACTERISATION TECHNIQUES TO ASSESS COMPOSITE BINDER **9**

Image analysis - Introduction and image mapping, Image analysis - Basic operations, Spectroscopy Techniques; Electrical Impedance analysis - Principle and different methods, Electrical Impedance analysis - Deliverables and Interpretation, Electrochemical testing (Corrosion) using Electrochemical Impedance Spectroscopy (EIS)

L – 45 TOTAL HOURS –45

REFERENCES:

1. "Materials Characterization Techniques" ,Sam Zhang et al, CRC Press, 2009
2. Yang Leng, "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods" Wiley, 2020

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: Characterize various Construction Materials.

CO2: prepare sample and study the cements using X Ray diffraction technique.

CO3: perform thermal analysis study of construction materials, surface area Measurement.

CO4: prepare specimen and analyse the cementitious systems using Optical and Scanning Microscopy

CO5: characterize techniques to assess composite binder with limestone-calcined clay using spectroscopy.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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

CEEY 255 SUSTAINABLE CONSTRUCTION L T P C

3 0 0 3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: about sustainable construction

COB2: the concepts of sustainable materials

COB3: energy calculations methods,

COB4: green buildings concepts

COB 5: sustainable environmental effects in construction

MODULE I INTRODUCTION 9

Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - Carbon dioxide (CO_2) contribution from cement and other construction materials.

MODULE II MATERIALS USED IN SUSTAINABLE CONSTRUCTION 9

Construction materials and indoor air quality - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Life cycle and sustainability.

MODULE III ENERGY CALCULATIONS 9

Components of embodied energy - calculation of embodied energy for construction materials - Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use

MODULE IV GREEN BUILDINGS 9

Control of energy use in building - ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations – Features of LEED and TERI – Griha ratings - Role of insulation and thermal properties of construction materials - influence of moisture content and modeling - Performance ratings of green buildings - Zero energy building

MODULE V ENVIRONMENTAL EFFECTS 9

Non-renewable sources of energy and Environmental aspects – energy norm, coal, oil, natural gas - Nuclear energy - Global temperature, Green house effects, global warming - Acid rain: Causes, effects and control methods - Regional impacts of temperature change.

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Kibert C.J., John, Sustainable Construction Green Building Design and Delivery, Wiley, 2022

REFERENCES:

1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4th Edition, Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell, UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2012.
5. New Building Materials and Construction World magazine, 2021

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: describe the various sustainable materials used in construction.

CO2: explain the method of estimating the amount of energy required for building.

CO3: describe the features of LEED, TERI and GRIHA ratings of buildings.

CO4: explore the concept and performance of zero-energy buildings.

CO5: select less carbon emission materials for construction.

Board of Studies (BoS) : **17th BoS of Civil held on 10.08.2022**

Academic Council: **19th AC held on 29.09.2022**

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

To ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums

CEEY 256	SHORING, SCAFFOLDING AND FORMWORK	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: planning of formwork, plant and site equipment's required for formwork.

COB2: design of forms for various elements such as slabs, beams, columns, walls, shells and tunnels.

COB3: advanced methods of form construction.

COB4: erection of forms for various elements such as slabs, beams, columns, walls, shells and tunnels.

COB 5: erection of forms domes and tunnels

MODULE I PLANNING, SITE EQUIPMENT & PLANT FOR FORM WORK **9**

Introduction - Forms for foundations, columns, beams walls etc., General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples. Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programmes - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork - Formwork accessories.

MODULE II MATERIALS ACCESSORIES, PROPRIETARY PRODUCTS & PRESSURES **9**

Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel - Aluminum - Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.

MODULE III DESIGN OF FORMS AND SHORES **9**

Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Allowable load vs. length behaviour of wood shores - Form lining Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props - Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.

MODULE IV BUILDING AND ERECTING THE FORM WORK 9

Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

MODULE V FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SCAFFOLDS 9

Hemispherical, Parabolic, Translational shells - Typical barrel vaults Folded plate roof details - Forms for Thin Shell roof slabs design considerations - Building the forms - Placing concrete - Form removed -Strength requirements -Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method - Form construction - Shafts. Slip Forms - Principles -Types - advantages - Functions of various components - Planning -Desirable characteristics of concrete - Common problems faced - Safety in slip forms special structures built with slip form Technique - Types of scaffolds - Putlog and independent scaffold -Single pole scaffolds - Truss suspended - Gantry and system scaffolds.

L – 45 TOTAL HOURS –45

REFERENCES:

1. Austin, C.K., “Formwork for Concrete”, Cleaver -Hume Press Ltd., London, 2006
2. Hurd, M.K., “Formwork for Concrete”, Special Publication No.4, American Concrete Institute, Detroit, 2003
3. Robert L. Peurifoy and Garold D. Oberlender, “Formwork for Concrete Structures”, McGraw- Hill, 2006
4. Kumar Neeraj Jha, “Formwork for Concrete Structures”, 2017

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: explain planning of formwork, plant and site equipment.

CO2: select material accessories for formwork connection and analyze pressures on formworks.

CO3: design the forms and shores

CO4: apply the knowledge of erecting forms for beams, slabs, columns, walls and causes of failures.

CO5: apply the knowledge of forms and its erection for domes and tunnels, types of slip forms and scaffolds.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

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

The holistic understanding of scaffoldings and its design leads to development of sustainable buildings

CEEY 257	RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: various resources involved in construction.

COB2: the effect of manpower planning.

COB3: the regulations for manpower management.

COB4: material procurement.

COB 5: tools for inventory management.

MODULE I INTRODUCTION TO RESOURCE PLANNING 9

Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

MODULE II MANPOWER PLANNING 9

Manpower planning, organizing, staffing, directing, and controlling - measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.

MODULE III HUMAN PSYCHOLOGY AND REGULATORY REQUIREMENTS 9

Introduction to the field of people management - basic individual psychology; motivation - job design and performance management - managing groups at work - self-managing work teams – Compensation – GPF – EPF – group insurance – housing - pension – laws related to welfare measures.

MODULE IV MATERIAL PROCUREMENT 9

Material purchasing– planning purchasing materials – norms of vendor rating – material selection and development – purchasing procedures and methods – sources of supply – out sourcing material management- procurement organization - procurement planning.

MODULE V INVENTORY MANAGEMENT 9

Inventory control - terms and definitions - types of inventory -EOQ - Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution - reasons for maintaining inventory - different tools for inventory.

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Chitkara, K.K., "Construction Project Management, Planning, Scheduling and Control", Tata McGraw-Hill Publishing Co., New Delhi, 2000.

REFERENCES:

1. Richard J. Tersine, "Modern Materials Management", John Hardin Campbell – 2007
2. Halpin, D.W., "Financial and Cost Concepts for Construction Management", John Wiley and Sons, New York, 2000.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1 : know about resource planning and management.

CO2: classify and explain various man power resources required in construction industry.

CO3 : analyze the regulations of manpower management.

CO4 : choose the source of supply of materials.

CO5 : apply the various tools of material management.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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

SDG 12: Securing a responsible production and consumption

The holistic understanding of Energy optimization through resource minimization techniques and processes.

CEEY 258	ENERGY CONSERVATION TECHNIQUES IN BUILDING CONSTRUCTION	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: the concept of design of energy conservation buildings

COB2: passive solar heating and cooling

COB3: design the day lighting and electrical lighting systems

COB4: heat control and ventilation for thermal building

COB 5:design the various climatic zones

MODULE I INTRODUCTION 9

Energy required for building construction - heat transfer – measuring conduction – thermal storage – measurement of radiation – the green house effect – psychometric chart – measuring latent and sensible heat. thermal comfort – site planning and development – temperature – humidity – wind – optimum site location sun protection –types of shading devices – conservation – heating and cooling loads - IGBC rating systems - sustainable sights - water efficiency - energy efficiency - materials and resources - indoor environmental quality.

MODULE II PASSIVE SOLAR HEATING AND COOLING 9

General principles of passive solar heating – key design elements - direct gain trombe walls, water walls, convective air loops – concepts – case studies – general principles of passive cooling – ventilation – predicting ventilation in building-window ventilation calculations - radiation – evaporation and dehumidification–mass effect– load control – air filtration and odor removal – heat recovery in large buildings

MODULE III DAYLIGHTING AND ELECTRICAL LIGHTING 9

Materials, components and details - insulation – optical materials – radiant barriers glazing materials - day lighting – sources and concepts – building design strategies – case studies – electric lighting –light distribution – electric lighting control for day lighted buildings – illumination requirement – components of daylight factor – recommended daylight factors – day lighting analysis – supplementary artificial lighting design

MODULE IV HEAT CONTROL AND VENTILATION 9

Requirements – heat transmission through building sections – thermal performance of building sections – orientation of buildings – building

characteristics for various climates – thermal design of buildings influence of design parameters – mechanical controls – examples. Ventilation – requirements – minimum standards for ventilation – ventilation design – energy conservation in ventilating systems – design for natural ventilation.

MODULE V DESIGN FOR CLIMATIC ZONES 9

Energy efficiency – an overview of design concepts and architectural interventions– energy efficient buildings for various zones – cold and cloudy – cold and sunny – composite – hot and dry – moderate – warm and humid – case studies of residences, office buildings and other buildings in each zones – energy audit –certification.

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Paul Tymkow, Savvas Tassou, Maria Kolokotroni, Hussam Jouhara, Building Services Design for Energy Efficient Buildings, Taylor and francis, 2021

REFERENCES:

1. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 2013
2. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2017.
3. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 2016
4. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2009.
5. Moore, F., Environmental Control System, McGraw Hill Inc. 2002.
6. Tyagi, A.K. (Ed). Handbook on Energy Audits and Management Tata Energy Research Institute, 2010.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: identify the required energy for building construction.

CO2: design and analyse the passive solar cooling and heating technique.

CO3: identify the required amount of daylight and electrical lighting for a building.

CO4: analyse the ventilation and thermal design of a building.

CO5: design a specific type of building for special climatic zones.

Board of Studies (BoS) :
17th BoS of Civil held on 10.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	L	L	M	-	-	L	-	L	-	-	-	-	L	L	L
CO2	L	L	M	-	-	L	-	L	-	-	-	-	-	M	-
CO3	L	L	M	-	-	-	-	L	-	-	-	-	-	M	-
CO4	L	L	M	-	-	L	-	L	-	-	-	-	-	M	-
CO5	L	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 holistic understanding of modern energy conservation construction techniques leads to development of energy efficient buildings

CEEY 259 **VALUE ENGINEERING** **L T P C**

3 0 0 3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: importance of value engineering, creative thinking and life cycle costing

COB2: taxes, insurance and calculation of depreciation

COB3: various methods of valuation

COB4: methods of land valuation

COB 5: property rights and liabilities valuation of real properties

MODULE I VALUE ENGINEERING 9

Introduction and background of value Engineering. Hurdles in value Engineering. Value Engineering Job Plan. Functional Analysis. Creative thinking, Cost modeling, Life cycle costing, Project work, Worksheets, Guidelines, Checklists. Value Engineering Case studies.

MODULE II PURPOSE OF VALUATION 9

Municipal & Govt. Taxes, insurance, Loss of rent, collection charges, sinking fund, Annual repairs & maintenance. Depreciation. Methods of calculation of depreciation. Different forms of values.

MODULE III METHODS OF VALUATION 9

Open land valuation, Factors affecting intrinsic values of land, Comparative method, Abstractive method, Belting method.

MODULE IV VALUATION OF LAND WITH BUILDINGS 9

Rental method, Land and building method, Valuation on profit basis, Direct comparison of capital value, Residual or Development method. Valuation of agricultural farm lands

MODULE V PROPERTIES RIGHTS AND MARKET VALUE 9

Self-imposed, legally created, Dominant and Servient Heritage Effect of easements on valuation. Real Estate market and market value, fair market value, open market value, affecting parameters. Valuation of real properties

L – 45 TOTAL HOURS –45

TEXT BOOKS:

1. Christopher .J and A. Thomas William, “Rural Development: Concept and Recent Approaches”, 2011

2. Katar Singh,"Rural Development: Principles, Policies and Management" SAGE Texts,2016

REFERENCES:

1. Nath.V "Rural Development And Planning In India", Concept publishing company , 2010
2. Srijeet Banerjee Issues on Rural Finance, Infrastructure and Rural Development, Abhijeet Publications, 2010
3. Tahir Hussain , Mary Tahir , Riya Tahir , "Fundamentals of Rural development " I.K. International publishing house2017

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: understand the complete knowledge background about value engineering

CO2: workout the depreciation, sinking and maintenance cost for a property

CO3: apply various methods of valuation

CO4: understand the importance of property right and its liability

CO5: distinguish different market value and workout the cost of a real property.

Board of Studies (BoS) : **17th BoS of Civil held on 10.08.2022**

Academic Council: **19th AC held on 29.09.2022**

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

The holistic understanding of valuation and value engineering will help in the usage of resources sustainably.

CEEY 260	CONSTRUCTION DEMOLITION AND WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: waste Generation in construction

COB2: treatment on demolition waste

COB3: processing of demolition waste

COB4: tools used for waste estimation

COB 5: environment degradation due to waste

MODULE I INTRODUCTION 9

Environmental Impact of Building Materials Embodied energy of materials; impact on the local environment; toxicity of the material; Nature and Source Direct and indirect waste; site types and origins; composition; quantity; current recycling/reuse potential of building materials - C & D waste – definition, applicability and waste generating activities – Quantity of Waste generated- Quantifying C & D Waste – Composition – C & D Waste Utilization – Initiatives to promote recycling of C & D waste in India – Codal Provisions

MODULE II WASTE MANAGEMENT 9

Construction and Demolition Waste Management Plans International good practice; planning requirements; demolition plans; site implementation; supplier agreements; sub−contractor management; role of waste management contractor; training; auditing; current markets; current disposal options; health and safety; reporting to local authorities. Hierarchy in waste management - Treatment of Construction and Demolition Waste, waste permits; waste licenses; waste transfer facilities; landfills; treatment technologies; hazardous waste facilities

MODULE III WASTE PROCESSING 9

Designing for Waste Prevention and Minimisation Waste prevention and minimization; client, contractor and designer attitudes; proper maintenance of existing buildings; reuse of existing building structure; design flexibility; design for reuse and recycling; Recycling – Process involved – Centralised/ Decentralised –Barriers - dimensional co−ordination and standardization; modular design; material selection and control.

MODULE IV WASTE FORECASTING TOOL 9

Waste Forecasting Tools Application of WRAP's designing out waste tool for buildings and civil engineering; WRAP net waste tool; BRE SMART Waste; WRAP Site Waste Management Plan Tracker

MODULE V ENVIRONMENTAL DEGRADATION 9

Environmental degradation due to indiscriminate disposal of C & D wastes in cities - Effective C & D Waste Management – Opportunities for resource conservation & employment generation - Dust Generation – Dust Mitigation - Future developments Potential future markets; 'smart' materials; use of eco−materials – Case Studies

L – 45 TOTAL HOURS – 45

TEXTBOOKS:

1. Greg Winkler, "Recycling Construction and Demolition waste: A LEED-Base Toolkit, Mc Grew Hill Professional,2010
2. Springer, "Recycling and Resource Recovery Engineering", Springer-Verlag Berlin Heidelberg (1996)

REFERENCES:

1. Tam.V.M, Chi Ming Tam, "Reuse of Construction and Demolition Waste in Housing Development", Nova Science Publishers, 2008.

COURSE OUTCOMES: On completion of the course, students will be able to

CO1: quantify the construction and demolition waste

CO2: select the type of treatment to be executed

CO3: minimize the waste using different methods

CO4: apply Tools for waste management

CO5: recognize the degradation of environment.

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

The understanding of demolition and waste management will enhance the quantity of construction materials recycled and reused and will lead to sustainable development.

CEEY 261	AUTOMATION IN CONSTRUCTION	L	T	P	C
		3	0	0	3

SDG: 11

COURSE OBJECTIVES: The course will impart knowledge on

COB1: the application of automation and use of robots in construction.

COB2: Computer applications and material processing.

COB3: HVAC and fire safety measures as per NBC code.

COB4: 3D printing in construction

COB 5: Site automation and robotics

MODULE I INTRODUCTION 9

Concept and application of Automation, requirements and design considerations and its effect on functional efficiency of building automation system- Review and analysis of state- of –art in construction automation – current scenario

MODULE II OFF AND ON SITE AUTOMATION IN CONSTRUCTION 9

Off- site automation in construction Information processing (computer applications), materials processing , case study (concrete batch plant) - Existing and prototype equipment for construction – Cranes – Tunnel Boring Machines - case study (concrete placement and finishing), final product design session

MODULE III BUILDING AUTOMATION 9

Introduction to building automation systems – components – Heating, ventilation, and air conditioning (HVAC) – Lighting – Electrical systems water supply and sanitary systems– Fire safety – security -Communication and office automation system -Water pump monitoring & control - Control of Computerized HVAC Systems

MODULE IV 3 D PRINTING 9

3D printing Introduction – process - Types of 3 D Printing - Contour crafting - Concrete printing - Selective binding and Binder jetting / D- shape - Printable Materials - Major Structures by 3D Printing - Current Challenges

MODULE V ROBOTICS IN CONSTRUCTION 9

Automation and robotic technologies for customized component, module and building prefabrication- Elementary technologies and single – Task construction robots - Site automation- robotic on site factories **-** Selecting

robot- Activated concrete cutting robot, concrete floor finishing robot- Ceiling panel positioning robot- Exterior wall painting robot-safety and training- case studies

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 the course, students will be able to

CO1: illustrate the application of building management system and automation on and off site projects.

CO2: Solve the construction issues through robotic techniques.

CO3: Analyse the application of fire installation and HVAC using the NBC code

CO4: elaborate on the methods of 3D printing

CO5: measure the application of robotics in civil construction

Board of Studies (BoS) : **Academic Council:**

17th BoS of Civil held on 10.08.2022 **19th AC held on 29.09.2022**

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

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

OPEN ELECTIVE COURSES

OEEY 701	**ANALYTICAL TECHNIQUES**	**L**	**T**	**P**	**C**
SDG: 6, 7		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

To make the students to understand the

COB1: basics in data analysis

COB2: basics and principles in volumetric and gravimetric analysis

COB3: types and principles of electro analytical methods

COB4: principles and analysis of spectroscopic techniques

COB5: the principle and methods in chromatography and thermal analysis

MODULE I DATA ANALYSIS 9

Precision and accuracy, Classification of errors, methods of minimization and elimination of errors Mean and standard deviation; absolute and relative errors; students t-test, F-test, linear regression for deriving calibration plots, covariance and correlation coefficient

Statistics for analytical experimentation: Probability, Regression analysis, Data analysis and signal enhancement.

MODULE II VOLUMETRIC METHODS OF ANALYSIS 9

Different methods of expressing concentration terms, Difference between titrimetic and volumetric analysis, Types and roles of indicators - Principle and reactions involved in neutralization, precipitation, complexometric and redox titrations, calculations involving stoichiometry – for all types of systems - Gravimetric analysis (volatilisation and precipitation methods)

MODULE III ELECTROANALYTICAL METHODS 9

Types of electrodes - Conductometric Titrations - Potentiometric titrations - pH-metry and ion-selective electrodes - Amperometric titrations - Coulometric Titrations, DM Electrode - polarography - electrogravimetry - voltammetry, cyclic voltammetry, impedance studies - Electrochemical sensors, ISFETs, CHEMFETs.

MODULE IV SPECTROPHOTOMETRIC TECHNIQUES 9

Quantitative applications of Colorimetric analysis – UV-Visible spectrophotometry – *Atomic absorption spectroscopy* (*AAS*) - atomic emission spectroscopy (AES), *Flame photometry*, ICP-AES - Fluorescence

spectroscopy, Stern Volmer Equation and quantum yield calculation.

MODULE V CHROMATOGRAPHIC TECHNIQUES AND THERMAL METHODS 9

Chromatography**:** Paper, TLC and column Chromatography – Detectors in Chromatography - GC, HPLC, (hyphenated techniques GC/MS, LC/MS) and GPC -– ion exchange chromatography – Electrochromatography**:** Capillary electrophoresis and gel electrophoresis

Thermal analytical techniques: TGA, DTA, DSC, DMA – Chemisorption Techniques – TPD, TPO, TPR, TPS.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
3. Skoog D.A., Holler F.J. and Nieman T.A., Principles of Instrumental Analysis, 5th Edition, Harcourt College Publication., Singapore, 1998.
4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

COURSE OUTCOMES:

The student will be able to

CO1: analyse the numerical data without error

CO2: perform the volumetric and gravimetric analysis of chemical compounds and interpret the result

CO3: perform the electro analytical titrations and analyse the result

CO4: identify the appropriate spectral technique and do the spectral analysis and interpret the data

CO5: perform the chromatographic techniques and separate the compounds

Board of Studies (BoS):
12th BoS of Chemistry held on 22.07.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG 6: Clean Water & Sanitation
SDG 7: Affordable and Clean Energy

Statement: Through various analytical methods, innovative, cheap and affordable materials can be developed and can be employed in the area of clean water, sanitation and energy

OEEY 702 ARTIFICIAL INTELLIGENCE AND IOT L T P C

SDG: 8 3 0 0 3

COURSE OBJECTIVES:

COB1: To learn the working of intelligent agents.

COB2: To study the various search techniques and optimization of search.

COB3: To represent knowledge in first order logic**.**

COB4: To know the fundamentals of IoT.

COB5: To learn the IoT architecture and protocol stack.

MODULE I ARTIFICIAL INTELLIGENCE INTRODUCTION 9

Artificial Intelligence Foundations - Artificial Intelligence History - Agents and Environments - Structure of Agents - Problem-Solving Agents - Search Algorithms - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Heuristic Functions.

MODULE II SEARCH OPTIMIZATIONS 9

Local Search and Optimization Problem - Continuous Spaces - Nondeterministic Actions - Partially Observable Environments - Online Search Agents and Unknown Environments - Constraint Satisfaction Problems – Backtracking Search – Adversarial Search and Games - Alpha Beta Search.

MODULE III KNOWLEDGE REPRESENTATION 9

Knowledge Based Agents – Propositional Logic – First Order Logic – Inference in First Order Logic – Forward Chaining – Backward Chaining.

MODULE IV IOT FUNDAMENTALS 9

Fundamentals of IoT – Characteristics of IoT – IoT architecture and Components – Logical Design of IoT – Communication Models – IoT Communication APIs.

MODULE V IOT ARCHITECTURE AND PROTOCOLS 9

Structure – Objectives – Three layer and Five Layer Architecture – Cloud and Fog based Architecture – IoT Network Protocol Stack - IoT Technology Stack – Case Study – Applications of AI in IoT.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, Fourth Edition, 2020. ISBN: 978-0134610993.

2. Dr Kamlesh Lakhwani, Dr Hemant Kumar Gianey, Joseph Kofi Wireko, Kamal Kant Hiran, Internet of Things (IoT): Principles, Paradigms and Applications of IoT, BPB Publications, First Edition, 2020, ISBN: ISBN: 978-9389423365.

REFERENCES:

1. S. Kanimozhi Suguna, M. Dhivya, Sara Paiva, Artificial Intelligence (AI): Recent Trends and Applications, CRC Press, 2021, ISBN: 978-0-367-43136-5.
2. Vlasios Tsiatsis, Stamatis Karnouskos, Jan, Internet of Things: Technologies and Applications for a New Age of Intelligence, 2nd Edition, Academic Press, 2019, ISBN: 978-0-12-814435-0

COURSE OUTCOMES: The student will be able to

- Identify the suitable search algorithms for solving problems.
- Employ AI adversarial game search techniques while evaluating the application of more real world problems.
- Use first order logic for wide variety of applications, from planning and diagnosis to knowledge representation and reasoning.
- Apply the technologies, standards, and protocols that are best suited for low-level sensor nodes.
- Determine the most appropriate IoT Devices and Sensors based on case Studies.

Board of Studies (BoS) : 21st BoS of CSE held on 27.02.2023

Academic Council: 20th AC 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	PO11	PO 12	PSO 1	PSO 2
CO1	H	M	H	L	M	-	L	-	-	L	-	M	H	M
CO2	H	H	H	L	M	-	L	-	-	L	-	H	M	H
CO3	H	H	H	L	L	-	-	-	-	L	-	L	M	H
CO4	H	M	H	L	L	-	-	-	-	-	-	M	M	H
CO5	H	H	H	L	L	-	-	-	M	-	M	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.

Statement: The objective of AIoT is to improve human-machine interactions, IoT operations and data management and analytics.

OEEY 703	BIOMATERIALS	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To enable the students understand importance of and properties of Biomaterials

COB2: To familiarize the students with different orthopaedic materials.

COB3: To understand different cardiovascular materials.

COB4: To help students study about materials in opthalmology

COB5: To make the students understand applications of various biomaterials

MODULE I BIOLOGICAL PERFORMANCE OF MATERIALS 9

Biocompatibility- Introduction to the biological environment – Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – Host response: the inflammatory process - coagulation and hemolysis- approaches to thrombo- resistant materials development.

MODULE II ORTHOPAEDIC MATERIALS 9

Bone composition and properties - temporary fixation devices - joint replacement – Biomaterials used in bone and joint replacement: metals and alloys – Stainless steel, cobalt based alloys, titanium based materials – Ceramics: carbon, alumina, zirconia, bioactive calcium phosphates, bioglass and glass ceramics – polymers: PMMA, UHMWPE/HDPE, PTFE – Bone cement – Composites.

MODULE III CARDIOVASCULAR MATERIALS 9

Blood clotting – Blood rheology – Blood vessels – The heart – Aorta and valves – Geometry of blood circulation – The lungs - Vascular implants: vascular graft, cardiac valve prostheses, cardiac pacemakers – Blood substitutes – Extracorporeal blood circulation devices.

probability-internal conversion- nuclear isomerism.

MODULE IV DENTAL MATERIALS 9

Teeth composition and mechanical properties – Impression materials – Bases, liners and varnishes for cavities – Fillings and restoration materials – Materials for oral and maxillofacial surgery – Dental cements and dental amalgams – Dental adhesives.

MODULE V MATERIALS IN OPTHALMOLOGY 9

Biomaterials in ophthalmology – Viscoelastic solutions, contact lenses, intraocular lens materials – Tissue grafts – Skin grafts – Connective tissue grafts – Suture materials – Tissue adhesives – Drug delivery: methods and materials – Selection, performance and adhesion of polymeric encapsulants for implantable sensors-biomemtic materials-Technology from nature.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Sujata V. Bhat. Biomaterials, Narosa Publication House, New Delhi, 2002.
2. Jonathn Black. Biological Performance of Materials: Fundamentals of biocompatibility, Marcel Dekker Inc, New York, 1992.
3. D.F.Williams (editor). Materials Science and Technology: A comprehensive treatment, Volume 14. Medical and Dental Materials, VCH Publishers Inc, New York, 1992.
4. F.Silver and C.Doillon. Biocompatibility: Interactions of Biological and implantable materials. Volume I Polymers, VCH Publishers Inc, New York, 1989.
5. L.L.Hench and E.C.Ethridge. Biomaterials: An Interfacial Approach, Academic Press, 1982.
6. Joon Park, R. S. Lakes, Biomaterials. An Introduction, Springer, third edition, 2010. Springer

COURSE OUTCOMES:

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

CO1: importance and properties of biomaterial..

CO2: different classes of orthopaedic materials

CO3: different types of cardiovascular materials.

CO4: various types of materials used in ophthalmology.

CO5: applications of various biomaterials

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 30.6.22	19th AC held on 29.09.2022

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

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

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

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

OEEY 704	BIOMEDICAL INSTRUMENTATION	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the human physiological systems.

COB2: To know the different aspects of biosignal acquisition.

COB3: To understand the basics in biopotential recorders.

COB4: To know the importance methods, instruments available for biomedical field.

COB5: To analyze the special biomedical instrumentation systems.

MODULE I HUMAN PHYSIOLOGICAL SYSTEMS 9

Cells and their structure – Nature of Cancer cells – Transport of ions through the cell membrane – Resting and action potentials – Bio-electric potentials – Nerve tissues and organs – Different systems of human body. Biopotential Electrodes and Transducers Design of Medical instruments – components of the biomedical instrument system – Electrodes – Transducers.

MODULE II BIOSIGNAL ACQUISITION 9

Physiological signal amplifiers – Isolation amplifiers – Medical preamplifier design – Bridge amplifiers – Line driving amplifier – Current amplifier – Chopper amplifier – Biosignal analysis – Signal recovery and data acquisition – Drift Compensation in operational amplifier – Pattern recognition – Physiological Assist Devices. Pacemakers – Pacemakers batteries – Artificial heart valves – Defibrillators – nerve and muscle stimulators Heart – Lung machine – Kidney machine.

MODULE III BIOPOTENTIAL RECORDERS 9

Characteristics of the recording system – Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) – Electroethinogrphy (ERG) and Electroculography (EOG) – Recorders with high accuracy – recorders for OFF line analysis.

MODULE IV OPERATION THEATRE EQUIPMENT 9

urgical diathermy- shortwave diathermy – Microwave diathermy – Ultrasonic disathermy – Therapeutic effect of heat – Range and area of irritation of different techniques – Ventilators – Anesthesia machine – Blood flowmeter – Cardiac

Output measurements – Pulmonary function analyzers – Gas analyzers – Blood gas analyzers – Oximeters – Elements of intensive care monitoring.

MODULE V SPECIALISED MEDICAL EQUIPMENTS 9

Blood Cell counter – Electron microscope – Radiation detectors – Photometers and colorimeters – digital thermometer – audiometers – X-rays tube – X-ray machine – image intensifiers – Angiography – Application of X-ray examination. Safety instrumentation: Radiation safety instrumentation – Physiological effects due to 50Hz current passage – Microshock and macroshock – electrical accident Hospitals – Devices to protect against electrical hazards – Hospitals architecture.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Arumugam M., Biomedical Instrumentation, Anurada Agencies Publishers, 1992.
2. Khandpur R.S., Handbook of Biomedical Instrumentation, Third Edition, Tata McGraw-Hill Education, 2014.
3. Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation Systems, Cengage Learning Publisher, 2010.
4. Gromwell L., Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Second Edition, Prentice Hall, 1980.

COURSE OUTCOMES:

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

CO1: the human physiological systems.

CO2: the different aspects of biosignal acquisition.

CO3: different biopotential recorders such as EEG, ECG, EMG, EOG

CO4: biomedical instruments involved in advanced operation theatres

CO5: the application of biomaterials towards specialized medical equipment such as electron microscope and radiation detectors

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 30.6.22	19th AC held on 29.09.2022

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

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

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

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

OEEY 705	BIOPHOTONICS	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To know the role of light and its interaction in the cells and tissues.

COB2: To understand the different imaging techniques for the biological systems.

COB3: To know the concepts of spectroscopy in biological applications.

COB4: To understand the optical force spectroscopy.

COB5: To understand the role of Biophotonic materials in applications.

MODULE I INTERACTION OF LIGHT WITH BIOLOGICAL SYSTEMS **9**

Interaction of light with cells, tissues, nonlinear optical processes with intense laser beams, photo-induced effects in biological systems.

MODULE II IMAGING TECHNIQUES **9**

Imaging techniques: Light microscopy, wide-field, laser scanning - confocal, multiphoton, fluorescence lifetime imaging, FRET imaging - Frequency-Domain lifetime imaging. Cellular Imaging - Imaging of soft and hard tissues and other biological structures.

MODULE III SINGLE MOLECULE SPECTROSCOPY **9**

Single molecule spectroscopy: UV-VIS spectroscopy of biological systems, single molecule spectra and characteristics – IR and Raman spectroscopy and Surface Enhanced Raman Spectroscopy for single molecule applications.

MODULE IV OPTICAL FORCE SPECTROSCOPY **9**

Optical Force Spectroscopy: Generation optical forces – Optical trapping and manipulation of single molecules and cells in optical confinement - Laser trapping and dissection for biological systems - single molecule biophysics, DNA protein interactions.

MODULE V BIOSENSORS 9

Biosensors, Principles- DNA based biosensors – Protein based biosensors– materials for biosensor applications- fabrication of biosensors.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Prasad. P.N., Introduction to Biophotonics, John Wiley & Sons, 2003
2. Michael P. Sheetz, Laser Tweezers in Cell Biology (Methods in Cell Biology), Vol.55, Academic Press Publishers, 1997.
3. Ranier .W, Nanoelectronics and Information Technology, Wiley Publishers, 2012.
4. Drexler. K.E., Nanosystems: Molecular Machinery, Manufacturing and Computation, Wiley Publishers, 1992.

COURSE OUTCOMES:

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

CO1: Make clear insights into the applications of light interaction with biological systems.

CO2: Compare different imaging techniques

CO3: Understand and analyse the various spectroscopic techniques used in biological system.

CO4: Effectively grasp the usage of the optical force spectroscopy.

CO5: Get clear ideas and communicate about the importance of use of spectroscopy in design of bio-photonic devices.

Board of Studies (BoS) : BOS of Physics was held on 30.6.22

Academic Council: 19th AC held on 29.09.2022

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

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

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

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

OEEY 706	DATA SCIENCE AND MACHINE LEARNING	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

CO1: To understand the needs of machine learning in Real Time.

CO2: To acquire knowledge about the data science in machine learning.

CO3: To study the Monte Carlo Sampling and processing.

CO4: To explore knowledge about real-time data analysis using various models.

CO5: To understand the deep learning.

MODULE I INTRODUCTION 9

Introduction to Artificial Intelligence - Machine Learning – Types of Machine Learning - Data preprocessing - Noise Removal - Data Transformation - Normalization - Importing, Summarizingand Visualizing Data – Statistics-Visualizing Data-Plotting Qualitative Variables and Quantitative Variables- Data Visualization in a Bivariate Setting

MODULE II MACHINE LEARNING ALGORITHMS 9

Introduction to Supervised and Unsupervised Learning-Linear Regression - Single Variable – Multivariate –Logistic - Naive Bayes - Decision Tree - Neural Network -Single Layer Perceptron - Multilayer BPN- Training and Test Loss-Statistical Learning-Estimating Risk-Modeling Data-Multivariate Normal Models-Bayesian Learning

MODULE III SAMPLING AND UNSUPERVISED LEARNING 9

Unsupervised Learning Algorithm -Clustering - Monte Carlo Sampling-Resampling-Markov Chain Monte Carlo-Monte Carlo Estimation-Monte Carlo for Optimization-Simulated Annealing – Cross-Entropy Method-Splitting for Optimization -Noisy Optimization-Risk and Loss in Unsupervised Learning – Expectation-Maximization (EM) Algorithm-EM Algorithm for Mixture Models-K-Means – KNN - Hierarchical

MODULE IV REGRESSION ANALYSIS AND REGULARIZATION 9

Linear Regression-Analysis via Linear Models-Model Selection and Prediction – Cross-Validation and Predictive Residual Sum of Squares-In-Sample Risk and Akaike Information Criterion-Inference for Normal Linear Models -Nonlinear Regression Models-Modeling Regularization-Reproducing Kernel Hilbert Spaces- Smoothing Cubic Splines- Gaussian Process Regression - Graphical Models - Bayesian Networks

MODULE V ADVANCED LEARNING 9

Semi-supervisory Learning - Reinforcement Learning Algorithm – Feed-Forward Neural Networks -Back-Propagation – QLearning-Methods for Training- Steepest

Descent- Levenberg–Marquardt Method - Limited-Memory BFGS Method- Adaptive Gradient Methods-Simple Polynomial Regression -Image Classification

L – 45 ; TOTAL HOURS – 45

REFERENCES:

1. Alex Smola, S.V.N. Vishwanathan, Introduction to Machine Learning, Cambridge University Press, 2008.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Second Edition, Chapman & Hall/CRC, 2014.
3. Kroese, Dirk P., et al. Data science and machine learning: mathematical and statistical methods. Chapman and Hall/CRC, 2019.

COURSE OUTCOMES:

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

CO1: pre process the data

CO2: identify the suitable machine learning algorithm and apply the same to solve the given problem.

CO3: explain risk analysis and optimization algorithms.

CO4: apply the suitable regression method and regularization of data.

CO5: explore the applications of advanced learning.

Board of Studies (BoS):	**Academic Council:**
17th BoS of IT held on 28.02.2023	20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5
CO1	M	L			L
CO2	M	L		M	
CO3	L	L	L		L
CO4	M	L	L	H	
CO5	L	H	L		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.

Statement: The Learning algorithms helps to design and develop solutions for solving real world application in any engineering domain.

OEEY 707	ELECTRIC VEHICLE AND BATTERY STORAGE TECHNOLOGY	L	T	P	C
SDG:8,9		3	0	0	3

COURSE OBJECTIVES:

COB 1: To study the concept of electric vehicles

COB2: To get familiarized with EV and PHEV Energy Storage Systems

COB3: To learn the basics of various electric drive trains

COB4: To study about sensors and electric vehicle control

COB5: To study about electric vehicle and its environmental impact.

MODULE I INTRODUCTION TO ELECTRIC VEHICLE (EV) 9

A Brief History -Technology, benefits and challenges in comparison with IC engine - EV classification and electrification levels - degree of hybridization - Concept of Hybrid Electric Vehicle (HEV) – Working Principle of an HEV drive train - concept of electric, hybrid electric and plug-in hybrid electric vehicles – HEV drive train topologies - plug-in HEV drive train topologies.

MODULE II EV AND PHEV ENERGY STORAGE SYSTEMS 8

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 FUEL CELL AND HYBRID ELECTRIC VEHICLE DRIVE TRAIN 10

Component Stage Based Efficiency Analysis of Series and Parallel HEV Drive Trains - Varied Driving Patterns and Regenerative Braking Efficiency Analysis - Overall Electric Drive Train Efficiency Analysis - Fuel Cell HEV: Modeling and Control - Power Electronics Interface of Fuel Cell and Traction System - Concept of Fuel Cell Plug-in HEV (FC-PHEV).

MODULE IV SENSORS AND VEHICLE CONTROL 11

Introduction, Basic Sensor Arrangement, Types of Sensors, Oxygen Sensor, Cranking Sensor, Position Sensor, Engine Oil Pressure Sensor, Linear and Angle Sensor, Flow Sensor, Temperature and Humidity Sensor, Gas Sensor, Speed and Acceleration Sensor, Knock Sensor, Torque Sensor, Yaw Rate Sensors, Tire Pressure Sensor, Actuators.

Protocols: In vehicle Networking (IVN) - Local Interconnect Network(LIN) – Control Area Network (CAN) – Media Oriented System Transport (MOST) and FlexRay - Wireless Access in Vehicular Environment (WAVE).

MODULE V ENVIRONMENTAL IMPACT AND ENERGY MANAGEMENT 6

Vehicle pollution in context - alternative and sustainable energy used via the grid hybridization - V2G, G2V, V2B, V2H - energy consumption in braking and regeneration - brake system of EVs and HEVs.

L – 45; TOTAL HOURS:45

TEXT BOOKS:

1. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.
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 Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press, 2016.
3. Tom Denton, “Electric and Hybrid Vehicles” Routledge Publishers, 1st edition, March 2016.

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

CO1: identify the opportunities and challenges of advances in electric vehicles

CO2 : model battery system for any EV

CO3: model and choose a suitable drive scheme suitable for developing an EV

CO4: compute the performance parameter of sensors, actuators and to apply suitable technique for automotive communication

CO5: choose proper energy consumption method to integrate with grid

Board of Studies (BoS) : 18th BoS of EEE held on 10.02.2023

Academic Council: 20th AC held on 13.04.2023

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

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

SDG 8: Decent work and economic growth

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

OEEY 708	GREEN BUILDING AND ENERGY	L	T	P	C
SDG: 11	MANAGEMENT	3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to impart knowledge on

COB1: the concept of green design

COB2: the basics of green design strategies

COB3: the elements of green building

COB4: the concept of green building materials

COB5: the concept of energy management.

MODULE I BASIC CONCEPTS 8

Green Design concepts and definitions - sustainability begins with climate - recent upsurge in the green building movement -incentives for building green - incentives and tax deductions-green building programs -defining sustainable communities-emerging directions- liability - spectacular landmarks

MODULE II DESIGN STRATEGIES 9

Conventional versus Green Delivery Systems- green design strategies- The Integrated Design Process (IDP) -the green-building project delivery process- the integrated multidisciplinary project team - design process for high-performance buildings -sustainable site selection-general considerations- site selection - development density and community connectivity –brown field redevelopment - alternative transportation -site development storm water design-heat-island effect - light-pollution reduction

MODULE III ELEMENTS OF GREEN BUILDING 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- Commissioning process – fundamental commissioning –retro commissioning -enhanced commissioning

MODULE IV GREEN COMPOSITES FOR BUILDINGS 9

Concepts of Green Composites-low-emitting materials -adhesives, finishes, and sealants -paints and coatings- flooring systems- earthen building materials- building reuse -materials reuse- construction waste management-recycled materials regional materials- rapidly renewable materials- bamboo-cork - insulation- linoleum straw-

bale construction-wheat board - use and selection of green office equipment - certified wood- life-cycle assessment of building materials and products

MODULE V ENERGY MANAGEMENT 10

Energy Management – Definitions and significance – objectives – Characterising of energy usage – Energy Management program – Energy strategies and energy planning Energy Audit – Types and Procedure – Optimum performance of existing facilities – Energy management control systems- Low Energy Approaches to Water Management. Management of Solid Wastes.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Osman Attmann., “Green Architecture Advanced Technologies and Materials”, McGraw Hill, 2010.
2. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, John Wiley and sons, 2007.
3. Moncef Krarti, “Energy Audit of Building Systems: an Engineering approach” CRC Press, LLC, Florida 2000.
4. “Alternative Building Materials and Technologies”. K.S.Jagadish, B.U. Venkataramareddy and K. S. Nanjundarao New Age International, 2007.

REFERENCES:

1. Doty S. and W. C. Turner, “Energy Management Hand book”, Fairmont Press, 2009.
2. LEED - Practices, Certification and Accreditation Handbook”. Sam Kubba, Butterworth-Heinemann, 2009.

COURSE OUTCOMES:

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

CO1: describe the basics of green design concept.

CO2: explain the concepts of green design strategies.

CO3: illustrate the elements of green building.

CO4: summarize the different green building materials.

CO5: describe the concept of energy management.

Board of Studies (BoS) : Academic Council:

17th BOS of CE held on 10.08.2022 20th AC 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	-	-	L	H	-	-	-	-	-	L	-	M
CO2	-	-	L	-	-	L	H	-	-	-	-	L	L	-	M
CO3	-	-	L	-	-	L	H	-	-	-	-	-	L	-	M
CO4	-	-	M	-	-	L	H	-	-	-	-	L	L	-	M
CO5	-	-	L	-	-	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 : The understanding of basics of green concepts, materials, energy management and leads to the development of sustainable building

OEEY 709	INDUSTRY 4.0 AND APPLICATIONS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To describe the concepts, trends and the paradigm of Industry 4.0

COB2:To analyze the IoT technologies for practical IoT applications

COB3: To develop the ability to use Internet of Things related protocols and connectivity methods

COB4:. To elaborate the business issues in Industry 4.0.

COB5: To select the appropriate design concepts of Industrial IoT systems for various application

PREREQUISITES: Basic concepts in automation

MODULE I INTRODUCTION TO INDUSTRY 4.0 9

The Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, The Journey so far: Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

MODULE II ROAD TO INDUSTRY 4.0 & RELATED DISCIPLINES 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, Cyber physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Support System for Industry 4.0, Cyber Security.

MODULE III DATA INFORMATION AND COLLABORATION 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 IV BUSINESS ISSUES IN INDUSTRY 4.0 9

Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

MODULE V INDUSTRY 4.0 APPLICATIONS 9

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer, 2017.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things" A press, 2017.
3. Deepak Gupta, Victor Hugo C. de Albuquerque, Ashish Khanna, Purnima Lala Mehta, "Smart Sensors for Industrial Internet of Things: Challenges, Solutions and Applications", Springer, 1st Edition, 2021.
4. Francis daCosta, “Rethinking the Internet of things: A Scalable Approach to Connecting Everything”, Apress, 2014.

REFERENCES:

1. Christoph Jan Bartodziej, "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics", Springer, 2016.
2. Gary Smart, "Practical Python Programming for IoT: Build advanced IoT projects using a Raspberry Pi 4, MQTT, RESTful APIs, Web Sockets, and Python 3", Pckt Publishing, 2020

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: apply the basic concepts and principles of Industry 4.0

CO2:identify, formulate and solve engineering problems using Industrial IoT

CO3:describe basics of cloud computing with IoT capability

CO4:discuss the challenges of the industry through IoT techniques

CO5:develop a domain specific IoT system

Board of Studies (BoS) :	**Academic Council:**
24th BOS of ECE held on 08.02.2023.	20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2	PSO3
CO1	H	H	M	M	L	L	L	L	L	L	L	L	H	H	H
CO2	M	H	M	M	L	L	L	L	L	L	L	L	H	H	H
CO3	M	M	L	M	L	L	L	L	L	L	L	L	H	H	H
CO4	H	M	M	M	L	L	L	L	L	L	L	L	H	H	H
CO5	H	H	M	M	L	L	L	L	L	L	L	L	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: Able to apply the theoretical concepts for the various application in Industry 4.0

OEEY 710	NANOTECHNOLOGY AND	L	T	P	C
SDG: 6,7,9,15	CATALYSIS	3	0	0	3

COURSE OBJECTIVES:

To make the student conversant with

COB1: basic knowledge on nanoscience and nanotechnology which includes the exotic properties of materials at nanoscale including various techniques for the processing of nanomaterials

COB2: various techniques available for the characterization of nanostructured materials

COB3: applications in selected fields and impacts of nanotechnology in ecosystem

COB4: Impart the basic concepts involved in catalytic processes.

COB5: Understand the importance of heterogeneous catalysis.

MODULE I INTRODUCTION AND PREPARATION OF NANOMATERIALS **9**

Introduction to nanomaterials, Properties of nanomaterials, Nanostructures: Zero-, One-, Two- and Three-dimensional structures, Surface Plasmon Resonance, Change of bandgap; Methods of preparation of nanomaterials, top-down approach and bottom-up: Chemical precipitation and coprecipitation; Sol-gel synthesis; Ball milling synthesis; lithography, Plasma Laser deposition (PLD) techniques, Thermolysis routes (Solvothermal, Hydrothermal and pyrolysis), Microwave assisted synthesis; Sonochemical synthesis; Electrochemical synthesis.

MODULE II CHARACTERIZATION TECHNIQUES **9**

Structural Characterization: X-ray diffraction, Scanning Electron Microscopy (SEM/HR-SEM/FE-SEM) with EDS, TEM (HR-TEM) and SAED analysis, Atomic force Microscopy (AFM). X-ray Photoelectron spectroscopy (XPS), Raman analysis. Introduction to advanced Scanning Probe Microscopy Techniques Scanning Tunnelling Mode (STM), Piezoelectric force microscopy (PFM). DLS and zeta potential analysis. BET surface area analysis, CHNSO micro analysis.

MODULE III APPLICATIONS AND ENVIRONMENTAL IMPACTS **9**

Current applications - Short-term Applications - Long - term Applications – Energy filed - solar cells, military battle suits. Biomedical applications – Photodynamic therapy in targeted drugs - quantum dot technology in cancer

treatment, MRI applications. Nanosensors: pH, heat, humidity, gas, toxic chemicals sensors and sensors for aerospace and defence – biosensors – water remediation - Environmental Impacts: toxicological health effects, relevant parameters in nanoparticles toxicology, integrated concept of risk assessment of nanoparticles.

MODULE IV CONCEPTS OF CATALYSIS 9

Acid-base catalysis – catalysis by transition metal ions and their complexes – supported transition metal complexes as catalysts – catalysis by enzymes – phase transfer catalysis - photocatalysis – adsorption – chemisorption on metals, metal oxides and semiconductors - kinetics of unimolecular and bimolecular surface reactions - Contact time - WHSV - time on stream - Catalyst deactivation and regeneration, TOF, TON.

MODULE V HETEROGENEOUS CATALYSTS 9

Metals, metal oxides, mixed metal oxides, supported metals, spinels, perovskites, super acids, hydrotalcites, zeolites and zeotypes (small, medium, large), shape selective catalysts, mesoporous materials (SBA, MCM, KIT, AlPOs, MOFs, COFs) Hydrothermal synthesis, sol-gel process, impregnation method, ion-exchange method - Operations in catalyst manufacture - drying, calcination, spray drying, Reactors- fixed bed and flow reactors.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill, New Delhi, 2007.
2. G. Cao, Nanostructures and Nanomaterials –Synthesis, Properties and Applications, Imperial College Press, London, 2004.
3. C. N. R. Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials, Volume 1, Wiley –VCH Verlag GmbH & Co. KgaA, Weinheim, 2004.
4. G. A. Ozin, A. C. Aresnault, L. Cadematriri, Nanochemistry: A chemical approach to nanomaterials, RSC Publishing, 2008
5. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanisms of Chemical Transformations, Macmillan Publishers India Limited, 2000.
6. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy (Editors), Catalysis

COURSE OUTCOMES:

The students will be able to

CO1: differentiate the nanomaterials based on their dimensions and acquire knowledge of various synthetic methods

CO2: understand the components of instrumental techniques of and characterization techniques for structural and properties of nanomaterials

CO3: select the appropriate nanomaterials for specific applications in the interested arena

CO4: Find the fundamentals of catalysis

CO5: Evaluate significance of heterogeneous catalysts.

Board of Studies (BoS):
12th BoS of Chemistry held on 22.07.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG 6: Clean Water and Sanitation
SDG 7: Affordable & Clean Energy
SDG 9 : Industry and Innovation
SDG 15 : Life on Land
Statement:
SDG 6, 7 & 9: Foundation to work in R&D of renewable energy and sensors sector and for teaching career.
SDG 15: R&D labs in API labs in the production novel materials for various applications

OEEY 711	PROJECT MANAGEMENT	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the concepts of organizational project management.

COB2: To acquire knowledge on leadership in project management.

COB3: To gain knowledge in stakeholder management and program management

COB4: To familiarize with the project scope and time management

COB5: To be conversant with project execution, monitoring and closing.

MODULE I INTRODUCTION – ORGANIZATIONAL PROJECT MANAGEMENT L:9

Introduction to Organizational Project Management- Organizational Project Management Framework- Project Linkages to Strategic Management - Relationships between Portfolio, Program, and Project Management - Organizational Issues and Project Management.

MODULE II PROJECT MANAGEMENT - LEADERSHIP L:9

Importance of Leadership in Project Management-Roles and Responsibilities of a Project Manager-Leadership vs. Management-Project Management Leader's Portfolio-Technical Management skills -Project Entrepreneurship skills- Project Leadership skills

MODULE III PROJECT STAKE HOLDER MANAGEMENT AND PROGRAM MANAGEMENT L:9

Project Stakeholder Management-Stakeholders Identification and Assessment - Stakeholders vs. Project Lifecycle - Stakeholders and Interested Parties- Program Management - Program Characteristics - Programs vs Projects - Programs vs Portfolios

MODULE IV PROJECT SCOPEAND TIME MANAGEMENT L:9

Project Scope: Planning, Defining, Verification and Change control -Project Activity sequencing -Precedence diagram method- Arrow diagram method – Project Activity Time Estimation -Tools for Activity Time Estimation -Schedule development – Resource levelling heuristics

MODULE V PROJECT EXECUTION,MONITORING AND CLOSING L:9

Execution phase overview-Delegating tasks -Assessing project status - Foreseeing future challenges - Managing progress and timeline adjustments Project execution guidelines - Monitoring phase overview - Key Performance Indicators -Evaluating progress-Assessing work quality -Setting quality assurance procedures -Monitoring risks -Closing phase overview -Obstacles in the closing phase -Evaluating project performance-Final reports and managing records -Project closing guidelines

L – 45; TOTAL HOURS – 45

TEXTBOOKS:

1. Projects: Planning, Analysis, Financing, Implementation and Review, Prasanna Chandra, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
2. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015

REFERENCES:

1. Project Management and Control, Narendra Singh, Himalaya Publishing, New Delhi, 2015.
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata McGraw-Hill, 2009
3. A Guide to the Project Management Body of Knowledge (PMBOK® Guide)–Sixth Edition, Author& publisher - Project Management Institute 2017
4. Lean Project Management: Philip Small, Arkham Publishing Limited, March 2020

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1:Explain the concepts of organizational project management

CO2: Discuss the leadership in project management.

CO3: Elucidate the stakeholder management and program management

CO4: Explain project scope and time management

CO5: Describe project execution, monitoring and closing

Board of Studies (BoS) :
21st BOS of Mechanical Engg. held on 10.02.2023.

Academic Council:
20th AC held on 13.04.2023

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

The comprehensive understanding of Project management principles and techniques brings prosperity, create jobs, and build prosperous equitable societies across the country

OEEY 712	REAL TIME EMBEDDED SYSTEMS	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB1: To define the fundamental concepts of real time systems

COB2: To analyze the various uniprocessor and multiprocessor scheduling mechanisms

COB3: To develop knowledge on programming languages and tools for real time systems.

COB4: To discuss the overview of real time data bases

COB5: To classify the fault tolerance and evaluation techniques in real time systems.

PREREQUISITES: Embedded Systems, Operating Systems

MODULE I INTRODUCTION : EMBEDDED SYSTEMS & REAL TIME SYSTEMS **9**

Introduction –Embedded system - characterizing real time system -Performance Measures for Real Time Systems – Estimating Program Run Times – Task Assignment and Scheduling.

MODULE II PROGRAMMING LANGUAGES AND TOOLS **9**

Desired language characteristics – ADA language - Data typing – Control structures – Facilitating Hierarchical Decomposition- Packages- Run time Error handling – Overloading and Generics – Multitasking – Timing Specifications – Programming Environments – Run time support.

MODULE III REAL TIME DATABASES **9**

Basic Definition, Real time Vs General Purpose Databases- Main Memory Databases- Transaction priorities-Transaction Aborts-Concurrency control issues-Disk Scheduling Algorithms-Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

MODULE IV REAL TIME COMMUNICATION **9**

Communications media, Network Topologies, Protocols- contention based, Token based, Stop-and-Go multihop, Polled Bus, Hierarchical Round Robin Protocol, Deadline-Based Protocols, Fault Tolerant Routing.

MODULE V FAULT TOLERANT AND EVALUATION TECHNIQUES 9

Fault Tolerance Techniques – Fault Types – Fault Detection-Fault and Error containment- Redundancy- Reliability Evaluation Techniques – Software error models.

L –45 ; TOTAL HOURS –45

TEXT BOOKS:

1. C.M. Krishna, Kang G. Shin, “Real – Time Systems”, McGraw – Hill International Editions, 2010.
2. Rajib Mall,”Real-time systems: theory and practice”, Pearson Education, 2007.

REFERENCES:

1. Xiaocong Fan, “Real-Time Embedded Systems: Design Principles and Engineering Practices”, Elsevier, 2015.
2. Albert M. K. Cheng, “Real-Time Systems: Scheduling, Analysis, and Verification“, Wiley publishers, 2003.
3. P. A. Laplante," Real-Time Systems Design & Analysis", Willey, 2011.
4. Qing Li, "Real Time Concepts for Embedded Systems", Elsevier, 2011.

COURSE OUTCOMES:

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

CO1: describe the characteristics of real time system.

CO2: apply scheduling algorithms based on the application.

CO3: discuss about the programming language characteristics and tools of real time systems.

CO4: choose the appropriate real time communication protocols.

CO5: analyze the fault tolerance and evaluation techniques in real time systems.

Board of Studies (BoS) :
24th BOS of ECE held on 08.02.2023.

Academic Council:
20th AC 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	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO2	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO3	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO4	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO5	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H

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

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Statement: Understanding of the real time systems will bring practical knowledge on quality education.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation
Statement: capable of promoting industrialization through the application of real-time system design principles.

OEEY 713	ROBOTIC TECHNOLOGY	L	T	P	C
SDG: 9		3	0	0	3

OBJECTIVES:

COB1: To study the basics of robotics technology.

COB2: To acquire knowledge about robot operating system.

COB3: To familiarize with robot assembly and aerial robots.

COB4: To learn about futuristic robots.

COB5: To know about the application of robots in various fields.

MODULE I INTRODUCTION L:6

Robot – Definition – Robot Anatomy – Co-ordinate Systems - Work envelope: Types and classification – Specifications – Pitch, Yaw, Roll, and Joint notations - Speed of motion - Pay load – Robot Parts and their functions – Need for robots.

MODULE II ROBOT OPERATING SYSTEM L:10

Master – Node – Topic – Messages – Subscriber – Publisher – Robot Operating System (ROS) packages – ROS file system – Services and actions – Custom publisher – Custom subscriber – ROS topic list and ROS topic information -ROS topic echo – ROS topic pub – Custom messages.

MODULE III ROBOT ASSEMBLY AND AERIAL ROBOTS L:12

Robotic assembly automation - Parts presentation methods - Assembly operations - Assembly system configurations - Design for robot assembly - Basics of aerial robots - Modelling and control of small Unmanned Aerial vehicles - Guidance and navigation of small range aerial robots.

MODULE IV FUTURE TECHNOLOGY L:9

Wheeled and legged Robot – Legged locomotion and balance – Arm movement, Gaze and auditory orientation control – Facial expression – Hands and manipulation – Sound and speech generation – Motion capture/Learning from demonstration.

MODULE V APPLICATIONS L:8

Implementation of Robots in Industries - Industrial application for material handling: machine loading and unloading, assembly, and inspection–Applications of robot in Arc welding, Spot welding, and Spray painting - Robots in Assembly operation, Cleaning and underwater applications –Applications of Robots in Agriculture, Mining, Defense, Nuclear, Medical, and Space.

L – 45; TOTAL HOURS – 45

TEXTBOOKS:

1. Robert J. Schilling, “Fundamentals of Robotics Analysis and Control”, PHI Learning.,2009.
2. Richard D. Klafter, Thomas. A, ChriElewski, Michael Negin, “Robotics Engineering an Integrated Approach”, Phi Learning.,2009
3. YoonSeokPyo, HanCheol Cho, RyuWoon Jung, TaeHoon Lim, ROS Robot Programming.
4. M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw Hill, 2001.

REFERENCES:

1. Bernard Hodges, “Industrial Robotics”, Second Edition, Jaico Publishing house, 1993.
2. Tsuneo Yohikwa, “Foundations of Robotics Analysis and Control”, MIT Press., 2003.
3. John J. Craig, “Introduction to Robotics Mechanics and Control”, Third Edition, Pearson,2008.
4. Craig.J. J, “Introduction to Robotics Mechanics and Control”, Addison-Wesley, 1999.Robotics Lab manual, 2007.

COURSEOUTCOMES:

After completion of the course, students should be able to

CO1: Explain the basics of robots.

CO2: Elucidate robot operating system.

CO3: Discuss about robot assembly and aerial robots.

CO4: Describe the future robot technology.

CO5: Explain the applications of robots.

Board of Studies (BoS) :

21st BOS of Mechanical Engg. held on 10.02.2023.

Academic Council:

20th AC held on 13.04.2023

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

The holistic knowledge of robot technology, its operating system, and future robot helps in developing robots for various applications.

OEEY 714	SOFT COMPUTING TECHNIQUES	L	T	P	C
SDG:8,9		3	0	0	3

COURSE OBJECTIVES:

COB 1: To enumerate the strengths and weakness of soft computing

COB2 To focus on the basics of neural networks

COB3: To learn the basics of fuzzy systems and hybrid Neurofuzzy systems

COB4: To emphasize the role of evolutionary computing algorithms

COB5: To learn the ANN, FIS and GA tool boxes for various soft computing applications.

MODULE I BASICS OF SOFT COMPUTING 8

Soft computing – Hard Computing – Artificial Intelligence as the basis of soft computing – Relation with logic driven and statistical method driven approaches- Expert systems – Types of problems: Classification, Functional approximation, Optimizations – Modeling the problem – Machine Learning – Hazards of Soft Computing – Current and future areas of research.

MODULE II ARTIFICIAL NEURAL NETWORK 10

Artificial Neuron – Multilayer perceptron – Supervised learning – Back propagation network –Types of Artificial Neural Network: Supervised Vs Un Supervised Network – Radial basis function Network – Self Organizing Maps – Recurrent Network – Hopfield Neural Network – Adaptive Resonance Theory – Issues in Artificial Neural Network – Applications.

MODULE III FUZZY SYSTEMS 10

Fuzzy Logic – Membership functions – Operators – Fuzzy Inference systems – Other sets: Rough sets, Vague Sets – Fuzzy controllers - Cooperative Neuro fuzzy systems – Neural network driven fuzzy reasoning – Hybrid Neuro fuzzy systems – Construction of Neuro Fuzzy systems: Structure Identification phase, Parameter learning phase – Applications.

MODULE IV EVOLUTIONARY COMPUTING & ALGORITHMS 7

Overview of evolutionary computing – Genetic Algorithms and optimization – Genetic Algorithm operators – Genetic algorithms with Neural/Fuzzy systems – Variants of Genetic Algorithms– Population based incremental learning – Meta heuristic algorithms - Evolutionary strategies and applications.

MODULE V MATLAB TOOL BOX FOR SOFT COMPUTING 10

Artificial Neural Network (ANN) Toolbox - training and testing with different activation functions- controller design using ANN toolbox Fuzzy Inference System (FIS) Editor

and tool box- fuzzy controller design - Genetic Algorithm Toolbox - Application of ANN, FIS and GA tool box to various power system and control applications.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. Samir Roy, “Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms”, Pearson, 2013

REFERENCES:

1. Anupam Shukla, Ritu Tiwari and Rahul Kala, “Real life applications of Soft Computing”, CRC press, 2010.
2. Fakhreddine O. Karray, “Soft Computing and Intelligent Systems Design: Theory, Tools and Applications”, Pearson, 2009
3. Matlab Simulink Manual

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

CO1: enumerate the theoretical basis of soft computing

CO2 : explain the Neural network architecture and different learning rules

CO3: apply the fuzzy systems and hybrid Neurofuzzy systems

CO4: demonstrate the different evolutionary and metaheuristic algorithms

CO5: demonstrate the most appropriate soft computing technique for a given situation using MATLAB tool box.

Board of Studies (BoS) :
18th BoS of EEE held on 10.02.2023

Academic Council:
20th AC held on 13.04.2023

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

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

SDG 8: Decent work and economic growth

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

SDG No. 9 Industry, innovation and infrastructure

Statement:

The development of soft computing techniques will meet out the desired needs such as new innovative systems for industry and establishing advanced infrastructure.

OEEY 715	STRUCTURAL INTERPRETATION OF	L	T	P	C
SDG: 4, 9	MATERIALS	3	0	0	3

COURSE OBJECTIVES:

To use the concepts (basic and advanced level) of analytical methods for structure elucidation of materials and the students will be trained for the

COB1: Interpretation of electronic spectral data of materials

COB2: Interpretation of magnetic spectral data of materials

COB3: Interpretation of structural and morphological data of materials

COB4: Interpretation of thermoanalytical data of materials

COB5: Interpretation of electrochemical and XPS data of materials

MODULE I ELECTRONIC DATA 9

UV-visible, fluorescence and phosphorescence: Characteristic absorption of simple chromophoric groups, conjugated/ aromatic/ ligand systems, metal complexes and materials. FT-IR and Raman: Characteristic group frequencies of organic, inorganic molecules and various materials (polymer, nano, semiconducting) Interpretation of organic and inorganic and hybrid materials using combination of the spectral data.

MODULE II MAGNETIC AND MASS DATA 9

Solid-state nuclear magnetic resonance spectroscopy: Compounds containing ^{1}H, ^{13}C, ^{19}F,^{27}Al, ^{29}Si, and ^{31}P nuclei. Electron spin resonance (ESR): Simulation of ESR spectra of paramagnetic species, spin dynamics in solid and liquid. Mass spectrometry: The production and analysis of positive ions, molecular ions, application of isotopic abundance measurements, fragmentation modes and rearrangement of ions. Interpretation of organic, inorganic compounds and materials using combination of the spectral data.

MODULE III STRUCTURAL AND MORPHOLOGICAL DATA 9

Fundamental theoretical framework for diffraction (XRD) and imaging methods (SEM, TEM and AFM) used in structural and compositional characterization of materials in solid, film state etc.

MODULE IV THERMOANALYTICAL DATA AND SURFACE AREA 9

Interpretation of Differential Thermal Analysis (DTA), Thermo-gravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC) data of various materials including inorganic complex, organic polymeric materials, composite, nano-composites etc; Surface area analysis; isotherms, types, BET surface area, pore dimensions, pore volume, etc.

MODULE V ELECTROCHEMICAL AND XPS DATA 9

Cyclic voltammetry for oxidation and reduction potentials, TAFEL polarization and Impedance spectroscopy for corrosion inhibitor behavior, chronoamperometry for charge or discharge of battery. X-ray photoelectron spectroscopy: Study the chemical composition and oxidation state of elements at the surface and interface. Applications of XPS in various arenas.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. R. S. Drago, Physical Methods for Chemists, W. B. Saunders,1992.
2. R. M. Silverstein, C. G. Bassler and T. C. Morril, Spectrophotometric Identification of Organic Compounds, 5th edition, Wiley, 1991.
3. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 3rd edition, McGraw Hill, 1980.
4. W. Kemp, Organic Spectroscopy, ELBS, 1979.
5. W. L. Jolly, The synthesis and characterization of inorganic compounds, Prentice-Hall, 1970.
6. John Wertz, Electron Spin Resonance: Elementary Theory and Practical Applications, Springer Science & Business Media, 2012.
7. R. F. Speyer, Thermal Analysis of Materials, CRC Press, 1994.
8. P.J. Goodhew, J. Humphreys and R. Beanland, Electron Microscopy and Analysis, Taylor & Francis, 2001.
9. John F Watts, John Woistenhoime, An introduction to surface analysis by XPS and AES, John Wiley and Sons, 2nd edition, 2003.
10. James, B. Condon, Surface Area and Porosity Determinations by Physisorption Measurement and Theory, Elsevier, 1st edition, 2006.

COURSE OUTCOMES:

The students will be able to

CO1: Interpret electronic spectral data of materials

CO2: Interpret magnetic spectral data of materials

CO3: Interpret structural and morphological data of materials

CO4: Interpret thermo analytical data and porous nature of materials

CO5: Interpret electrochemical and XPS data of materials

Board of Studies (BoS):

12th BoS of Chemistry held on 2207.2022

Academic Council:

19th AC held on 29.09.2022

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

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

SDG 4: Quality Education
SDG 9: Industry and Innovation

Statement:
SDG9: Foundation to work in R&D laboratory, chemical industry, independent researcher and for teaching career.
SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities.