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

Regulations 2019
Curriculum and Syllabi

(Amendments updated upto July 2021)

M.Tech.
(Structural Engineering)

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

REGULATIONS 2019
CURRICULUM AND SYLLABI
(Amendments updated upto July 2021)

M.TECH.
STRUCTURAL ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

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

MISSION

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

DEPARTMENT OF CIVIL ENGINEERING

VISION AND MISSION

VISION

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

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES
M.TECH STRUCTURAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Exhibit expertise in analysis and design of Reinforced Concrete, Steel structures as per codal provisions with an emphasize on economy and sustainability.

PEO 2: Develop and practice cost effective and sustainable cementitious composites in real time projects with care for environment

PEO 3: Evaluate the performance of new or distressed structures with scientific approach by using state of the art software tools.

PEO 4: Pursue innovative research in the field of Structural Engineering to cater the changing needs of society.

PEO 5: Demonstrate leadership in a team by exhibiting ethical approach, good communication skills and time management.

PROGRAMME OUTCOMES

PO1: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level of higher than the requirements in the appropriate bachelor program.

PO4: An ability to apply engineering techniques and relevant software to offer solution to structural engineering problems with emphasize on sustainability.

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

REGULATIONS -2019 FOR

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

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires **"Programme"** means Post Graduate Degree Programme (M.Tech. / MCA/ M.Sc.)

"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.,

"Institution" means B.S. Abdur Rahman Crescent Institute of Science & Technology.

"Academic Council" means the Academic Council, which is the apex body on all academic matters of B.S. Abdur Rahman Crescent Institute of Science & Technology.

"Dean (Academic Affairs)" means Dean (Academic Affairs) ofB.S. Abdur Rahman Crescent Institute of Science & Technology who administers the academic matters.

"Dean (Student Affairs)" means Dean (Student Affairs) of B.S. Abdur Rahman Crescent Institute of Science & Technology, who looks after the welfare and discipline of the students.

"Controller of Examinations" means the Controller of Examinations of B.S. Abdur Rahman Crescent Institute of Science & Technology who is responsible for the conduct of examinations and declaration of results.

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.	

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 of this Institution as specified in the clause 3.2 [Eligible entry qualifications for admission to P.G. programmes] or any other degree examination of any University or authority accepted by this Institution as equivalent thereto.

2.2.2 Eligibility 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 (3 years)	6	12
MCA (Lateral Entry)	4	8
MCA (2 years)	4	8
M.Sc.	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	Qualifications for admission
1.	Aeronautical Engineering	M.Tech. (Avionics)	B.E. / B. Tech. (Aeronautical Engineering)
2.	Civil Engineering	M.Tech. (Structural	B.E. / B. Tech. (Civil Engineering) / (Structural Engineering)

		Engineering)	
		M. Tech. (Construction Engineering and Project Management)	B.E. / B. Tech. (Civil Engineering) / (Structural Engineering) / B. Arch.
3.	Mechanical Engineering	M.Tech. (Manufacturing Engineering)	B.E. / B.Tech. (Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering)
		M.Tech. (CAD/CAM)	
4.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engg.)	B.E. /B.Tech. (EEE/ECE/E&I/I&C / Electronics / Instrumentation)
		M.Tech. (Power Electronics and Drives)	
5.	Electronics and Communication Engineering	M.Tech. (Communication Systems)	B.E. / B.Tech. (EEE/ ECE / E&I / CSE IT / I&C / Electronics / Instrumentation)
		M.Tech. (VLSI and Embedded Systems)	B.E./ B.Tech. (ECE / E&I / I&C / EEE / CSE / IT)
6.	Electronics and Instrumentation Engineering	M.Tech. (Electronics and Instrumentation Engineering)	B.E./ B.Tech. (EIE/ICE/Electronics/ECE/EEE)
7.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. / B.Tech. (CSE/IT/ECE/EEE/EIE/ICE/ Electronics / MCA)
8.	Information Technology	M.Tech. (Information	B.E. / B.Tech. (IT/CSE/ECE/EEE/EIE/ICE/

		Technology)	Electronics / MCA)
9.	Computer Applications	MCA (3 years)	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level
		MCA – (Lateral Entry)	B.Sc. Computer Science / B.Sc. Information Technology / BCA
		MCA (2 years)	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level or B.Sc. Computer Science / B.Sc. Information Technology / BCA
10.	Mathematics	M.Sc. (Actuarial Science)	Any Degree with Mathematics / Statistics as one of the subjects of study
11.	Physics	M.Sc.(Physics)	B.Sc. (Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation)
12.	Chemistry	M.Sc.(Chemistry)	B.Sc. (Chemistry / Applied Science)
13.	Life Sciences	M.Sc. Molecular Biology &Biochemistry	B.Sc. in any branch of Life Sciences
		M.Sc. Biotechnology	B.Sc. in any branch of Life Sciences
		M.Sc. Microbiology	B.Sc. in any branch of Life Sciences
		M.Tech. Biotechnology	B.Tech. (Biotechnology / Chemical Engineering) / M.Sc. in any branch of Life Sciences

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 oriented core courses
iv. Project work / thesis / dissertation
v. Laboratory Courses
vi. Seminars
vii. Mini Project
viii. Industrial Internship
ix. Value Added Courses
x. MOOC Courses (NPTEL, SWAYAM, etc.,)

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.	74-80
MCA (3 years)	118 - 126
MCA(Lateral Entry)	80 - 85
MCA (2 years)	85 - 90
M.Sc.	77- 82

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 four weeks of industrial internship or 160 hours per

semester.

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 28	18 to 26
MCA	12 to 33	12 to 26
M.Sc.	9 to 32	10 to 26

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

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

3.5 PROJECT WORK/DISSERTATION

3.5.1 Project work / Dissertation 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 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 / Dissertation 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 / dissertation 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 whole class. He/she is responsible for maintaining the academic, curricular and co-curricular records of all students throughout their period of study.

4.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department / Dean of School of the students shall attach a certain number of 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 offer advice to the students on academic and personal matters, and guide the students in taking up courses for registration and enrolment in every semester.

5.0 CLASS COMMITTEE

5.1 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:

5.2 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

5.3 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.

5.4 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 syllabus.

5.5 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.

6.0 COURSE COMMITTEE

6.1 Each common theory / laboratorycourse 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.

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 0fees.

7.2 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.

7.3 A student can withdraw from an enrolled course at any time before the first 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 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.

8.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

8.1 A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. A student can avail the break of study before the start of first assessment test of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1). If any student is debarred for want of attendance or suspended due to any act of indiscipline, it will not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only in the subsequent year. The student availing break of study is permitted to write arrear examinations by paying the prescribed fees.

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / DISSERTATION

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 (3 years)	45

MCA (Lateral Entry)	22
MCA (2 years)	22
M.Sc.	18

9.2 If the student has not earned mini0mum number of creditsspecified, 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

10.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds, representing for the institution in approved events, etc.) 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. The courses in which the student is awarded “I” grade, shall register and redo the course when it is offered next.

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 that course to the Class Advisor. The Class Advisor will consolidate and furnish the list of students who have earned less that 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of School. Thereupon, the Dean (Academic Affairs) shall announce the names of such students prevented from writing the semester end examination in each course.

10.3 A student who has obtained ‘I’ grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall redo 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.

10.4 A student shall register to redo a core course wherein “I” or “W” grade is awarded. If the student is awarded, “I” or “W” grade in an elective course either the same elective course may be repeated or a new elective course may be chosen with the approval of Head of the Department / Dean of School.

11.0 REDO COURSES

11.1 A student can register for a maximum of two redo courses per semester in the evening after regular working hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters, without affecting the regular academic schedule and not exceeding prescribed maximum credits.

11.2 The Head of the Department with the approval of Dean (Academic Affairs) may arrange for the conduct of a few courses in the evening after regular working hours, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

11.3 The number of contact hours and the assessment procedure for any redo course will be the same as those during regular semesters except that there is no provision for any substitute examination and withdrawal from an evening redo course.

12.0 ASSESSMENTS AND EXAMINATIONS

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

Every practical course shall have 75% weightage for continuous assessments and 25% for semester end examination. However a student should have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.3 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 component shall have a total of three assessments with two continuous assessments having 25% weightage each and semester end examination having 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination for the award of pass grade. The evaluation of practical component shall be through continuous assessment.

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

12.5 In the case of Industrial training, 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 organisation. The weightage for Industry internship report shall be 60% and 40% for viva voce examination.

12.6 In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by 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.

12.7 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be considered for grading along with the marks scored in the semester end arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination to award grades and the internal assessment marks secured during the course of study shall not be considered.

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 arrear examination for theory component. There shall be no arrear or improvement examination for lab component.

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 semester.

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 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
W	0
I	0
AB	0

"W" denotes withdrawal from the course.

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

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester end examination.

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 feeto the 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” and "W" grades are excluded for calculating GPA.

"U", “I”, "AB" and **"W"** 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

However, to be eligible for First Class with Distinction, a student should not have obtained ‘U’ or ‘I’ grade in any course during his/her period ofstudy and should have completed the P.G. programme within a minimum period (except break of study). To be eligible for First Class, a student should have passed the examination in all the courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study is not considered. The students who do not satisfy the above two conditions shall be classified as second class. For the purpose of classification, the CGPA shall be

rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

16.0 DISCIPLINE

16.1 Every student is expected to observe disciplined and decorous behaviour 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 MASTERS DEGREE

17.1 A student shall be declared to be eligible for the award of the Masters 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.

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

CURRICULUM & SYLLABI FOR

M. Tech. (Structural Engineering)

CURRICULUM

Sl. No.	Course Code	Course Title	L	T	P	C
		SEMESTER I				
1.	MAD6184	Probability, Matrix Theory and Linear Programming	**3**	**1**	**0**	**4**
2.	CED6101	Advanced Design of Concrete Structures	**3**	**1**	**0**	**4**
3.	CED 6102	Dynamics of Structures	**3**	**1**	**0**	**4**
4.	CED 6103	Advanced Concrete Technology	**3**	**0**	**2**	**4**
5.	CED 6104	Structural Engineering Design Studio	**0**	**0**	**2**	**1**
6.		Professional Electives #				**3**
						20
		SEMESTER II				
1.	CED6211	Finite Element Analysis in Structural Engineering	**3**	**0**	**2**	**4**
2.	CED6212	Earthquake Resistant Design of Structures	**3**	**0**	**0**	**3**
3.	GED6201	Research Methodology	**4**	**0**	**0**	**4**
4.	CED6213	Advanced Design of Metal Structures	**3**	**1**	**0**	**4**
5.		Professional Electives #				**9**
6.		Value added course				**-**
						24
		SEMESTER III				
1.		Professional Electives#				**6**
2.		General Elective##				**3**
3.	CED7101	Project (Phase I)**				**6**
4.	CED7102	Internship*				**1**
5.		MOOC (related to project)				**-**

10 + 6

SEMESTER IV

1.	CED7101 Project (Phase II)	**18**
		6 + 18 = 24
	Total Credits	**78**

Student has to take a minimum of 9 credits from odd and even semester professional elective courses

Student has to take a minimum of 3 credits from general elective courses

* 30 days of Industrial training will be undertaken by regular candidates during first year summer vacation and the credit will be awarded in the 3rdsemester.

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

PROFESSIONAL ELECTIVES

LIST OF ODD SEMESTER ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEDY 101	Blast Resistant Design of Structures	**3**	**0**	**0**	**3**
2.	CEDY 102	Condition Assessment and Rehabilitation of Structures	**3**	**0**	**0**	**3**
3.	CEDY 103	Corrosion of Steel in Concrete	**3**	**0**	**0**	**3**
4.	CEDY 104	Design of Bridges	**3**	**0**	**0**	**3**
5.	CEDY 105	Design of Industrial Structures	**3**	**0**	**0**	**3**
6.	CEDY 106	Design of Steel Concrete Composite Structures	**3**	**0**	**0**	**3**
7.	CEDY 107	Experimental Methods in Structural Engineering	**3**	**0**	**0**	**3**
8.	CEDY 108	FRP Composites for structures	**3**	**0**	**0**	**3**
9.	CEDY 109	Matrix Methods of Structural Analysis	**3**	**0**	**0**	**3**
10.	CEDY 110	Optimization in Structural Design	**3**	**0**	**0**	**3**
11.	CED6123	Project Management in Construction	**3**	**0**	**0**	**3**
12.	CEDY 111	Theory of Elasticity and Plasticity	**3**	**0**	**0**	**3**
13.	CEDY 112	Theory of Plates and Shells	**3**	**0**	**0**	**3**
14.	CEDY 113	Formwork for concrete structures	**2**	**0**	**0**	**2**
15.	CEDY 114	Prefabricated Structures	**2**	**0**	**0**	**2**
16.	CEDY 115	Smart Cities	**1**	**0**	**0**	**1**
17.	CEDY 116	Structural Health Monitoring	**1**	**0**	**0**	**1**
18.	CEDY 117	Advanced Oxidation Process	**3**	**0**	**0**	**3**
19.	CEDY 118	Separation Processes in Environmental Applications	**3**	**0**	**0**	**3**

LIST OF EVEN SEMESTER ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CEDY 201	Advanced Foundation Design	**3**	**0**	**0**	**3**
2.	CEDY 202	Chemistry of Cement and Concrete	**3**	**0**	**0**	**3**

3.	CEDY 203	Composite Materials	**3**	**0**	**0**	**3**
4.	CEDY 204	Courses offered by NPTEL & SWAYAM	**3**	**0**	**0**	**3**
5.	CEDY 205	Fracture Mechanics of concrete	**3**	**0**	**0**	**3**
6.	CEDY 206	Green Building and Energy Efficient Structures	**3**	**0**	**0**	**3**
7.	CEDY 207	Prestressed Concrete Structures	**3**	**0**	**0**	**3**
8.	CEDY 208	Soil - Structure Interaction	**3**	**0**	**0**	**3**
9.	CEDY 209	Soil Dynamics and Machine Foundation	**3**	**0**	**0**	**3**
10.	CEDY 210	Stability of Structures	**3**	**0**	**0**	**3**
11.	CEDY 211	Structural Safety and Reliability	**3**	**0**	**0**	**3**
12.	CEDY 212	Tall Structures	**3**	**0**	**0**	**3**
13.	CEDY 213	Wind and Cyclone Effects on Structures	**3**	**0**	**0**	**3**
14.	CEDY 214	Fire Protection of Structures	**2**	**0**	**0**	**2**
15.	CEDY 215	Design of Masonry Structures	**2**	**0**	**0**	**2**
16.	CEDY 216	Construction Contracts	**1**	**0**	**0**	**1**
17.	CEDY 232	Energy Efficient Structures	**3**	**0**	**0**	**3**
18.	CEDY 233	Green concepts in building Environment	**3**	**0**	**0**	**3**

GENERAL ELECTIVES FOR M.TECH PROGRAMMES

Sl. No.	Course Code	Course Title	L	T	P	C
1	GEDY101	Project Management	**3**	**0**	**0**	**3**
2	GEDY102	Society, Technology & Sustainability	**3**	**0**	**0**	**3**
3	GEDY103	Artificial Intelligence	**3**	**0**	**0**	**3**
4	GEDY104	Green Computing	**3**	**0**	**0**	**3**
5	GEDY105	Gaming Design	**3**	**0**	**0**	**3**
6	GEDY106	Social Computing	**3**	**0**	**0**	**3**
7	GEDY107	Soft Computing	**3**	**0**	**0**	**3**
8	GEDY108	Embedded System Programming	**3**	**0**	**0**	**3**
9	GEDY109	Principles of Sustainable Development	**3**	**0**	**0**	**3**
10	GEDY110	Quantitative Techniques in Management	**3**	**0**	**0**	**3**
11	GEDY111	Programming using MATLAB& SIMULINK	**1**	**0**	**2**	**2**
12	GEDY112	JAVA Programming	**3**	**0**	**0**	**3**

Sl. No.	Course Code	Course Title	L	T	P	C
13	GEDY113	PYTHON Programming	**3**	**0**	**0**	**3**
14	GEDY114	Intellectual Property Rights	**1**	**0**	**0**	**1**
15	GEDY115	Research and Publication Ethics	**2**	**0**	**0**	**2**

MAD6184 PROBABILITY, MATRIX THEORY AND LINEAR PROGRAMMING	L	T	P	C
	3	1	0	4

OBJECTIVES:

The aim of this course is to

- provide a comprehensive introduction to the probability distributions used in engineering.
- familiarize students with advanced matrix theory and variational problems.
- expose the students to Operations Research using concepts of linear programming.

MODULE I PROBABILITY DISTRIBUTIONS 10+03

Axioms of probability – addition and multiplication theorem – conditional probability - total probability – random variables - moments – moments generating functions and their properties- Binomial, Poisson, Geometric, Uniform, Exponential and Normaldistributions.

MODULE II TWO DIMENSIONAL RANDOM VARIABLES 08+03

Joint distributions - marginal and conditional distributions - functions of random variables-covariance - correlation and regression - Central limit theorem.

MODULE III ADVANCED MATRIX THEORY 9+03

Matrix norms - singular value decomposition - QR algorithm - pseudo inverse - least square approximations.

MODULE IV LINEAR PROGRAMMING 10+03

Formation - graphical method - simplex method - Big-M method - Two Phase method - transportation and assignment problems.

MODULE V CALCULUS OF VARIATIONS 08+03

Variation and its properties – Euler’s equation – functional dependent on first and higher order derivatives – functional dependent on functions of several independent variables – variational problems with moving boundaries – isoperimetric problems – Ritz and Kantorovich methods.

L – 45; T – 15; Total – 60

TEXT BOOKS:

1. S.M.Ross, “A First Course in Probability”, 9th edition, Pearson Education, 2013.
2. Lewis.D.W., “Matrix Theory”, Allied Publishers, Chennai,1995.
3. Taha, H.A., “Operations Research - An Introduction ", 10th edition, Pearson Prentice Hall,2016.
4. A.S. Gupta, “Calculus of variations with applications”, PHI Pvt. Ltd, New Delhi,2011.

REFERENCES:

1. H. Cramer., “Random Variables and Probability Distributions”, Cambridge University Press(2004).
2. Roger A. Horn, Charles R. Johnson, “Matrix Analysis”, Cambridge University Press; 2nd edition(2012).
3. Robert. J. Vanderbilt., “Linear Programming: Foundations and Extensions”, Springer US(2014).
4. David. J. Rader., “Deterministic Operations Research”, Wiley(2010).
5. Elsgolts, “Differential Equations and Calculus of Variations", University Press of the Pacific(2003).

OUTCOMES:

At the end of the course students will be able to

- Solve problems using concept of standard, discrete and continuous distributions.
- Solve problems using one dimensional and two dimensional random variables.
- Find eigen values and eigen vectors of a higher order matrix.
- Solve problems of linear programming.
- Solve problems of calculus of variations by direct methods and using Euler’s formulae.

CED 6101 **ADVANCED DESIGN OF CONCRETE STRUCTURES** **L T P C**

3 1 0 4

OBJECTIVES:

- To impart knowledge on the design of RCC beams under combined shear, torsion and bending, limit state of serviceability for structural members.
- To provide exposure on the design of slender columns, deep beams, corbels, grid floor, spandrel beams.
- To understand the concept of yield line analysis and gain knowledge on the design of flat slabs.
- To expand the knowledge in studying the inelastic response of reinforced concrete structural members.
-

MODULE I BEHAVIOUR OF CONCRETE MEMBERS 9+3

Behaviour of concrete under uniaxial and multiaxial states of stress - confined concrete- Effect of cyclic loading on concrete and reinforcing steel - Ultimate Deformation and ductility of members with flexure- strength and deformation of members with shear and torsion - Bond and anchorage - Serviceability limit states: estimation of deflections and crack widths in RC members

MODULE II DESIGN OF SLENDER RC COLUMNS 9+3

Behaviour of slender RCC Columns - failure modes - Design moments for braced and unbraced columns - design of slender columns as per IS 456

MODULE III DESIGN OF SPECIAL STRUCTURAL ELEMENTS 9+3

Design of Plain and R.C walls - Strut and tie method of analysis and Design of for corbels and deep beams – Design of spandrel beams - Design of Grid floor

MODULE IV FLAT SLABS & YIELD LINE THEORY OF SLABS 9+3

Design of flat slabs and flat plates according to IS method – Check for shear -Yield line theory of slabs - Introduction to Hillberg's strip method of analysis (Principles only).

MODULE V INELASTIC BEHAVIOUR OF CONCRETE BEAMS 9+3

Moment – Curvature relationship - Plastic hinge formation - Redistribution of

moments - Moment redistribution for a two span continuous beam - Strength and ductility of concrete frames -Ductile Detailing for RC frames - Design of cast-in-situ joints in frames.

L – 45; T – 15; Total Hours - 60

REFERENCES:

1. Unnikrishnan Pillai and Devdas Menon, Reinforced Concrete Design, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006.
2. Subramanian. N, Design of Reinforced Concrete Structures, Oxford University Press, 2013
3. Park. R., &Paulay .T.,Reinforced Concrete Structures, John Wiley & Sons,1975.
4. Varghese, P.C. Advanced Reinforced Concrete Design, Prentice Hall of India,2005.
5. Purushothaman, P, Reinforced Concrete Structural Elements: Behaviour Analysis and Design, Tata McGraw-Hill, 1986.
6. Krishna Raju, N. Advanced Reinforced Concrete Design (IS 456-2000), CBS Publishers & Distributors, New Delhi, 2010.

OUTCOMES:

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

- Describe the behaviour of reinforced concrete structural members and compute serviceability response of structural elements.
- Employ the Indian standard code of practice for the design of slender RC columns.
- Design the special structural elements such as RC walls, deep beams, corbels, grid floor and spandrel beams.
- Appropriately choose and design the two-way slab system for buildings.
- Critically describe the inelastic behaviour of structures and ductile detailing of RC structures

CED 6102	DYNAMICS OF STRUCTURES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To impart knowledge about theory of vibrations and vibration parameters to analyse the dynamic forces caused by an earthquake.
- To introduce the design of buildings for blast and impact forces as per BIS codes of practice.

MODULE I INTRODUCTION TO VIBRATION AND DAMPING 9+3

Simple Harmonic Motion-Longitudinal Vibrations Equation of motion- dynamic equation of motion- D'Alemberts principle- equivalent stiffness-Springs connected in series and parallel -frequency and period Amplitude of motion- Energy method for the equation of motion- Nature of Exciting Forces, Mathematical Modeling of Dynamic Systems

MODULE II SINGLE DEGREE OF FREEDOM SYSTEM 9+3

Free and Forced Vibration with and without Damping - Response to Harmonic Loading- Damped SDOFs - Underdamped, Overdamped and Critically damped- Logarithmic decrement, method of determining damping- Response to General Dynamic Loading using Duhamel's Integral

MODULE III MULTIPLE DEGREE OF FREEDOM SYSTEM 9+3

Two Degree of Freedom System- Orthogonality Principle - Multiple Degree of Freedom System- Equation of motion of multi degree of freedom with lumped and distributed mass-Stiffness, mass and damping matrices. Influence Coefficient- Eigen vector normalizations, problems-Modal co-ordinates- Introduction of modal analysis- Rayleigh Method

MODULE IV INTEGRATION METHODS FOR DYNAMIC RESPONSE 9+3

Nonlinear MDOF systems - Wilson Theta method - Newmark's beta method - step-by- step numerical integration techniques

MODULE V DESIGN AGAINST BLAST AND IMPACT 9+3

Characteristics of internal and external blast - Impact and impulse loads - pressure distribution on buildings above ground due to external blast - underground explosion -design of buildings for blast and impact as per BIS codes of practice.

L – 45; T – 15; Total Hours - 60

REFERENCES:

1. Anil K.Chopra, “Dynamics of Structures: Theory and Applications to Earthquake Engineering”, Prentice Hall, Englewood Cliffs, New Jersy, Second Edition, 2001.
2. Cheng, F.Y., “Matrix Analysis of Structure Dynamics”, Marcel Dekker, New York,2001.
3. Clough, R.W. and Penzien,J., “ Dynamics of Structures”, Computers and Structures, Incorporated, 2003, 2nd Edition, 2003.
4. Mario Paz, “Structural Dynamics: Theory and Computation”, CBS Publications, New Delhi, 2001.
5. Manicka Selvam K., “Elementary Structural Dynamics”, Dhanpatrai and sons, NewDelhi,2001.
6. Hurty.W.C, Rubinstein.M.F, ”Dynamic of Structures”, Prentice Hall of India Pvt. Ltd. New Delhi,2002.

OUTCOMES:

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

- Develop the mathematical modeling of dynamic systems using fundamental theory and equation of motion
- Develop the equation of motion for single degree of freedom
- Analyse to determine the response of multi degree freedom system
- Find the dynamic response of structures using numerical integration procedure
- Design the buildings for blast and impact forces using BIS codes of practice

CED 6103 ADVANCED CONCRETE TECHNOLOGY L T P C

3 0 2 4

OBJECTIVES:

- To impart sufficient knowledge on the transition zone in concrete, mix design of concrete, rheological behaviour of fresh concrete and hardened properties of concrete.
- To provide knowledge on durability properties of concrete, Non-destructive testing for concrete and different types of special concretes.

MODULE I STRUCTURE OF CONCRETE, MIX DESIGN & RHEOLOGY OF CONCRETE 9

Introduction to concrete – Mineral and chemical admixtures – Structure of hydrated cement paste – Transition zone in concrete - Design of concrete mix proportions by ACI and IS 10262:2009 method - IS Method, ACI Method, DOE Method– Statistical quality control–Sampling and acceptance criteria. High Performance – Entropy and Shack lock's Empirical graphs –particle packing theory – Rheological behaviour of fresh concrete

MODULE II HARDENED CONCRETE 9

Properties of hardened concrete and their significance- Strength-Porosity relationship – Failure modes in concrete – Behaviour of concrete under various stress states – Elastic behaviour in concrete - Creep, shrinkage and thermal properties of concrete.

MODULE III DURABILITY OF CONCRETE 9

Strength and Durability Relationship – Volume changes on concrete – Permeability – Interaction between Permeability, Volume Change and Cracking – Factors contributing to cracks in concrete- Freeze and thaw - sulphate attack, alkali aggregate reaction, corrosion of steel rebar – acid attack - concrete in sea water – Tests on durability properties of concrete - water absorption, permeability, sorptivity, resistance to chemical attack, freeze and thaw resistance, accelerated corrosion test, RCPT test, half-cell potential test and macrocell corrosion test.

MODULE IV NON-DESTRUCTIVE TESTING FOR CONCRETE 9

Non-Destructive testing: Rebound hammer–Windsor probe–Ultrasonic pulse velocity – Acoustic emission – Pulse-echo method – Initial surface absorption – Radar technique– Infrared Thermography – Quantab test – Portable crack measuring microscope – Cover meter –Resistivity of concrete – Semi-destructive testing.

MODULE V ADVANCED CEMENTITIOUS COMPOSITES 9

Fibre reinforced Cementitious Composites - High strength Cementitious Composites –– Polymers in concrete-Self Compacting Concrete—Shrinkage compensating concrete– Engineered Cementitious Composite - Tube Reinforced Concrete - High Volume fly ash concrete - Structural Light Weight Concrete – Heavyweight Concrete –Sprayed Concrete.

Total Hours : 45

List of Experiments

1. Mix design of normal strength grade and high strength grade concrete
2. Correlation between cube strength, cylinder strength, splitting tensile strength and modulus of rupture
3. Study of stress - strain curve of plain concrete, self-compacting concrete and high strength concrete and determination of Young's modulus.
4. Fresh properties of self-compacting concrete
5. Durability Tests on Concrete – RCPT, sorptivity test, Acid resistance test, Sea water resistance, permeability test.
6. Test on hardened concrete using Non - Destructive Testing Techniques
    i. Rebound Hammer method
    ii. Ultrasonic method

Total Hours - 30

REFERENCES:

1. Zongjin Li, Advanced Concrete Technology, John Wiley & Sons, 2011.
2. Nayak, N.V, and Jain, A.K, Handbook on Advanced Concrete Technology, Narosa Publishing House Pvt. Ltd., New Delhi, 2012.
3. Neville, A.M., and Adam M. Neville, Properties of Concrete, 5th Edition, Pearson, 2011.
4. Krishnaraju,N., Design of Concrete Mixes, CBS Publishers, New Delhi,2007.

5. Mehta P.K., and Paulo J.M. Monteiro, Concrete: Microstructure, Properties, and Materials, McGraw-Hill Professional, USA, 2005.
6. Malhotra, V.M. and Carino, N.J., “Handbook on Non-destructive Testing of Concrete”, CRC Press, 2004.

OUTCOMES:

On completion of the course, students will be able to

- Describe the rheological behaviour of fresh concrete and perform the mix design of concrete as per specified standards.
- Elucidate the properties of hardened concrete and study the behavior of concrete under various stress
- Describe and perform the durability characteristics of different types of concrete.
- Evaluate the concrete structure by using various non-destructive testing methods.
- Suggest suitable type of concrete based on the application and durability requirements.

CED 6104 STRUCTURAL ENGINEERING DESIGN STUDIO

L	T	P	C
0	0	2	1

OBJECTIVES:

- To get acquainted with latest software's used in the field of structural engineering for analysis, and design

MODULE I ANALYSIS OF STRUCTURES **15**

Static and Dynamic analysis of G+3 structure using software (ETABS / STAADPRO)

MODULE II DESIGN & DETAILING OF STRUCTURES **15**

Preparation of spread sheets for structural design of RCC and Steel structures.
Detailing of RCC and Steel structures.

Total Hours :30

REFERENCES:

1. Arthur.H Nilson, David Darwin and Charles W Dolan, Design of Concrete Structures, Tata McGraw Hill, 2004.
2. Park,R and Paulay T, Reinforced Concrete Structures, John Wiley & Sons,NewYork,1975.
3. Subramanian.N, Design of Steel Structures, Oxford University Press, New Delhi, 2008.
4. Swami Saran, Analysis and Design of Substructures, Oxford and IBH Publishing, New Delhi, 2008
5. IS 456 :2000, Indian Standard for Plain and Reinforced Concrete- Code of Practice, BIS, New Delhi
6. IS 13920 : 1993, Indian Standard for Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice, BIS, New Delhi

OUTCOMES:

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

- Analyse the structure by using the relevant software
- Perform design of RCC and Steel structures through spread sheets and drafting by using CAD software

SEMESTER – II

CED 6211	FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To introduce the fundamental concepts of finite element method
- To incorporate overview of matrix techniques and concepts of one, two and higher order elements
- To expose the finite element software to analyse the structural members

MODULE I FUNDAMENTAL CONCEPTS 9

Stresses and equilibrium – Boundary conditions – strain displacement relations – stress- strain relations – potential energy and equilibrium – weighted integral and weak formulation – variational approach – Rayleigh Ritz method – Galerkin method**.**

MODULE II ONE AND TWO DIMENSIONAL FORMULATION 9

The concept of an element - derivation of Elemental Equations – coordinates and shapes functions – Assembly of global stiffness matrix and global load vector – treatment of boundary conditions – constant strain triangle – stress calculations – Isoparametric elements - Lagrange and serendipity elements

MODULE III HIGHER ORDER ELEMENTS 9

Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.

MODULE IV MESHING AND SOLUTION PROBLEMS 9

Pre and post processor interpretations - p and h methods of refinement - ill conditioned elements - discretization errors – patch test - auto and adaptive mesh generation techniques - error evaluation

MODULE V NONLINEAR AND VIBRATION PROBLEMS 9

Material and Geometric Non-linearity - Consistent System Matrices _Dynamic Condensation - Eigen Value Extraction - modal methods _ integration methods -

Application to Thermal analysis.

List of Exercises:

1. Analysis of simple and continuous beam
2. Analysis of Two-dimensional Truss
3. Nonlinear Analysis of a Cantilever Beam
4. Eigenvalue Buckling Analysis
5. Modal Analysis of a Cantilever Beam
6. Harmonic Analysis of a Cantilever Beam
7. Transient Analysis of a Cantilever Beam

L-45;P-30;Total Hours :75

REFERENCES:

1. Seshu, P., Text Book of Finite Element Analysis, Prentice-Hall of India Pvt. Ltd.,New Delhi, 2007.
2. Cook Robert. D., Plesha, Michael. E & Witt, Robert.J. Concepts and Applications of Finite Element Analysis, Wiley Students Edition, 2004.
3. David V. Hutton Fundamentals of Finite Element Analysis, Tata McGraw-Hill Edition, 2005.
4. Tirupathi R. Chandrupatla, Ashok D. Belegundu, “Introduction to finite elements in engineering”, Prentice Hall of India, New Delhi, 2007.
5. Krishnamoorthy,C.S, “Finite Element Analysis Theory and Programming”, TataMcGraw Hill Publishing Co.Ltd. New Delhi 2004.
6. Reddy, J.N, “An Introduction to the finite element method”, McGraw Hill International Edition, New York, 3rd edition 2008.

OUTCOMES:

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

- solve the boundary value problems using approximate methods.
- derive the elemental equations and shape function for one and two dimensional elements.
- generate the isoparametric functions for various elements.
- perform the mesh refinement and error evaluation for various elements.
- model and analyse 2D and 3D systems using finite element software.

CED 6212 EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the phenomena of earthquakes and its measurements, factors that affect the design of structures in seismic areas.
- To impart knowledge on the fundamentals of load calculation for various structural systems, design and detailing aspects of structures subjected to earthquake loading.
- To provide insight knowledge on the seismic retrofitting techniques and response control system of structures.

MODULE I ENGINEERING SEISMOLOGY & DYNAMIC RESPONSE OF STRUCTURES 9

Introduction to engineering seismology – plate tectonics- faults- causes of earthquake-- Seismic waves - Liquefaction – Evaluations & its Mitigation- Seismic Bearing Capacity of Foundations - Magnitude of earthquake – Intensity-measurement – seismographs – Characteristics of strong ground motions - seismic zones of India – Review on the Dynamic response of structures

MODULE II SEISMIC DESIGN CONCEPTS 9

Earthquake load on simple buildings – load path – floor and roof diaphragms – seismic resistant building architecture – plan configuration – vertical configuration – pounding effects – mass and stiffness irregularities – Flexible Building and Rigid Building Systems- torsion in structural system

MODULE III SEISMIC METHODS OF ANALYSIS 9

Philosophy and Principles of earthquake -resistant design- Design earthquake loads-– Seismic Methods of Analysis – seismic co-efficient method – response spectrum analysis - factors in seismic analysis – Modal Analysis – Time History Method

MODULE IV SEISMIC BEHAVIOUR OF STRUCTURES 9

Behaviour of unreinforced and reinforced masonry walls – Behaviour of Infill walls – Improving seismic behaviour of masonry buildings – Seismic design of masonry

buildings - earthquake resistant design of RC members – beams – columns –joints of frames – slabs – staircases – shear wall – behaviour & design of shear walls – steel frames – steel panel zones – bracing members–connection design and joint behaviour.

MODULE V SEISMIC RESTORATION & RESPONSE CONTROL SYSTEMS 9

Seismic restoration techniques - Damages in structures - repair materials for seismic strengthening - retrofitting techniques - response control systems - Active, Passive, Semi- active & hybrid systems

Total Hours : 45

REFERENCES:

1. Duggal S.K., Earthquake Resistant Design of Structures. Oxford university press,2007.
2. Paulay.T and Priestly. M.N.J., Aseismic Design of Reinforced Concrete and Masonry Building, John Wiley and Sons, 2007.
3. Anil K.Chopra, Dynamics of Structures Theory and Applications to Earthquake Engineering, Prentice Hall of India (P) Ltd., New Delhi, 2nd Edition, 2015.
4. Datta T.K., Seismic Analysis of Structures, John Wiley & Sons, 2010.

OUTCOMES:

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

- identify the types of seismic waves, measure the magnitude of earthquake and evaluate the natural frequencies & modes shapes for structures.
- Describe the conceptual design of the structural systems
- perform seismic analysis of structures using various methods.
- describe the seismic behaviour and design the masonry, RC and steel buildings.
- suggest suitable retrofitting and strengthening methods for structural members and describe the seismic base isolation & passive energy dissipation for seismic response control of civil engineering structures.

GED 6201 RESEARCH METHODOLOGY

L	T	P	C
4	0	0	4

OBJECTIVES:

- To provide a perspective on research to the scholars
- To educate on the research conceptions for designing the research
- To impart knowledge on statistical techniques for hypothesis construction
- To gain knowledge on methods of data analysis and interpretation
- To learn about the effective communication of research finding

MODULE I RESEARCH PROBLEM FORMULATION 12

The research problem – Sources of research problem – Information, how to deal with it – Criteria / characteristics of a good research problem – Errors in selecting a good research problem – Types of research – Nature and use of arguments.

MODULE II HYPOTHESIS FORMULATION 12

Research design – meaning and need – basic concepts, Different research designs, experimental design – principle – important experimental designs, Design of experimental setup, mathematical modeling, simulation – validation and experimentation, dimensional analysis and similitude.

MODULE III STATISTICAL TECHNIQUES 12

Statistics in research – concept of probability – popular distributions –hypothesis testing- sample design- design of experiments – factorial designs -– orthogonal arrays- ANOM - ANOVA - Multivariate analysis - use of optimization techniques – traditional methods – evolutionary optimization techniques –transportation model

MODULE IV STATISTICAL ANALYSIS OF DATA 12

Research Data analysis – interpretation of results – correlation with scientific facts- Accuracy and precision – error analysis, limitations - Curve fitting, Correlation and regression.

MODULE V RESEARCH REPORT 12

Purpose of written report – audience, synopsis writing, preparing papers for international journals, thesis writing – organization of contents – style of writing – graphs and charts – referencing, oral presentation and defense, ethics in research, Patenting, Intellectual Property Rights.

Total Hours : 60

REFERENCES:

1. Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai,2011.
2. George E. Dieter., Engineering Design, McGraw Hill – International edition, 2000.
3. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
4. Holeman, J.P., Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2007.
5. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi, 2010.

OUTCOMES:

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

- Identify the research problem.
- Analyze the data using mathematical techniques.
- Apply the statistical concepts in research.
- Demonstrate the different research methods applicable to a specific problem.
- Prepare the papers for the Journals

CED 6213 ADVANCED DESIGN OF METAL STRUCTURES L T P C
3 1 0 4

OBJECTIVES:

- To impart sufficient knowledge to students on various codal provisions for steel structural design.
- To offer knowledge to analyse and design different types of bolted and welded connections; industrial structural members; cold formed structural elements; and special structures such as chimney etc.
- To give exposure to students on plastic analysis of structures.

MODULE I DESIGN OF CONNECTIONS 9+3

Types of connection - importance - codal provisions as per IS: 800 - behaviour and design of bracket connection - unstiffened and stiffened seated connections – framed connections - connections for force and moment transmission – tee stub and end plate connections - stiffeners and other reinforcement.

MODULE II PLASTIC ANALYSIS OF STRUCTURES 9+3

Introduction - concepts of plastic design - shape factor - redistribution of moments plastic collapse load - conditions of plastic analysis - methods of plastic analysis plastic design of portal frames- Connections - requirement - design of straight and haunched connections.

MODULE III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS 9+3

Review of loads on structures - dead, live wind and seismic loads as per standards - requirements of industrial buildings - structural framing - braced frames & unbraced frames - analysis and design of Industrial building components such as roof truss, rafter bracing, purlin, eave girder, stanchions, gable column and bents - analysis and design of gable frames - design of moment resisting baseplates.

MODULE IV ANALYSIS AND DESIGN OF COLD–FORMED STEEL STRUCTURES 9+3

Types of cross sections – concepts of local buckling and effective width – codal provisions as per IS: 801 - analysis and design of unstiffened and stiffened compression elements - design of webs of beams - design of flexural members -

economic design for beam strength - concept of lateral buckling of beams - concept of lateral bucking and bracing requirement – concept of shear lag and flange curling - design of compression members - design of wall studs and connection details.

MODULE V DESIGN OF ALUMINUM & TUBULAR STRUCTURES 9+3

Design of Aluminum Structures: Introduction – Stress-strain relationship – Permissible stresses – Tension members – Compression members – Laced and battened columns – Beams – Local buckling of elements of compression – Riveted and bolted connections. Design of tubular structures –Design of tension and compression members, Connections, truss configurations, space structures.

L – 45; T – 15; Total Hours : 60

REFERENCES:

1. W.F. Chen, E.M. Lui, Principles of Structural Design, CRC Press,2005
2. Teaching Resource for Structural Steel Design, INSDAG, Kolkatta, 2010.
3. Wei-Wen Yu, Cold-Formed Steel Design, John Wiley & Sons, 2000.
4. Ramchandra, S., Design of Steel Structures, Vol.-II, Standard Publications, New Delhi, 2010.
5. Subramanian N, Steel Structures - Design and Practice, Oxford University Press,2011.
6. Duggal S.K., Design of Steel Structure, Tata McGraw-Hill Education, 2009.

OUTCOMES:

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

- design connections for the expected shear force and bending moment
- describe the concepts of plastic design, methods of plastic analysis and plastic collapse mechanism.
- design components of industrial building such as roof truss, purlins, columns, bracing based on application requirement.
- analyse and design cold formed flexural members, compression members and wall studs.
- Design the tension and compression members of aluminum & tubular Structures

VALUE ADDED COURSES

ETABS	L	T	P	C
	0	0	2	1

OBJECTIVES

- To impart knowledge on ETABS Software

MODULE I INTRODUCTION TO ETABS 8

Modeling of a building structure: an overview, Objectives and strategies - Introduction to ETABS: Its history and current capabilities - ETABS GUI - Modeling overview from start to finish by a simple example - Analysis Flavors - Linear, Non-linear

MODULE II OBJECT BASED MODELLING 7

Major differences from element-based modeling - Good work methods - Modeling Objects of ETABS viz, point, line, area and link objects - Polymorphism of objects - Point Objects - Line objects - Area objects - Link Objects - All type of objects present in the same model.

MODULE III LOAD CASES & ANALYSIS 8

Setting up load cases for analysis - Overview of analysis available in ETABS viz. Linear/Nonlinear cases and types such as static, Spectrum, buckling, modal, time history, staged analysis etc - Simple examples of each type of analysis - Non-linear analysis to account for contact problems and geometric non-linearity like P-Delta analysis, Staged analysis etc - Non-linear Pushover analysis - An overview, objectives and strategies - Detailed example of pushover analysis, interpretation of results and drawing the inferences - Discrete non-linear element - The usefulness of such non-linear elements - Concept of energy dissipation. Analysis with dampers and base isolators - Base Isolation basics.

MODULE IV DESIGN OF VARIOUS STRUCTURES 7

Design of concrete frames - Design of Steel frame elements - Modeling and design of shear walls - Foundation modeling importance, cases - Practical hints on modeling to satisfy the building codes - Certain non-linear analyses related with P-Delta - Design of shell elements like base mats and flat slabs

P – 30; Total Hours –30

TEXT BOOKS:

1. RAGHUNANDAN M H “Analysis of Structural Elements by STAAD Pro for beginners [with RCC design]: 2nd Edition, 2018

REFERENCES:

1. Prof. Sham Tickoo **“**Exploring Bentley STAAD.Pro CONNECT Edition, 3rd Edition by CADCIM Technologies, 2018

OUTCOMES:

The student will be able to

- model a building using ETABS software
- create an element-based model
- load and analyze linear and nonlinear cases
- design various structures using ETABS

CED 7102	INTERNSHIP	L	T	P	C
		0	0	2	1

GENERAL GUIDELINES:

- It is one credit for two weeks of internship.
- Internship shall be of not less than two weeks duration and shall be organized by the Dean of the Department.
- Students should choose preferably, government agencies/ IIT's/ NIT's /major industries in their specialization to do their internship
- At the end of industrial internship, the student shall submit a certificate and feedback from the organization. Students should also submit a brief report.
- The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a Departmental Committee constituted by the Head of the Department.

CED 7101	PROJECT WORK (PHASE I)	L	T	P	C
		0	0	0	6

OBJECTIVES:

To provide opportunity for the students to exhibit their capacity in executing a project work and provide meaningful solution to research or real-world problem related to Structural and civil Engineering.

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 Structural and Civil Engineering and approach any faculty member of the department with expertise in that field and get his 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 related to proposed topic and the faculty member willing to act as guide shall be informed to the project 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 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 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.

OUTCOMES:

Students will be able to

- Apply their practical knowledge and skill in Civil Engineering with specialization in to solve real time problems
- Prepare an appropriate documentation

CED 7101	PROJECT WORK (PHASE II)	L	T	P	C
		0	0	0	18

OBJECTIVES:

To provide opportunity for the students to exhibit their capacity in executing a project work and provide meaningful solution to research or real-world problem related to Structural and civil Engineering.

GENERAL GUIDELINES:

- Project work phase II is a continuation of phase I following the same guidelines.
- The project 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 investigation.
- The students are expected to analyse the obtained results and discuss the same in an elaborate manner by preparing necessary charts / tables / curves to get an inference.
- The important conclusions need to be drawn and scope for further research also to be highlighted.
- The 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 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 coordinator 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.

OUTCOMES:

Students will be able to

- Apply their practical knowledge and skill in Civil Engineering with specialization in to solve real time problems.
- Prepare an appropriate documentation.

VALUE ADDED COURSE	L	T	P	C
	0	0	0	0

OBJECTIVES:

- To expose the latest technology / tools used in the industry and enable the students acquire knowledge and skill set in the same.

GENERAL GUIDELINES:

- Students should undergo any relevant certification course offered by the institution or other institutions / universities / IIT / IISc etc. for a minimum of 40 hours.
- Selection and completion of value-added course by the students shall be endorsed by Head of the Department.

OUTCOMES:

- Students should be exposed and gained knowledge in any one latest technology used in the industry

MOOC COURSE	L	T	P	C
	0	0	0	0

OBJECTIVES:

- To learn the basics principles and concepts of the topic in which a project work is undertaken by the student.

GENERAL GUIDELINES:

- Students shall identify a MOOC course related to his/her project topic in consultation with the project supervisor.
- Student shall register for a MOOC course with minimum two credit offered by any recognized organization during the project phase I.
- Selection and completion of MOOC course by the students shall be endorsed by Head of the Department.

OUTCOMES:

Students will be able to

- Familiarize the basic principles and concepts related to the topic of his/her project work.
- Utilize the knowledge gained in the field of study to perform literature review with ease.
- Formulate the experimental / analytical methodology required for the project work

PROFESSIONAL ELECTIVES
ODD SEMESTER

CEDY 101	BLAST RESISTANT DESIGN OF STRUCTURES	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To impart knowledge on the concepts of phenomenon of explosion and ground shock on the structures.
- To understand the structural analysis for impulsive loading and design against the blast in buildings.
- To provide in-depth knowledge on the blast retrofitting structures and understand the finite element software tools for designing the structures.

MODULE I BASIC CONCEPTS **7**

Explosion Phenomena, Shock Front, Fragmentation, Waves, Ground Shock and Interaction with Structures

MODULE II ANALYSIS FOR BLAST LOADING **8**

Structural Analysis for Impulsive Loading; Pressure-Impulse (PI) Diagrams; Material Behavior under High Strain-Rate of Loadings

MODULE III BLAST RESISTANT DESIGN **8**

Blast Resistant Design of Structures; Performance-Based Blast Design; Progressive Collapse; Anti-Terrorism Planning and Design of Facilities

MODULE IV BLAST RETROFITTING OF STRUCTURES **7**

Indian/ International Standards and Codes of Practice; Numerical Analysis Tools for Blast Analysis using Finite Element (FE) Software and Hydro codes.

Total Hours : 30

REFERENCES:

1. T. Bangash , Explosion-Resistant Buildings: Design, Analysis, and Case Studies, springer – Verlag Berlin Heidelberg, 2006

2. David Cormie, Geoffrey Mays, Peter Smith**,** Blast effects on buildings, Snippet view, 2009

OUTCOMES:

On completion of the course, students will be able to

- Identify the types of blast loadings
- Analyse structures against blast loading
- Design the structures against blast loading
- Identify the retrofitting methods for blast resistant structures

CEDY 102	CONDITION ASSESSMENT AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in-depth knowledge on various causes of failures due to environmental problems and natural hazards.
- To give a detailed assessment procedure for evaluating the distressed structure, materials available for effecting repair and techniques for effective rehabilitation.
- To offer sound knowledge on seismic rehabilitation of damaged structures

MODULE I CAUSES FOR FAILURES 9

Causes of distress in structural members – design and material deficiencies – over loading - Embedded Metal Corrosion, Disintegration Mechanisms, Moisture Effects, Thermal Effects, Structural Effects, Faulty Construction - Damages due to earthquake, fire & cyclone - case studies - learning from failures

MODULE II DIAGNOSIS AND ASSESSMENT OF DISTRESS 9

Visual inspection – non destructive tests – ultrasonic pulse velocity method – rebound hammer technique – ASTM classifications – pullout tests – Bremor test – Windsor probe test – crack patterns- crack detection techniques – Chemical testing - case studies – single and multistorey buildings – Fibre optic method for prediction of structural weakness

MODULE III MATERIALS FOR REPAIR 9

Strategy & Design, Selection of Repair Materials, Surface Preparation, Bonding repair Materials to Existing concrete, Placement Methods, - Epoxy Bonded Replacement Concrete, Preplaced Aggregate Concrete, Shotcrete/ Gunite, Grouting, Injection Grouting, Micro concrete - methods of corrosion protection - corrosion inhibitors - protective coating materials for rebar and concrete - corrosion resistant steel – cathodic protection

MODULE IV MODERN TECHNIQUES OF RETROFITTING 9

Guniting - jacketing – use of chemicals in repair – application of polymers – ferrocement SIFCON, SIMCON, Fibre Reinforced Polymer Composites - rust eliminators and polymer coating for rebars- mortar repair for cracks- shoring and underpinning – strengthening by pre-stressing – case studies–bridges–water tanks–cooling towers–heritage buildings – high rise buildings.

MODULE V SEISMIC REHABILITATION OF STRUCTURES 9

Guidelines for Seismic Rehabilitation of Existing Buildings, Seismic Vulnerability and Strategies for Seismic Retrofit- case study for a RC building, steel frame building and masonry building.

Total Hours : 45

REFERENCES:

1. Emmons, P.H., “Concrete Repair and Maintenance”, Galgotia Publication, 2001
2. Malhotra, V.M. and Carino, N.J., “Handbook on Non-destructive Testing of Concrete”, CRC Press,2004.
3. Denison Campbell, Allen and Harold Roper, “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical, UK, 1991.
4. Natarajan C., R. Janardhanam, Shen-En Chen, Ryan Schmidt, Ino-U.S. “Forensic Practices - Investigation Techniques and Technology”, NIT, Tiruchirappalli, 2010.
5. FEMA 273; NEHRP Guidelines for the Seismic Rehabilitation of Buildings,2005
6. ATC- 40: Seismic Evaluation and Retrofit of Concrete Buildings, Vol. 1 & 2,2005
7. Seible, F. and Calvi, G.M., “Seismic Design and Retrofit of Bridges”, John Wiley,2005.

OUTCOMES:

On completion of the course, students will be able to

- Specify the various causes for distress in structures due to environmental problems and natural hazard.
- Critically diagonize the distressed structure and generate a systematic condition assessment of damaged structures using conventional and non-destructive testing methods.

- Suggest suitable materials for repair based on damage level, deterioration mechanism and durability requirements of the distressed structures.
- Recommend repair techniques for rehabilitation of damaged structural elements based on deterioration level, serviceability and durability requirements.
- Suggest suitable retrofitting and vulnerability strategic methods for seismically damaged structures.

CEDY 103 CORROSION OF STEEL IN CONCRETE L T P C

3 0 0 3

OBJECTIVES:

- To impart sound knowledge on mechanism of corrosion of steel in concrete, its causes, consequences and control measures.
- To offer knowledge on codal provisions for enhancing durability and corrosion rate measurement in distressed structures including rehabilitation techniques.

MODULE I CORROSION MECHANISM 9

Corrosion mechanism – black rust - pits - stray current - bacterial corrosion-causes of corrosion – carbonation - chloride attack - influence of concrete cover-corrosion damage – damage in conventionally reinforced concrete and prestressed concrete - stress corrosion cracking - hydrogen embrittlement- cost of corrosion - worldwide scenario.

MODULE II CORROSION CONTROL IN REINFORCED CEMENT CONCRETE 9

Control of carbonation - control of chlorides - high performance concrete-corrosion inhibitors – anodic, cathodic and mixed Inhibitors-protective coatings to steel rebars – fusion bonded epoxy coating, galvanization, cement polymer composite coating, inhibited cement slurry coating and anticorrosive polymer cementitious coatings - stainless steel reinforcement - sealers and membranes – cathodic protection.

MODULE III CONDITION EVALUATION AND CORROSION 9

Preliminary survey - visual Inspection - detailed survey - delamination, - cover - half cell potential measurements - carbonation depth measurement - chloride determination and resistivity measurement - corrosion rate measurement – linear polarization resistance techniques - impedance studies - macrocell techniques - potential-time behavior studies and accelerated corrosion studies.

MODULE IV REHABILITATION TECHNIQUES 9

Physical and chemical rehabilitation techniques - concrete removal and surface preparation - patches - coatings and sealers - membranes and barriers -

encasement and overlays - sprayed concrete - corrosion inhibitors - electrochemical repair techniques – basic principles – cathodic protection - chloride removal and realkalization

MODULE V CODAL REQUIREMENTS FOR DURABILITY 9

Indian standard codal requirements for enhancing durability of R.C.C. structures - Indian and ASTM codal provisions for coated rebars -galvanized reinforcement-corrosion inhibitors - bond strength test.

Total Hours : 45

REFERENCES:

1. Arnon Bentur, Sidney Diamond and Neal S. Berke, Steel Corrosion in Concrete –Fundamentals and Civil Engineering Practice, E & FN SPON Publications, Madras,1997.
2. John P.Broomfield, Corrosion of steel in concrete - Understanding, investigation and repair, E & FN SPON Publications, Madras,1997.
3. Mars G. Fontana, Corrosion Engineering Mc-Graw Hill Publishers, New Delhi,2001.
4. Philip H. Perkins, Repair, Protection and Waterproofing of Concrete Structures, Elsevier Applied Science Publishers, London, 1986.

OUTCOMES:

At the end of course, students will be able to

- describe the corrosion mechanism of steel in concrete including its causes and consequences.
- suggest active and passive measures to control corrosion of steel rebars in concrete environment.
- perform condition evaluation studies on corrosion damaged structures by employing conventional and electrochemical corrosion rate measurement techniques.
- recommend physical and chemical rehabilitation techniques based on serviceability needs.
- Specify standards to conduct performance evaluation tests on coated rebars and corrosion inhibitors.

CEDY 104 DESIGN OF BRIDGES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on types of bridges, need for investigation, load distribution theories, IRC specification for road bridges and design of short span bridge.
- To develop an understanding of the behaviour and design of long span bridges, prestressed concrete bridges.
- To give exposure to design principles of plate girder bridges, steel truss bridges, types of bearings and design of sub structures.

MODULE I INTRODUCTION AND SHORT SPAN BRIDGES 9

Components of bridge - Need for investigation- types of bridges and loading standards - Materials of construction- investigation and planning - choice of type - I.R.C. specifications for road bridges - general design considerations - load distribution theories- Design of RCC solid slab bridges- analysis and design of slab culverts, T-beam, deck slab and cantilever slab.

MODULE II LONG SPAN BRIDGES 9

Design principles of continuous bridges - box girder bridges - balanced cantilever bridges - Cable stayed bridge.

MODULE III PRESTRESSED CONCRETE BRIDGES 9

General aspects-types of prestressed concrete bridges - typical cross section detailing - over view of design principles of prestressed concrete - pre-tensioned prestressed concrete bridge - post-tensioned prestressed concrete bridge - design of post-tensioned prestressed concrete slab bridge deck and T-beam.

MODULE IV STEEL BRIDGES 9

Types of plate girder bridges - design principles - codal provisions and loading standards- design of plate girder bridges - intermediate stiffeners - end bearing stiffeners- Truss bridges-types-design of truss bridge.

MODULE V BEARINGS AND FOUNDATION FOR BRIDGES 9

Bridge bearings – types - design principles – design of steel rocker bearing. – Design of piers and abutments of different types – bridge foundation– Types of bridge

foundations– design of well foundation – design of pile foundation.

Total Hours :45

REFERENCES:

1. Krishnaraju, N., "Design of Bridges" Oxford and IBH Publishing Co., New Delhi, 2010.
2. Petros P. Xanthakos, " Theory and Design of Bridges", .John Wiley & Sons, 2007.
3. Hambly, E.C., Bridge Deck Behaviour, Chapman and Hall. (1991).
4. T.R. Jagadeesh and M.A. Jayaram, “Design of Bridge Structures,” Prentice-Hall of India, New Delhi, 2006.
5. Ponnuswamy, Bridge Engineering, Tata McGraw-Hill Education, 2008.
6. Johnson Victor D., "Essentials of Bridge Engineering", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2008.
7. Raina. V. K “Concrete Bridge Practice Analysis, Design and Economics”, 4th Edition, Shroff Publishers and Distributors Pvt. Ltd., 2014)

OUTCOMES:

At the end of course, students will be able to

- design slab culverts and T-beam bridge superstructure for the IRC loading conditions.
- describe the design principles of continuous bridges, box girder, balanced cantilever bridges and arch bridge for its use in real time conditions
- design posttensioned prestressed concrete slab bridge and T-beam bridge superstructure for the IRC loading.
- design steel plate girder bridge and truss bridge based on IRS loading conditions.
- design bearing and substructure for pile foundation and well foundation as per IRC.

CEDY 105 DESIGN OF INDUSTRIAL STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To provide relevant knowledge on functional requirements of industrial buildings and to design various industrial building components.
- To provide knowledge on design of various special structures and transmission line towers

MODULE I GENERAL 9

Classification of industries and industrial structures – general requirements of various industries – engineering, textiles, chemicals etc, - planning and layout of buildings and components.

MODULE II FUNCTIONAL REQUIREMENTS 9

Lighting – illumination levels – characteristics of good lighting – principles of day lighting design – artificial lighting – ventilation – natural and mechanical ventilation – evaporate cooling design – measurement – contaminant control – installation and operation - acoustics – fire safety – guidelines from factories act

MODULE III INDUSTRIAL BUILDINGS 9

Industrial building frames - analysis of industrial bents – design of gable frames - industrial roofs - crane girders - machine foundations

MODULE IV SPECIAL STRUCTURES 9

Design of corbels and nibs - analysis and design of bunkers and silos – design of chimneys –– design of cooling towers

MODULE V POWER TRANSMISSION STRUCTURES 9

Tower configuration and bracings – loads acting on towers – analysis and design of lattice towers – transmission line towers – tower foundations

Total Hours :45

REFERENCES:

1. SP 32: 1986, Handbook on Functional Requirements of Industrial buildings.
2. Manohar S.N., Tall Chimneys; Design and Construction, Tata McGraw Hill, 1985.

3 Santhakumar A.R. and Murthy S.S, Transmission Line Structures, McGraw-Hill, 1990.

4 Krishna Raju, Advanced Concrete Structures, McGraw Hill, New Delhi, 2000.

5 Ramchandra, Design of Steel Structures, Standard Book House, NewDelhi,2007.

6 Dayaratnam P., Design of Steel Structures, Wheeler and Co., New Delhi,1999.

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OUTCOMES:

Upon successful completion of the course, students will be able to

- plan for general requirements in an industry and prepare a layout on buildings and structural components for various industries
- make an appropriate lighting & ventilation and identify a suitable measure to control fire as per factories act in an industrial structure.
- design an industrial building with bents along with crane girder; describe suitable foundations for the various types of machines/equipment in an industry.
- analyse and design a RC structure such as corbels, bunkers, silos, chimneys and cooling towers in an industry.
- Identify suitable tower configurations for power transmission, analyse and design a lattice tower with suitable foundations.

CEDY 106 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the behaviour of composite beams, columns and connections.
- To understand the behaviour and design concepts of composite box girder bridges and composite trusses.

MODULE I CONCEPTS OF STEEL CONCRETE COMPOSITE CONSTRUCTION **9**

Introduction to steel-concrete composite construction - theory of composite structures - introduction to steel-concrete - steel sandwich construction.

MODULE II DESIGN OF COMPOSITE MEMBERS **9**

Behaviour of composite beams - columns - design of composite beams - steel - concrete composite columns - design of composite trusses

MODULE III DESIGN OF CONNECTIONS **9**

Types of connections - design of connections in the composite structures - shear connections - design of connections in composite trusses

MODULE IV COMPOSITE BOX GIRDER BRIDGERS **9**

Introduction - behaviour of box girder bridges - design concepts

MODULE V CASE STUDIES ON STEEL CONCRETE COMPOSITE CONSTRUCTION **9**

Case studies on steel-concrete composite construction in buildings-Seismic behaviour of composite structures.

Total Hours : 45

REFERENCES:

1. Johnson R.P., Composite Structures of Steel and Concrete, Blackwell Scientific Publications (Second Edition), UK, 2005.
2. Owens, G.W. and Knowels. P., Steel Designers Manual (Fifth edition), Steel Concrete Institute (UK), Oxford Blackwell Scientific

Publications,2002.

OUTCOMES:

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

- Describe the composite structures using various theories.
- Design the composite beams and columns.
- Analyse and design the connections in composite structures.
- Design composite box girder bridges.
- Describe the steel concrete composite construction in buildings through case studies.

CEDY 107 EXPERIMENTAL METHODS IN STRUCTURAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on the similitude principles and model analysis that governs the design, testing and interpretation of models.
- To provide sufficient knowledge on the various aspects of elastic and inelastic models of various materials
- To impart sound knowledge on the various model fabrication techniques and emphasis on instrumentation techniques
- To gain knowledge on the various types of loading that are acting on the structures.

MODULE I THEORY OF STRUCTURAL MODELS 7

Dimensions and Dimension Homogeneity - Dimensional Analysis - Structural Models- Similitude requirements-Physical Modeling and choice of geometric scale-Modeling process-Advantages and limitation of Model Analysis-Accuracy of Structural Models.

MODULE II MATERIALS FOR ELASTIC AND INELASTIC MODELS **9**

Materials for elastic models-Plastics-Time effects in Plastics-effect of loading rate, temperature and environment-Inelastic models – Prototype and model concretes-design mixes for model concrete-structural steel models-reinforcement for small scale concrete models – Model prestressing reinforcement and techniques - Bond characteristics of model steel - bond similitude.

MODULE III MODEL FABRICATION TECHNIQUES **9**

Basic cutting, shaping and machining operation-basic fastening and gluing techniques- Construction of structural steel models-Construction of concrete models-Fabrication of concrete masonry models-Construction of Plastic Models - size effects, accuracy, and reliability in materials systems.

MODULE IV INSTRUMENTATION- PRINCIPLES AND APPLICATIONS **9**

Quantities to be measured-strain measurements-mechanical strain gauges, electrical strain gauges-Displacement measurements-mechanical dial gauges, Linear Variable differential transformer, linear resistance potentiometers - Full field strain measurement and crack detection methods-brittle coating-photo elastic coating, other crack detection methods-Stress and Force Measurements- load cells, embedded stress meters and plugs-Data Acquisition and reduction-types of data recording, various data acquisition systems-Introduction on fibre optic sensors for smart structures.

MODULE V STRUCTURAL MODEL TESTING **11**

Types of loads - discrete vs distributed loads- flexural and axial test on structural members - Non destructive testing techniques - methods of NDT – Rebound hammer testing, Liquid penetrant testing, Ultrasonic pulse velocity method, Acoustic emission technique, Application of NDT for quality assessment and damage detection of structures and materials- Probability application in NDT, Statistical quality control - Materials for dynamic models - properties of steel and concrete- Loading systems for dynamic modeling- vibration and resonant testing, wind tunnel testing, shock tubes and blast chambers, shaking tables, drop hammers and impact pendulums – Case studies-shaking table tests on concrete and steel buildings.

Total Hours : 45

REFERENCES:

1. Bungey, J.H., S.G. Millard, S.G and Grantham, M.G., “Testing of Concrete in Structures”, CRC Press, 4th Edition, 2014.
2. Harry, G. Harris and Gajanan M. Sabnis, “Structural Modeling and Experimental Techniques”, CRC Press, 1999.
3. Reese and Kawahara, “Handbook on Structural Testing”, Prentice Hall / Fairmont Press, 1993.
4. Malhotra and Carino, “Handbook of Nondestructive Testing of Concrete”, CRC Press, 2004.

OUTCOMES:

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

- Describe the similitude principles and model analysis that governs the design, testing and interpretation of models
- Prepare the elastic and inelastic model for various types of materials, which facilitate to the study their behaviour.
- Develop the techniques for fabricating small-scale structural models.
- Identify the correct type of instrument and sensor design for a particular experimental measurement application and match this instrument with a signal conditioning and data acquisition system to obtain an integrated measurement.
- Test a structure for various types of loading

CEDY 108 FRP COMPOSITES FOR STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- To introduce the principles of repairing and strengthening various structures and relevant modern strengthening techniques.
- To focus on the fundamental behaviour and mechanics of the strengthened structures such as composite action between the strengthening material and the existing structure.
- To introduce various structural design methods and practical applications.

MODULE I FRP COMPOSITES 9

Principles of strengthening and repair of structures - Terminologies - Principles of structural strengthening - Techniques for strengthening concrete structures - FRP composites - Formation of FRP - Typical properties - Advantages and disadvantages - FRP in construction: a brief history - example applications in construction.

MODULE II BOND BEHAVIOUR BETWEEN FRP AND CONCRETE 9

Strengthening schemes: steel and FRP - Importance of bond behaviour between FRP and concrete - Test methods of bond strength - Behaviour of bonded joints.

MODULE III SHEAR STRENGTHENING 9

Need for shear strengthening - Methods of shear strengthening - Likely failure modes - Selection of strengthening schemes - Shear capacity of strengthened beams - Shear strengthening design - Shear strengthening of concrete members – example - Design example

MODULE IV FLEXURAL STRENGTHENING OF BEAMS & SLABS 9

Methods of strengthening - Failure modes - Flexural strength - Interfacial stresses - Debonding strength models - Design recommendation - Flexural strengthening of concrete members - Design example. Strengthening of concrete slabs - Methods of strengthening - Failure modes - Design recommendation for one-way slabs – Design recommendation for two-way slabs

MODULE V STRENGTHENING OF COLUMNS 9

Confinement of Columns - Method of strengthening - Failure modes and typical behaviour - Compressive strength (circular, rectangular and elliptical columns) - Stress-strain behaviour (best-fit and design models) - Seismic retrofit of columns

Total Hours : 45

REFERENCES:

1. Chen,J.F., Smitth S.T, FRP-strengthened RC structure, Wiley, Technology & Engineering, 2002.
2. Hota V.S. Ganga Rao, Narendra Taly,. Vijay P. V, Reinforced Concrete Design with FRP composites, CRC Press, 2006.
3. Leonard C. Hollaway, Michael B. Leeming, Strengthening of Reinforced Concrete Structures: Using Externally-bonded FRP Composites in Structural and Civil Engineering, CRC Woodhead Publishing, 2000.
4. Lawrence C. Bank, Composites for Construction: Structural Design with FRP Materials, John Wiley & Sons, 2006.
5. Perumalsamy Balaguru, Antonio Nanni, James Giancaspro FRP Composites for Reinforced and Prestressed Concrete Structures: A Guide to Fundamentals and Design for Repair and Retrofit, Taylor & Francis US, 2008.

OUTCOMES:

On completion of these modules, students will be able to

- demonstrate the principles of repairing and strengthening various structures.
- propose, select, analyse and design appropriate strengthening schemes.
- describe the various strengthening methods and illustrate the guidelines & recommendation for beams and slabs
- design FRP wrapped beams and slabs against flexure
- explain the behaviour of FRP wrapped columns under compression

CEDY 109 MATRIX METHODS OF STRUCTURAL ANALYSIS L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge to compute deflections and forces in statically determinate and indeterminate structures using matrix methods.
- To provide an in-depth analytical knowledge on the physical interpretation of stiffness matrices to assemble stiffness matrices.

MODULE I FUNDAMENTAL CONCEPTS AND TRANSFORMATION 9

Introduction – forces and displacement measurements – principle of superposition – methods of structural analysis – betti's Law – stiffness and flexibility matrices of the elements - indeterminate structures – transformation of system force to element forces – element flexibility to system flexibility – system displacement to element displacement – transformation of forces and displacement in general – normal and orthogonal transformation.

MODULE II FLEXIBILITY METHOD 9

Choice of redundant – ill and well-conditioned equations – automatic choice of redundant – rank technique – transformation of one set of redundant to another set – thermal expansion – lack of fit – application to pin jointed plane truss – continuous beams - frames and grids.

MODULE III STIFFNESS METHOD 9

Development of stiffness method – analogy between flexibility and stiffness – analysis due to thermal expansion, lack of fit – application to pin-jointed plane and space trusses– continuous beams – frames and grids – problem solving.

MODULE IV MATRIX DISPLACEMENT METHODS - SPECIAL TOPICS 9

Static condensation technique – substructure technique - transfer matrix method – symmetry & anti symmetry of structures – reanalysis technique.

MODULE V DIRECT STIFFNESS METHOD 9

Discrete system – direct stiffness approach – application to two and three dimensional pin jointed trusses - plane frames grids–three dimensional space frames.

Total Hours :45

REFERENCES:

1. Mcguire and Gallagher, R.H, Matrix Structural Analysis, John Wiley, 2001.
2. RajasekaranS and Sankara Subramanian G, Computational Structural Mechanics, Prentice Hall of India, 2001.
3. Meek J. L., Computer methods in Structural Analysis, Taylor and Francis, 2017.
4. Godbole P.N., Sonparote, R.S., Dhote, S.U., Matrix Methods Of Structural Analysis, PHI Learning Pvt. Ltd., 2014.
5. Nelsm J.K., Nelson K James and Mc Cormac J C., Structural analysis using Classical and Matrix methods, John Wiley &sons, 2002.

OUTCOMES

On successful completion of these modules, students will be able to

- transform the different kinds of matrices.
- apply the matrix flexibility method for planar trusses, beams, and frames.
- compute reactions, internal forces and deflections for planar trusses, beams, and frames using matrix stiffness method.
- analyze the matrix displacement method for symmetry and anti-symmetry of structures using various techniques.
- extend the direct stiffness method for three-dimensional framed structure.

CEDY 110 OPTIMIZATION IN STRUCTURAL DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To impart sufficient knowledge on basic concepts of optimization and classical methods.
- To give detailed overview of queuing theory, exposure to various optimization techniques for design of structural elements and linear programming methods for plastic design.

MODULE I BASIC CONCEPTS IN OPTIMIZATION 9

Basic concepts of minimum weight - minimum cost design - objective function – constraints - classical methods.

MODULE II QUEUING THEORY 9

Queuing model - poisson and exponential distributions - queues with combined arrivals and departures - random and series queues

MODULE III OPTIMIZATION TECHNIQUES AND ALGORITHMS 9

Linear programming - integer programming - quadratic programming - dynamic programming and geometric programming methods for optimal design of structural elements.

MODULE IV COMPUTER SEARCH METHODS 9

Linear programming methods for plastic design of frames - computer search methods for univariate and multivariate minimization.

MODULE V OPTIMIZATION THEOREMS 9

Optimization by structural theorems – Maxwell - mitchell and heyman's Theorems for trusses and frames - fully stresses - design with deflection constraints- optimality criterion methods.

Total Hours :45

REFERENCES:

1. Quang Liang, Q., Performance-based Optimization of Structures: Theory and Applications, Taylor & Francis, 2005.

2. Ratan Prakash Agarwal, Ravi P. Agarwal, Recent Trends in Optimization theory and applications, World Scientific, 2010
3. Iyengar. N.G.R and Gupta.S.K, Structural Design Optimisation, Affiliated EastWest Press Ltd, New Delhi, 2002
4. Richard Bronson, Operation Research, Schaum's Outline Series, McGraw-Hill Book Co., Singapore, 2005

OUTCOMES:

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

- describe the various basic concepts in optimization.
- perform the queuing theory in structural analysis.
- execute different optimization techniques for the design of structural elements.
- appropriately use the computer search methods for analysis of structures.
- describe the various optimization theorems for analysis of structures.

CED 6123	PROJECT MANAGEMENT IN CONSTRUCTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

This course will impart knowledge on

- Project Life cycle
- Inception and feasibility study
- Construction phase
- Project delivery
- Project closeout

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 feasibility study of a project. Design Work Plan Producing Contract Documents Managing Scope Growth During Design Managing Small Projects Project Team Meetings Weekly Monthly Reports Drawing and Equipment Index Distribution of Documents Authority Responsibility Check List Check List of Duties for Design Team Management Evaluation of Design Effectiveness Constructability Post Design Review

MODULE III PROJECT DELIVERY 10

Importance of Construction Assumptions for Construction Phase 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 Number of Contracts Selection Criteria Contractual Relationship 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

Historical perspective - labour productivity - factors affecting job - site productivity - labor relations in construction - materials management - materials procurement and delivery- inventory control - construction equipment - choice of equipment and standard production rates – Equipment Productivity – Problems

MODULE V PROJECT CLOSE OUT

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

Total Hours –45

TEXT BOOKS:

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

REFERENCES:

1. Frank Harris & Ronald McCaffer with Francis Edum – Fotwe, Modern Construction Management, Sixth Edition, Blackwell Publishing,2006.
2. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi,2014.
3. Chris Hendrickson and TungAu, Project Management for Construction– Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.

OUTCOMES:

The student will be able to

- define project life cycle and project management functions
- demonstrate and explain the various design and construction process
- outline the different delivery methods.
- Apply different techniques in execution.
- summarize the issues in closure of project.

CEDY 111 THEORY OF ELASTICITY AND PLASTICITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on the general features of elastic systems and to analyze two- dimensional state of stresses and strains.
- To familiarize the students to solve the torsion of non-circular cross-sections by various approaches.
- To understand the fundamental concepts to solve problems in structural members by various energy methods.
- To provide sufficient background on the theory of plasticity.

MODULE I ANALYSIS OF STRESS & STRAIN 9

Basic concepts of deformation of deformable Bodies, Notations for stress and strain in two and three dimensions. Stress transformation laws - Differential equations of equilibrium in two and three dimensions in Cartesian coordinates, Generalized Hooke's law - Lame's constants.

MODULE II TWO DIMENSIONAL PROBLEMS 9

Plane stress and plane strain problems - examples- Airy's stress function – polynomials- direct method of determining Airy's stress function - Two dimensional problems in rectangular coordinates - bending of a cantilever loaded at free end - bending of a beam by uniform load - Equation of Equilibrium in polar coordinates - Two dimensional problems in polar coordinates for curved beam, thick cylinders and plate with holes.

MODULE III STRAIN ENERGY METHODS 9

Total strain energy- complementary energy - Principle of virtual work and total potential energy- Theorem of minimum potential energy, Betti’s reciprocal theorem, principle of linear superposition, uniqueness of elasticity solution. Theorem of minimum complementary energy- Griffith’s theory of rupture - Castigliano’s theorem - Principle of least work.

MODULE IV TORSION OF VARIOUS SHAPED BARS 9

Torsion of straight bars–elliptic cross section- Saint Venant’s theory–Membrane analogy – narrow rectangular cross section - Torsion of thin-walled open sections - Torsional stress concentration.

MODULE V PLASTICITY **9**

Introduction - physical assumptions, yield criteria of metals, graphical representation of yield criteria, Flow rule (plastic stress - strain relation) - Prandle Reuss equation - Levy Mises equation – Lower bound, upper bound and uniqueness Theorems - Application to simple problems in tension - compression, Torsion solution of Elastic Plastic problems.

Total Hours : 45

REFERENCES:

1. Arthur P Boresi, Ken P.Chong, *Elasticity in Engineering Mechanics*, John Wiley & Sons, 2000.
2. Stuart Antman, Nonlinear Problems of Elasticity, Springer Publication, 2nd Edition2005.
3. Timoshenko and Goodier, Theory of Elasticity, 3rd Edition, McGraw Hill, 2010.
4. Kachanov L M, Fundamentals of the Theory of Plasticity, Dover Publications,2013.
5. Sadhusingh, Theory of Elasticity, Khanna Publishers, New Delhi 2012

OUTCOMES:

On successful completion of this course, students will be able to

- critically describe the mathematical and physical foundations of the continuum mechanics of solids, including deformation, stress measures and constitutive relations.
- solve the two-dimensional problems in Cartesian and polar coordinates
- apply the principles to evaluate the problems related to torsion of non-circular cross-sections.
- analyse the structural members by various energy methods
- describe the basic concepts on the theory of plasticity.

CEDY 112 THEORY OF PLATES AND SHELLS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on the behavior of thin and thick plates in cartesian and polar coordinates.
- To understand the behaviour of reinforced concrete plate and shell elements at material level, element level and system level

MODULE I THIN AND THICK PLATES 9

Plate equation and behaviour of thin plates in cartesian- polar coordinates- isotropic and orthotropic plates- bending and twisting of plates.

MODULE II ANALYSIS & DESIGN OF PLATES 9

Navier's solution and energy method, rectangular, circular plates with various end conditions - design steps - minimum thickness and reinforcements as per I.S. specifications for R.C. folded plates.

MODULE III BEHAVIOUR OF SHELLS 9

Shell behaviour, shell surfaces and characteristics, classifications of shells, equilibrium equations in curvilinear coordinates, force displacement relations.

MODULE IV ANALYSIS OF SHELLS 9

Membrane analysis and bending theory of shells of revolution, cylindrical shells under different loads, shallow shells, solutions of typical problems

MODULE V DESIGN OF SHELLS 9

Design of spherical, conical, paraboloid, ellipsoid, cylindrical hyperbolic paraboloid, northlight shells – Detailing of shell structures

Total Hours : 45

REFERENCES:

1. Timoshenko.S& S.W. Krieger, Theory of Plates & Shells, McGraw Hill &Co.,New York, 1990.
2. Varadhan K., and Baskar, K, Analysis of Plates (Theory & Problems), Naraosa Publishing House,1999
3. Ramaswamy.G.S, Design and Construction of Concrete Shell Roofs, CBS Publishers, 1986.
4. Reddy, J.N., Mechanics of Laminated Composites Plates and Shells,

CRCPublishers, 2nd Edition, 2003.
5. Philip L Gould, Analysis of Shells and Plates, Prentice Hall, 1998.

OUTCOMES:

Upon successful completion of this course, students will be able to

- describe the behaviour of thin and thick plates.
- solve and establish classical solutions for various types of plates.
- illustrate the characteristics on different types of shells and develop equilibrium equations and force displacement relations.
- analyse the various types of shells under different loading conditions
- design the various types of shell structures.

CEDY 113	FORM WORK FOR CONCRETE STRUCTURES	L	T	P	C
		2	0	0	2

OBJECTIVES:

To impart knowledge on

- Planning of formwork, plant and site equipment's required for formwork.
- Design and erection of forms for various elements such as slabs, beams, columns and walls.

MODULE I MATERIALS AND DESIGN OF FORMS 07

Requirements and selection for Formwork , Formwork Materials, such as Timber, Plywood, Steel, Aluminum Form, Plastic Forms, and Accessories, Horizontal and Vertical Formwork Supports; Formwork Design Concepts, Illustration of Formwork system for Foundations, walls, columns, slab and beams and their design

MODULE II FORMS FOR SPECIAL STRUCTURES 08

Design Formwork for Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower. Formwork for Bridge Structures, Flying Formwork such as Table form, Tunnel form, Slipform, Formwork for Precast Concrete

MODULE III BUILDING AND ERECTING THE FORM WORK 08

Carpentry shop and job mill - forms for footings – wall, column, sloped, strap and 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.

MODULE IV FORMWORK MANAGEMENT 07

Formwork Management Issues pre award and post award, Formwork failures-causes and Case Studies in Formwork Failure, Various causes of failures. Formwork issues in multi-story building construction

Total Hours : 30

REFERENCES:

1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 2012.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 2005.
3. Jha, “Formwork for Concrete Structures”, Tata McGraw-Hill Education, 2012.
4. Robert L. Peurifoy and Garold D. Oberlender, Formwork For Concrete Structures, 4th Edition McGraw - Hill, 2010.

OUTCOMES:

On completion of these modules, students will be able to

- identify the required materials and their properties of the formwork.
- design the formwork for various structural elements.
- Construct various formwork
- Managing the formwork

CEDY 114	PREFABRICATEDSTRUCTURES	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To impart required knowledge about the behavior of prefabricated RC structures
- To understand the concepts in the construction of prefabricated structural components for industrial buildings

MODULE I DESIGN PRINCIPLES 05

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.

MODULE II REINFORCED CONCRETE 05

Prefabricated structures - long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, framed buildings with partial and curtain walls - connections – beam to column and column to column.

MODULE III FLOORS, STAIRS, WALLS AND ROOFS 10

Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, Types of wall panels, blocks and large panels, curtain, partition and load bearing walls, load transfer from floor to wall panels, 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 IV INDUSTRIAL BUILDINGS AND SHELL ROOFS 10

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 Betor Verlag, 2009.
5. Warszawski, A., Industrialization and Robotics in Building - A managerial approach, Harper and Row, 1990.

OUTCOMES:

Upon successful completion of this course, students will be able to

- apply the design principles used to construct prefabricated structures.
- create a panel and framed buildings with their connections of prefabricated RC structures.
- Classify the types of floors, stairs, walls and roofs and describe their behaviour of structures.
- Construct a prefabricated structural component for industrial buildings.

CEDY 115	SMART CITIES	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To examine the core challenges relating to the foundation of sustainable smart cities and gain knowledge to understand to smart & sustainable urban development.
- To explore issues relating to the development and deployment of new and emerging technologies, that will create a thorough understanding of smart processes and systems of the present and future.

MODULE I UNDERSTANDING SMART CITIES **8**

Introduction to Smart City - How did the idea evolve - History and Evolution of Smart Cities, worldwide - barriers and benefits of smart cities - Development Perspectives - Definitions and Core Concepts - characteristics and factors of Smart cities. Built environment – Energy – Telecommunications – Transportation - Health and human services - Water and wastewater - Public safety and Payments

MODULE II TOWARDS SMART CITIES IN INDIA **7**

ICT initiatives in Indian Cities - economic development - smart city technologies: inventory and standardization- potential of commercialization and emerging trends- e-democracy and e-governance - Case studies in India : Palava - Dombivalli, Mumbai, Lavasa- Pune.

Total Hours : 15

REFERENCES:

1. Jesse Berst, Liz Enbysk and Christopher Williams Smart Cities Readiness Guide - The planning manual for building tomorrow’s cities today, Smart Cities Council, 2014.
2. Aniket Bhagwat, Suparna Bhalla, Sanjay Prakash Ashish Bhalla Destination 100 The Making of Smart Cities in India**,** Future Institute publishers, 2014,
3. Vinod kumar T. M., Geographic Information Systems for Smart Cities, Copal Publishing, New Delhi, 2014,

4. Peng, L., Tao, Z., ‘Establish the Intelligent City System and Realize its Level Analysis”, Telematics and Informatics, 2010.

5. Brkovic, M. B., ‘Planning in the Information Age: Opportunities and Challenges of e- Planning, CORP, 2004

OUTCOMES:

Upon completion of the course, the student will be able to

- Describe the concept, discourse and practice of “smart cities” across the globe.
- Initiate the ICT in smart city for economic development of India

CEDY 116 STRUCTURAL HEALTH MONITORING

L	T	P	C
1	0	0	1

OBJECTIVES:

- To impart knowledge on fundamentals of structural health monitoring.
- To learn the principles of structural health monitoring using fiber-optic and Piezo electric sensors.

MODULEI INTRODUCTION TO STRUCTURAL HEALTHMONITORING 10

Definition of structural health monitoring (SHM) - Motivation for SHM, - SHM as a way of making materials and structures smart - SHM and biomimetics - Process and pre-usage monitoring as a part of SHM - SHM as a part of system management - Passive and active SHM,NDE, SHM and NDECS - Variety and multidisciplinary: the most remarkable characters of SHM - Birth of the SHM Community

MODULE II STRUCTURAL HEALTH MONITORING WITH FIBER-OPTIC AND PIEZOELECTRIC SENSORS 5

Classification of fiber-optic sensors, Intensity-based sensors, Phase- modulated optical fiber sensors, or interferometers, Wavelength based sensors, or Fiber Bragg Gratings (FBG), Photo elasticity in a plane stress state, Structures with embedded fiber Bragg gratings, Orientation of the optical fiber optic with respect to the reinforcement fibers, Examples of applications in aeronautics and civil engineering, Stiffened panels with embedded fiber Bragg gratings, Concrete beam repair, Experimental results and conventional analysis of acoustic emission signals, Algorithms for damage localization, Algorithms for damage characterization, Available industrial AE systems, New concepts in acoustic emission

Total Hours : 15

REFERENCES:

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, Wiley- ISTE,2006

2. Douglas EAdams, Health Monitoring of Structural Materials and Components-Methods with Applications, John Wiley and Sons,2007.
3. J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and Intelligent Infrastructure, Vol-1, Taylor and Francis Group, London, U.K, 2006.
4. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc,2007.

OUTCOMES:

On successful completion of this course, students will be able to

- elaborate the fundamentals of structural health monitoring
- use an appropriate health monitoring technique using fiber-optic and Piezoelectric sensors.

CEDY117	ADVANCED OXIDATION PROCESS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the fundamentals of Advanced Oxidation Processes (AOPs) and its application for the removal of contaminants from water and wastewater.
- To understand and design effective AOP treatment systems

MODULE I - Introduction to AOPs **8**

Introduction to AOPs for water and wastewater treatment process –AOPs mechanism – photo oxidation reactions – photocatalytic reactions, photo initiated oxidation – UV- H_2O_2 / ozonation, fenton / photofenton – photocatalysis – light source choice used in AOPs and their spectral distributions

MODULE II - Heterogeneous Process **10**

Introduction to nano & heterogeneous photocatalysis effect of system composition and process. Identification of degradation products, Photoreactors (liquid phase/ gas phase) – solar/ artificial light photo reactors – operation of pilot plants – comparing reactor efficiencies – system design – solar collectors – technology issues – slurry, supported catalyst – reuse – Synthesis methods – bulk, chemical approaches, physical approaches

MODULE III - Homogenous AOPs **8**

Ozonation, electro-chemical oxidation, ultrasonication, UV – Photolysis- H_2O_2/UV radiation, Fenton/Photo Fentons Oxidation, chemical and non-chemical AOPs, Solar/Fenton radiation process- advantages and disadvantages of homogeneous processes

MODULE IV - Enhancement Of Quantum Yield **9**

Non-thermal plasma-electron hydraulic cavitation and sonolysis- super water oxidation – γ rays- electron beams, Quantum yield improvement by additional oxidants – hydrogen peroxide persulphate catalyst reaction – catalyst modification- applications of semiconductor photolysis. Process fundamentals, applications and commercial process.

MODULE V - Industrial Applications and Economic assessment of AOPs 10

Application of AOPs for industries like textile, petroleum, pharmaceutical,tannery and petrochemical industry. Ground water decontamination – drinking water treatment – cost calculation – economic analysis.

Total hours : 45

TEXT BOOKS

1. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" , Imperial College Press, 2004.
2. MAulin P Shah , “Advanced oxidation process for effluent treatment plants”, Elsiever, 2020.

REFERENCES:

1.Simon Parsons, "Advanced oxidation processes for water and wastewater treatment", IWA Publishing, 2004
2. Thomas Oppenländer, "Photochemical Purification of Water and Air: Advanced Oxidation Processes (AOPs): Principles, Reaction Mechanisms, Reactor Concepts", Wiley-VCH Publishing, 2003.

OUTCOMES:

After completion of the course, the students are expected to:

- Describe the concepts of various AOPs to solve water and wastewater pollution problems
- Explain the various reactors used in the heterogeneous processes
- Identify the suitable homogenous AOPS for the treatment of water and wastewater
- Describe the concepts and applications of nonthermal plasma and quantum yield
- Explain the industrial applications of AOPs in industries

CEDY118	SEPARATION PROCESSES IN ENVIRONMENTAL APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on

- The different separation processes and its mechanism
- The concepts of Phase equilibrium
- The principle and applications of adsorption process
- The ion exchange process and its application
- The types of membrane and its applications

MODULE 1: ENVIRONMENTAL SEPERATIONS **9**

Pollution sources, Environmental separations-Historic perspective of environmental pollution- Separation mechanisms -Equilibrium-based processes, Rate-based processes Countercurrent operation, Productivity and selectivity, separating agents

MODULE 2: PHASE EQUILIBRIUM **9**

Degrees of freedom analysis, Phase equilibrium, Equilibrium-limited analysis, Minimum number of stages, Rate-limited processes, Batch and Continuous distillation, Extraction in Environmental applications, Leaching processes, McCabe–Thiele analysis

MODULE 3: ADSORPTION PROCESS **9**

Absorption and stripping, packed columns, Adsorption principles, Sorbent selection regeneration, Transport processes, Process design factors, Design of fixed-bed adsorber.

MODULE 4: ION EXCHANGE AND ITS APPLICATIONS **9**

Ion exchange- Objectives, Environmental applications, Ion-exchange mechanisms, Ionexchange media, Equipment and design procedures; Extraction and leaching.

MODULE 5: MEMBRANE AND ITS PERFORMANCE **9**

Membranes-Merits and demerits of membrane processes, membrane materials, membrane modules, Environmental applications, Separation mechanisms-Membrane processes, membrane performance.

Total hours : 45

TEXT BOOKS

1. Noble, R.D and Terry P.A., “Principles of Chemical Separations with Environmental Applications”, Cambridge University Press, 2004.
2. J.G. Crespo, Karl W. Böddeker , “Membrane Processes in Separation and Purification” , NATO ASI series, Springer, 2013.
3. Seader J D and Henley E J, Separation Processes Principles, 3rd Edition, John Wiley&Sons, 2011

REFERENCES

1. H Strathmann, Ion-Exchange Membrane Separation Processes, Elsevier Science, 2004
2. Ed Ronald W. Rousseau, Handbook Of Separation Process Technology, Wiley India · 2009

OUTCOME:

The students will be able to

- Describe the importance of separation processes in environmental applications.
- Explain the best separation process for a given problem
- Describe the principles of adsorption and its design factors
- Identify the ion exchange mechanism suitable for environmental applications
- Describe the environmental applications of membrane

PROFESSIONAL ELECTIVES - EVEN SEMESTER

CEDY 201	ADVANCED FOUNDATION DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course is aimed at

- Enabling the learners to be familiar with field and lab test encountered in engineering practice
- To impart knowledge to analyze and design shallow and deep foundation.

MODULE I SOIL EXPLORATION FOR DIFFERENT PROJECTS 09

Methods of subsurface exploration, Field tests, penetration tests, Methods of borings along with various penetration tests - Plate load test, field permeability tests

MODULE II SHALLOW FOUNDATIONS 10

Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Factors affecting bearing capacity Factors influencing selection of depth of foundation, types of shallow foundations, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.

MODULE III LATERAL AND UPLIFT LOAD EVALUATION OF PILES 10

Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.

MODULE IV WELL FOUNDATION 08

Types, components, construction methods, design methods (Terzaghi, IS and IRC approaches), check for stability, base pressure, side pressure and deflection.

MODULE V RETAINING WALLS 08

Types -flexible and rigid earth retention systems, counter fort, gravity, diaphragm walls, sheet pile walls, soldier piles and lagging. Support systems for flexible

retaining walls (struts, anchoring), construction methods, stability calculations, design of flexible and rigid retaining walls.

Total Hours: 45

REFERENCES:

1. N.P. Kurian, “Design of foundation systems: Principles and Practices”, Narosa Publishing House, 2014
2. Bowles J E “Foundation Analysis & Design” McGraw Hill Education; 5 edition
   (1 July 2017)
3. T. W. Lambe& R. V. Whitmen, “Soil Mechanics” - Wiley Eastern Ltd.,2000
4. Varghese P.C.,"Design of Reinforced Concrete Foundations”, PHI Learning Private Limited, New Delhi, 2009
5. Murthy, V.N.S., "Advanced Foundation Engineering", CBS Publishers, New Delhi, 2007

OUTCOMES:

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

- Decide the suitability of soil strata for different projects
- Design shallow foundations based on the bearing capacity of soil
- Analyze and design the pile foundation, perform lateral and uplift load analysis for pile foundation
- Analyze and design well foundation
- Design retaining wall and checking the stability

CEDY 202 CHEMISTRY OF CEMENT AND CONCRETE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart students in depth knowledge about interior chemistry of cement and concrete in terms of hydration, setting, hardening, physiochemical and mechanical properties of Portland cement.
- To make students understand the resistance of concrete to destructive agencies, significance of adding mineral admixtures and chemical admixtures in concrete.

MODULE I HYDRATION, SETTING AND HARDENING OF PORTLAND CEMENT **9**

Hydration of cement – definition and influencing parameters. Mechanism of hydration of clinker minerals. Hydration of Portland cement – mechanism – kinetics – composition of liquid phase – heat of hydration. Setting of Portland cement. Hydrated Portland cement paste – constituents – general pore structure– strength of hydrated cement.

MODULE II PHYSIOCHEMICAL AND MECHANICALPROPERTIES OF CONCRETE **9**

Heat of hydration – effect of proportion and composition of clinker minerals – effect of sulphate content – effect of alkali content. Setting time – effect of proportion of clinker minerals – effect of sulphate content – effect of alkali content. Strength – strength to porosity relationship – methods of testing – influence of cement paste - aggregate interfaces – Effect of proportion of clinker minerals – effect of initial temperature rise effect of sulphate content – effect of alkali content – effect of surface area and particle size distribution. Creep in concrete – influencing parameters. Drying shrinkage – influencing parameters. Durability of concrete – effect of microstructure development – cracking – permeability of cement paste - aggregate interfaces. Freeze-thaw attack – wear resistance

MODULE III RESISTANCE OF CONCRETE TO DESTRUCTIVE AGENCIES **9**

Action of frost – causes, influencing factors and assessment. Thermal expansion and durability of concrete. Resistance to fire. Electrolysis of concrete. Action of sulphate – activating agents – volume change – rate of attack – improvement of

sulphate resistance – role of water and effect of surface condition – resistance of different types of cement. Action of sea water – chemical action – frost action – corrosion of reinforcement. Action of acids – inorganic acids – attack on concrete in sewers –organic acids – action of carbon dioxide. Action of mineral oils and gases on concrete.

MODULE IV EFFECT OF MINERAL ADMIXTURES IN CONCRETE 9

Mineral admixtures – fly ash, blast furnace slag and micro silica. Hydration of fly ash containing cement – kinetics of hydration – heat of hydration – compounds occurring in paste form – mechanism of reaction of fly ash containing cements – paste microstructure. Portland blast furnace cement – processing – composition – hydration process. Micro silica – effects on fresh concrete – setting and hardening of concrete.

MODULE V EFFECT OF CHEMICAL ADMIXTURES IN CONCRETE 9

Chemical admixtures - categories - air entraining admixtures – water reducing admixtures – super plasticizing admixtures – retarding admixtures – accelerating admixtures – water resisting admixtures. Specialty admixtures – polymer dispersions – foaming agents – expanding agents – corrosion inhibitors

Total Hours : 45

REFERENCES:

1. Peter C. Hewlett, Lea's Chemistry of Cement and Concrete, Elsevier Butterworth Heinemann Publications, U.K.,2006.
2. Nayak, N.V., and. Jain, A.K, Handbook on Advanced Concrete Technology Narosa Publishing Pvt. Ltd., New Delhi,2012.
3. Ramachandran, V.S. and James J. Beaudoin, Handbook of Analytical Techniques in Concrete Science and Technology- Principles, Techniques and Applications, Noyes Publications, USA,2001.
4. Rixom, M.R. and Noel P. Mailvaganam, Chemical Admixtures for Concrete, E & FN Spon Publishers, USA,1999.

OUTCOMES:

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

- describe the physiochemical and mechanical properties of Portland cement.
- explain the various physiochemical and mechanical properties of concrete.
- discuss the resistance of concrete against destructive agencies
- explain the effect of mineral admixtures in concrete
- explain the effect of chemical admixtures in concrete

CEDY 203	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart sufficient knowledge about classification and characteristics of composite materials used in structures.
- To understand the analysis of laminated composites, netting analysis, manufacturing and fabrication processes of fibres.

MODULE I CLASSIFICATION AND CHARACTERISTICS OF COMPOSITE MATERIALS **9**

Need for the composite materials – types of composite materials and their use in structures.

MODULE II BASIC CONCEPTS **9**

Hooke's law for orthotropic and anisotropic materials – micromechanics and macro mechanics – lamina stress-strain relations referred and principal material directions and arbitrary axes.

MODULE III ANALYSIS OF LAMINATED COMPOSITES **9**

Governing equations for anisotropic and orthotropic plates – angle-ply and cross- ply laminates – static, dynamic and stability analysis for simpler cases of composite plates– interlaminar stresses

MODULE IV FAILURE THEORY **9**

Netting analysis – failure criteria – sandwich construction.

MODULE V MANUFACTURING AND FABRICATION PROCESSES **9**

Manufacturing of glass – boron and carbon fibres – open mould and closed mould processes.

Total Hours : 45

REFERENCES:

1. Agarwal B.D and L.J.Broutman, Analysis and performance of fiber composites, John-wiley and sons, 1980.
2. Calcote L.R, Analysis of limited structures, Van Nostrand Reinhold Co.,

1989

3. Lubin G, Handbook on Fibre glass and advanced plastic composites, Van Nostrand Co., New York, 1989.
4. Jones R.M., Mechanics of composite materials, CRC Press, 1998

OUTCOMES:

On successful completion of these modules, students will be able to

- classify the composite materials and their use in structures.
- identify the principle material direction and arbitrary axes
- apply the various theories for analysis of laminated composites
- perform netting analysis in sandwich construction
- analyse, manufacture and fabricate the composite materials.

CEDY 205	FRACTURE MECHANICS OFCONCRETE	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge on the behaviour on fatigue and damage tolerance problems in structures.
- To provide in-depth knowledge on the stress distribution and energy theories related to fatigue load.

MODULE I INTRODUCTION TO FATIGUE 9

Loads – cyclic loads – high cycle fatigue – low cycle fatigue- stress-life approach: S-N curve – size effect – loading effect – surface, plating, thermal and mechanical–temperature – environment.

MODULE II STRAIN-LIFE APPROACH 9

Introduction – material behaviour – monotonic stress-strain behaviour, basic definition – true and engineering stress-strain relationship, cyclic stress-strain behaviour, cyclic strain hardening and softening, cyclic stress-strain curve determination, stress-strain power law relation.

MODULE III FATIGUE LIFE CALCULATION 9

Prediction of fatigue life using S-N and miner's approach – general calculation of equivalent stress range, stresses to be considered, S-N curves and joint classifications, – prediction of crack propagation– general, constant amplitude loading, variable amplitude loading, geometric functions and crack growth integrals– general, load calculation, stress calculation, probability of failure – design formats – general, allowable stresses, allowable cumulative damage ratio, comments on the design formats

MODULE IV STRESS DISTRIBUTION & ENERGYTHEORIES 9

Stress distribution at discontinuities – stress concentration factors – cracks linear elastic fracture mechanics, stress intensity factor – monotonic and cyclic loads - fracture toughness – energy theories – J-integral; crack growth studies: fatigue crackgrowth-constantamplitudeloading–variableamplitudeloading–crack growthmodels–remaininglife-prediction–residualstrengthevaluation–plastic collapse condition, yield condition, remaining life approach

MODULE V FRACTURE OF CONCRETE STRUCTURES 9

Fracture mechanics approach for concrete – limitations – non-linear fracture models with tension softening – fracture energy – size effect – remaining life prediction – residual strength evaluation.

Total Hours : 45

REFERENCES:

1. Prashanth Kumar, Elements of Fracture Mechanics, Tata McGraw-Hill Education, 2009.
2. Shah SP,Stuart E. Swartz,Ouyang C,Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock and Other Quasi-Brittle Materials. John Wiley & Sons, 1995.
3. Madhava RaoAG, Appa Rao T.V.S.R, Fatigue and Fracture in Steel and Concrete Structures, Taylor & Francis, 1992.
4. George C. Sih, A. Ditomasso, Fracture mechanics of concrete: Structural application and numerical calculation, Springer Science & Business Media, 2012.
5. Alberto Carpinteri, Applications of Fracture Mechanics to Reinforced Concrete, CRC Press, 1992.
6. ACI 215R-74, Considerations for Design of Concrete Structures Subjected to Fatigue Loading, ACI Committee.

OUTCOMES:

On successful completion of these modules, students will able to

- develop S-N curve for structures failed due to fatigue loading.
- apply strain-life approach to calculate fatigue damage.
- calculate fatigue life of structures.
- apply various theories and fracture models related to fatigue response of structures.
- describe and compute fracture energy of concrete structures

CEDY 206	GREEN BUILDING AND ENERGY EFFICIENT STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart the knowledge on

- Design of energy efficient buildings
- Thermal performance of building sections by providing a mix of passive solar design strategies
- Usage of materials with low embodied energy to increase the thermal comfort

MODULE II NTRODUCTION 9

Energy required for building construction - heat transfer – measuring conduction – thermal storage – measurement of radiation – the greenhouse 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's rating systems - sustainable sights - water efficiency - energy efficiency - materials and resources - indoor environmental quality.

MODULE II PASSIVE SOLAR HEATINGAND 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 odour removal – heat recovery in large buildings

MODULE III DAYLIGHTING ANDELECTRICALLIGHTING 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 CONTROLANDVENTILATION 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 FORCLIMATIC 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.

Total Hours: 45

REFERENCES:

1. Moore F., Environmental Control system, Mc Graw Hill Inc.,2004
2. Brown, GZ Sun, Wind and Light: Architectural design strategies, JohnWiley,2013.
3. Cook. J, Award –Winning passive Solar Design, Mc-Graw Hill,2005

OUTCOMES:

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

- identify the required energy for building construction.
- design and analyse the passive solar cooling and heating techniques.
- identify the required amount of daylight and electrical lighting for a building.
- analyse the ventilation and thermal design of a building.
- design a specific type of building for special climatic zones.

CEDY 207 PRESTRESSED CONCRETE STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- To understand the behaviour and performance of prestressed concrete structures.
- To impart knowledge to analyze and design prestressed concrete flexural and shear members.
- To expand knowledge to design the prestressed concrete structures such as circular prestressing, composite construction members.

MODULE I BASIC CONCEPTS & ANALYSISOFSTRESSES 9

Basic concepts – advantages of PSC – materials required – systems and methods of prestressing – analysis of sections – stress concept – strength concept – load balancing concept –stresses in tendons - losses of prestress – deflections of prestressed concrete members - factors influencing deflections – effect on tendon profile on deflections - short term and long term deflections as per codal provisions
.

MODULE II DESIGN OFPSCMEMBERS 9

Flexural strength – simplified procedures as per codes – shear and principal stresses – ultimate shear resistance of PSC members - design of shear reinforcement – behaviour under torsion – modes of failure - design for torsion, shear and bending - design of PSC sections for flexure - transmission of prestress in pre-tensioned members –bond and transmission length – end zone reinforcement – anchorage zone stresses - stress distribution - design of anchorage zone reinforcement. Prestressed Concrete Slabs: Types of prestressed concrete floor slabs- design of prestressed concrete one way and two-way slabs— design of prestressed concrete simple flat slabs and continuous flat slab floors

MODULE III STATICALLYINDETERMINATESTRUCTURES 9

Analysis of indeterminate structures – continuous beams – concept of concordance and linear transformations.

MODULE IV DESIGN OF TENSION AND COMPRESSIONMEMBERS 9

Design of tension members - design of prestressed concrete pipes and cylindrical water tanks - design of compression members with and without flexure - design of prestressed concrete piles.

MODULE V DESIGN OFCOMPOSITEMEMBERS 9

Analysis and design of composite members – flexure and shear of composite members - partial prestressing - advantages and applications.

Total Hours 45

REFERENCES:

1. Krishna Raju, N., Prestressed concrete, Tata McGraw Hill Company, New Delhi,2012.
2. Rajagopal, N, Prestressed concrete, Second Edition, Narosa Publications, New Delhi,2007.
3. Lin.T.Y., Design of Prestressed Concrete Structures, John Wiley and Sons 4. Inc,2000.
4. Sinha, N.C, & S.K.Roy, Fundamentals of Prestressed Concrete, S.Chand & Co, New Delhi,2000.
5. Ramaswamy G.S. ,Modern Prestressed Concrete Design, Arnold Heinimen, New Delhi,1990.

OUTCOMES:

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

- apply the principles for analyzing the prestressed concrete structures; evaluate the short- and long-term losses and deflection for PSC members
- establish appropriate approaches to calculate the design strength for flexure, shear & torsion and design the PSC members.
- analyse the indeterminate PSC structures
- apply the principles and techniques for the design of circular prestressing and demonstrate the various structures such as poles, piles.
- analyse and design the composite structural members.

CEDY 208 SOIL - STRUCTURE INTERACTION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide engineers with the fundamental concepts and theory of dynamic soil-structure interaction
- To expose the students to various design charts.

MODULE I SOIL-FOUNDATION INTERACTION 9

Introduction to soil-foundation interaction problems – soil behaviour, foundation behaviour, interface behaviour-scope of soil foundation interaction analysis-soil response models-winkler, elastic continuum, two parameter elastic models - elastic plastic behaviour-time dependent behaviour

MODULE II BEAM ON ELASTIC FOUNDATION-SOIL MODELS 9

Infinite beam - two parameters - isotropic elastic half-space - analysis of beams of finite length - classification of finite beams in relation to their stiffness.

MODULE III PLATE ON ELASTIC MEDIUM 9

Infinite plate- winkler - two parameters - isotropic elastic medium -thin and thick plates - analysis of finite plates - rectangular and circular plates -numerical analysis of finite plates -simple solutions.

MODULE IV ELASTIC ANALYSIS OF PILE 9

Elastic analysis of single pile-theoretical solutions for settlement and load distributions - analysis of pile group, interaction analysis - load distribution in groups with rigid cap.

MODULE V LATERALLY LOADED PILE 9

Load deflection prediction for laterally loaded piles - sub grade reaction and elastic analysis - interaction analysis - pile raft system - solutions through influence charts

Total Hours : 45

REFERENCES:

1. Murthy, V.N.S., "Advanced Foundation Engineering", CBS Publishers, New Delhi,2007.

2. Saran, S, "Analysis and Design of Substructures", Taylor & Francis Publishers,2006
3. Salgado,R., "The Engineering of Foundations", Tata McGraw Hill Education Private Limited, New Delhi,2011.

OUTCOMES:

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

- analyse the soil foundation interaction problems using soil response models.
- perform elastic analysis of foundation and consider soil structure interaction in design.
- perform the numerical analysis of finite plates
- perform the interaction analysis of pile group
- predict the load deflection behavior for laterally loaded piles

CEDY 209 SOIL DYNAMICS AND MACHINE FOUNDATION **L T P C 3 0 0 3**

OBJECTIVES:

- To familiarize students with the dynamic properties of soil.
- To create an understanding about the importance of designing machine foundation for reciprocating and impact machines.

MODULEI THEORY OF VIBRATION 10

Introduction – Nature of dynamic loads – vibrations of single degree freedom system – free vibrations of spring – mass systems – forced vibrations – viscous damping, Transmissibility – Principles of vibration measuring instruments – effect of Transient and Pulsating loads – vibrations of multi degree freedom system.

MODULE II BEHAVIOUR OF SOIL UNDER DYNAMICSTRESS 10

Dynamic stress – strain characteristics – principles of measuring dynamic properties – Laboratory Techniques – Field tests – Factors affecting dynamic properties - Typical values- Dynamic bearing capacity – Dynamic earth pressure.

MODULE III MACHINE FOUNDATIONS 10

Types – Design criteria – Permissible amplitudes and Bearing pressure, Degrees of freedom - Analysis under different modes of vibration of block foundation

MODULEIV DESIGN OF FOUNDATIONS FOR RECIPROCATING AND IMPACT MACHINES 10

Analysis of Two Degree freedom systems under free and forced vibrations - Principles of Design of Foundations for reciprocating and impact machines as per IScode.

MODULE V VIBRATIONISOLATIONTECHNIQUES 05

Types and methods – Isolating materials and their properties

Total Hours : 45

REFERENCES:

1. Bharath Bhusan Prasad, “Soil Dynamics and Earthquake Engineering”, PHI, New Delhi,2009.
2. S. Prakash, “Soil Dynamics”, McGraw Hill Book Co., New York,1999

3. Moore, P.J., "Analysis & Design of Foundations for Vibrations", Oxford &IBH, 2006.
4. Krammer S.L., "Geotechnical Earthquake Engineering", Prentice hall, International Series, Pearson Education (Singapore) Pvt. Ltd.,2004.

OUTCOME:

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

- Understand the concept of dynamic loads
- Analyse the soil properties under dynamic loading
- Familiarize with foundation for vibrating machines
- Perform analysis on reciprocating and impact machines
- Suggest suitable methods for vibration isolation

CEDY 210 STABILITY OF STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- To impart students' sufficient knowledge about basic concepts of elastic structural stability, analytical approaches to stability and analysis of inelastic buckling of columns.
- To give exposure on the stability analysis of beam columns and frames using FEM and other methods and analysis of buckling of beams and thin plates.

MODULE I STABILITY OF COLUMNS 9

Concepts of elastic structural stability- analytical approaches to stability - characteristics of stability analysis- elastic buckling of columns- equilibrium; energy and imperfection approaches – non-prismatic columns- built up columns- orthogonality of buckling modes- effect of shear on buckling load - large deflection theory.

MODULE II METHODS OF ANALYSIS AND INELASTIC BUCKLING 9

Approximate methods – Rayleigh and Galerkin methods – numerical methods – finite difference and finite element - analysis of columns – experimental study of column behaviour – south well plot - column curves - derivation of column design formula - effective length of columns - inelastic behaviour- tangent modulus and double modulus theory

MODULE III BEAM COLUMNS AND FRAMES 9

Beam column behaviour- standard cases- continuous columns and beam columns – column on elastic foundation – buckling of frames – single storey portal frames with and without side sway – classical and stiffness methods – approximate evaluation of critical loads in multistoried frames – use of wood's charts.

MODULE IV BUCKLING OF BEAMS 9

Lateral buckling of beams – energy method- application to symmetric and simply symmetric I beams – simply supported and cantilever beams - narrow rectangular cross sections- – numerical solutions – torsional buckling – uniform and non-uniform torsion on open cross section - flexural torsional buckling – equilibrium and energy approach.

MODULE V BUCKLING OFTHIN PLATES 9

Isotropic rectangular plates - governing differential equations - simply supported on all edges – use of energy methods – plates with stiffeners – numerical techniques.

Total Hours : 45

REFERENCES:

1. Ashwini Kumar, Stability of Structures, Allied Publishers Ltd,1998.
2. NGR Iyengar, Structural Stability of Columns and Plates, Affiliated East- West Press Pvt. Ltd,2007.
3. Stephen P. Timoshenko and Gere Theory of Elastic Stability, McGraw-Hill Company,2000.
4. Allen, H.G and Bulson, P.S., Background to Buckling, McGraw-Hill Book Company,1980.
5. Gambhir, M.L, Stability Analysis and Design of Structures, Springer,2004.
6. Chai H Yoo, Sung Lee, Stability of Structures - Principles and Applications, Elsevier,2011.

OUTCOMES:

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

- describe the basic concepts of elastic structural stability and identify suitable analytical approaches to stability of structures.
- analyse the inelastic buckling of structures by various approximate methods.
- Illustrate the buckling behaviour of various structural components and evaluate under critical loading conditions.
- perform stability analysis by different approaches for various types of beams.
- establish differential equations for thin plates under different edge conditions.

CEDY 211 STRUCTURAL SAFETY AND RELIABILITY L T P C
3 0 0 3

OBJECTIVES:

- To impart adequate knowledge on Safety aspects involved in construction industry.
- To develop the ability to obtain quantitative estimates of the reliability of structures under different limit state conditions.
- Promote an appreciation of the wide spectrum of applications in this area and potential benefits from the use of these techniques in the design and assessment of major structures.

MODULE I INTRODUCTION 9

Structural safety - role of safety officers, responsibilities of general employees, safety committee, safety monitoring.; Concepts of Safety Factors, Safety, Reliability and Risk Analysis.

MODULE II PROBABILITY CONCEPTS 9

Fundamentals of Set Theory and Probability; Probability Distribution, Regression Analysis, Hypothesis Testing. Stochastic Process and Its Moments; Probability Distributions. Probability of failure. Fatal accident rate. Societal risk. Anatomy of failure. Management of safety.

MODULE III STRUCTURAL RELIABILITY THEORY AND METHODS 9

The R-S problem in structural design and assessment, Probability of Failure and the Reliability Index. Convolution Integral, Standardised Method for Normal Variables, First Order Reliability Method, Monte Carlo Simulation. Second order Reliability Method.

MODULE IV RELIABILITY ANALYSIS 9

Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method)

MODULE V RELIABILITY-BASED DESIGN 9

Specification of Characteristic Load/Resistance Values, Design Values, Partial Factors, Target Reliability, Methods of Code Calibration. The use of ISO 2394 method and its significance. Problems

Total Hours : 45

REFERENCES:

1. Construction Safety Management Tim Howarth, Paul Watson, Wiley-Blackwell, 2008.
2. Choi S K, Grandhi R V and Canfield R A. Reliability Based Structural Design, Springer Verlag, London, UK, 2007.
3. Haldar, A., and Mahadevan, S., Probability, reliability and statistical methods in engineering design. John Wiley and Sons, New York, 2000
4. Ranganathan. R., Structural reliability analysis and design, Jaico Publishing House, Mumbai, 1999.

OUTCOMES:

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

- describe the safety practices to be followed during various construction operations.
- explain the awareness about safety in site.
- evaluate the probability of failure of structural elements and simple structural systems.
- perform reliability-based limit state design of simple structural elements and recognize the sensitivity of the outcome to the uncertainty in different variables.
- Explain the reasons leading to different values of partial safety factors for load and resistance variables in design and assessment standards.

CEDY 212	TALL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the problems associated with large heights of structure with respect to different loads.
- To gain knowledge on the behaviour, analysis and design of various structural systems.
- To impart knowledge on stability of tall buildings and also on dynamic analysis of wind and earthquake loadings.

MODULE I DESIGN CRITERIA & LOADING 9

General - factors affecting growth, height and structural form - design philosophy - loading - gravity loading - wind loading - earthquake loading - combinations of loading - strength and stability - stiffness and drift limitations - human comfort criteria- creep effects - shrinkage effects - temperature effects - fire - foundation settlement - soil-structure interaction

MODULE II STRUCTURAL FORMS 9

Structural forms – braced frame, rigid frame, in filled frame, shear wall structures, wall- frame structures, framed tube structures, outrigger braced structures, space structures, hybrid structures, R.C.floor systems - one-way slab on beams and girders - two-way flat slab - two-way flat plate - waffle flat slabs - two-way slab and beam - steel framing floor systems - one-way beam system - two-way beam system - three-way beam system - composite steel - concrete floor systems.

MODULE III MODELING, BEHAVIOUR & ANALYSIS OF STRUCTURAL SYSTEMS 9

Modeling for analysis - assumptions - modeling for approximate analyses - modeling for accurate analysis - reduction technique. types, behaviour and analysis methods of braced frames - behaviour and analysis of rigid frame structures - behaviour, analysis & design of infilled frame structures - behaviour and analysis of shear wall, coupled shear wall and wall-frame structures - behaviour of tubular structures, core structures and outrigger-braced structures

MODULEIV STABILITY OF TALL BUILDINGS 9

Overall buckling analysis of frames (approximate methods) - overall buckling analysis of wall frames - second order effects of gravity loading - translational - torsional instability - out-of-plumb effects - effects of foundation rotation - creep and shrinkage effects - temperature effects.

MODULE V DYNAMICANALYSIS 9

Response to wind loading - along-wind response - across-wind response - estimation of natural frequencies & damping - types of excitation - design to minimize dynamic response - response to earthquake motions - response to ground accelerations - response spectrum analysis - estimation of natural frequencies and damping - human response to building motions.

Total Hours : 45

REFERENCES:

1. Bryan Stafford Smith and AlexCoull, Tall building Structures, Analysis Design, John Wiley and Sons, Inc.1991.
2. Taranath B.S, Structural Analysis and Design of Tall Buildings McGraw Hill Book Co.,2010.
3. Lin .Y. and Burry D. Stotes, Structural Concepts and Systems for Architects and Engineers, John Wiley,1994.
4. Lynn.S. Beedle, Advances in Tall Buildings, CBS Publishers and Distributors,1996
5. Lawson T V, Wind Effects on Buildings, Applied Science Publishers,1980.

OUTCOMES

On successful completion of these modules, students will be able to

- compute the different types of loading acting on tall structures and identify the different factors affecting the tall structures.
- classify and use appropriate types of structural systems in tall structures.
- construct modeling using various analysis techniques and describe its behaviour for various structural systems.
- manipulate the second order effects of gravity loading, translational and torsional instability in the analysis of tall structures
- analyze the response of wind and seismic motions on tall structures.

CEDY 213	WIND AND CYCLONE EFFECTS ON STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart sufficient knowledge on the concepts of wind effects on structures.
- To familiarize on the modeling and designing the structures for wind and cyclone effects as per the codal recommendations.

MODULE I INTRODUCTION 9

Types of wind – characteristics of wind – wind velocity, method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects - dynamic nature of wind – pressure and suctions - spectral studies, gust factor.

MODULE II WIND TUNNEL STUDIES 9

Wind tunnel studies- types of tunnels, prediction of acceleration – load combination factors – wind tunnel data analysis – calculation of period and damping value for wind design - modeling requirements – interpretation of results-aero dynamic and aero-elastic models

MODULE III WIND EFFECTS ON STRUCTURES 9

Classification of structures - rigid structures, flexible structures - static and dynamic effects on tall buildings - chimneys.

MODULE IV DESIGN OF STRUCTURES FOR WIND LOAD 9

Design principles for wind loading on structures as per IS and NBC codal provisions – design of tall buildings – chimneys – transmission towers – industrial sheds.

MODULE V CYCLONE EFFECTS ON STRUCTURES 9

Cyclone effect on low rise structures – sloped roof structures - tall buildings -effect of cyclone on claddings and design of cladding as per codal provisions in cladding design –procedure and modeling of cladding.

Total Hours : 45

REFERENCES:

1. Cook., N.J., The Designer's Guide to Wind Loading of Building Structures, Butterworths, 1989.
2. Kolousek., et.al., Wind Effects on Civil Engineering Structures, Elsevier Publications, 1994.
3. Lawson T.V., Wind Effects on Building Vol. I and II, Applied Science Publishers, London,1980.

OUTCOMES:

On successful completion of this course, students will have the ability to

- describe the concepts on the wind effects on structures.
- perform the wind tunnel studies, analyse and compute the various parameters for wind design.
- critically describe the behavior of various types of structures due to wind loading.
- Employ the standards for the design of various structures due to wind loading.
- Describe and perform the design of structures against cyclone.

CEDY 214	FIRE PROTECTION OF STRUCTURES	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To describe the principles and methods of construction and how they relate to life and fire safety.
- Explain engineering and construction principles and the different loads and stresses exerted on a building in their relation to life and fire safety.
- Compare the characteristics and types of materials used in the construction of buildings and how they react in fire conditions.
- Recognize the different structural components of buildings and their reactions under fire conditions.

MODULE I CLASSIFICATION OF BUILDINGS AND TYPES OF PRODUCTION PROCESSES **7**

Types of construction and classification of buildings, Main building elements, Requirements of buildings, Combustibility and fire resistance, Fire hazard category of production processes. Process of combustion in fire, Effect of fire load & ventilation condition on enclosure fire, growth and decay of fire in enclosure.

MODULE II CALCULATION OF REQUIRED FIRE RESISTANCE LIMIT OF BUILDING STRUCTURES **8**

Initial condition for calculating fire resistance of structures, Duration of fire, Temperature of fire, Main points on the method of investigating temperature regimes of fires, Results of experimental investigations on fires, Simulation of temperature regimes of fires, Determination of fire in residential and public buildings, Determination of fire duration of fire in industrial buildings and warehouses, Standardization of fire resistance of structures.

MODULE III METHODS OF TESTING STRUCTURES FOR FIRE RESISTANCE **8**

Problems of testing for fire resistance, Set-up for testing fire resistance, Temperature regime of the tests, Test pieces of structures, Conditions of loading and supporting of structures, Measurements. Simple Design of elements for given fire resistance.

MODULE IV FIRE RESISTANCE OF REINFORCED CONCRETE STRUCTURES 7

Main aspects of the calculations for fire resistance, Thermo technical part of the calculation Boundary conditions, Calculation of temperature in plane structures (one- dimensional temperature field), Calculation of temperature in bar type structures (Two- dimensional temperature field), Calculation of depth at which a given temperature is reached, Effect of moisture in concrete on the heating of structures, Thermo physical properties of concrete at high temperatures ,Statics part of calculations, Change in the strength of reinforcement steel with increase of temperature

Total Hours : 30

REFERENCES:

1. John A. Purkiss “Fire Safety Engineering Design of structures”-, Butterworth Heinemann – 2009.
2. Brannigan, F. L. & Corbett, G. P. (2008). Brannigan’s Building Construction for the Fire Service. Sudbury, MA: Jones & Bartlett Publishers.
3. U.S Bendev Etal, “Fire Resistance of Buildings”- Amerind Publishing Co. Pvt. Ltd 2006.
4. Andrew H. Buchman “Structural design for fire safety, comprehensive overview of the fire resistance of building structures”-, John Wiley and sons.- 2001.

OUTCOMES:

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

- Interpret the intentions of code requirements for fire safety.
- Understand the concepts of fire severity and fire resistance.
- Design steel, concrete or timber structures to resist fire exposure.

CEDY 215 DESIGN OF MASONRY STRUCTURES

L	T	P	C
2	0	0	2

OBJECTIVES: :

- To provide basic knowledge on the various materials used for masonry construction.
- To provide in-depth knowledge on the behavior of masonry walls and buildings
- To understand the concepts related to the seismic design and evaluation of masonry structures.

MODULE I MATERIALS & PROPERTIES 7

Properties of constituents: units - burnt clay, concrete blocks, mortar, grout, reinforcement; Masonry bonds and properties: patterns, shrinkage, differential movement, masonry properties - compression strength

MODULE II BEHAVIOUR OF MASONRY WALLS 8

Stresses in masonry walls: vertical loads, vertical loads and moments–eccentricity & kern distance, lateral loads - in-plane, out-of-plane; Behaviour of masonry walls and piers: axial and flexure, axial- shear and flexure,

MODULE III BEHAVIOUR OF MASONRY BUILDINGS 8

Behaviour of Masonry Buildings: unreinforced masonry buildings - importance of bands and corner & vertical reinforcement, reinforced masonry buildings - cyclic loading & ductility of masonry walls - Behaviour of masonry in filled in RC frames: strut action.

MODULE IV SEISMIC DESIGN OF MASONRY STRUCTURES 7

Structural design of masonry in buildings: methods of design – WSD, USD, seismic design - seismic loads, codal provisions, infilled, connectors, ties; Seismic evaluation and strengthening of masonry buildings: methods - in-situ, non-destructive testing.

Total Hours :30

REFERENCES:

1. Hendry, A.W., Sinha, B.P. Davies, S.R., Design of Masonry Structures, Taylor & Francis, 2004.
2. Robert G. Drysdale, Ahmad A. Hamid, Lawrie R. Baker, Masonry Structures: Behavior and Design, Masonry Society, second edition , 2009.
3. Richard Klingner**,** Masonry Structural Design**,** McGraw Hill Professional, 2010.
4. Christine Beall, Masonry Design and Detailing 6/E, McGraw Hill Professional, 2012.

OUTCOMES:

On successful completion of this course, students will be able to

- elaborate the materials for masonry construction.
- describe the behavior of masonry walls under vertical and horizontal loads.
- explain the behaviour of unreinforced and reinforced masonry buildings.
- perform the seismic design and evaluation of masonry structures.

CEDY 216	CONSTRUCTION CONTRACTS	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To improve the knowledge of the students in various elements of contract, legal requirements, regulations and other laws related to it.

MODULE I CONSTRUCTION CONTRACTS 6

Indian contracts act – elements of contracts – types of contracts – public private partnership in contract - design of contract documents – international contract document - FIDIC– standard contract document – law of torts.

MODULE II LEGAL REQUIREMENTS 7

Insurance and bonding – laws governing sale, purchase and use of urban and rural land – land revenue codes – tax laws – income tax, sales tax, excise and custom duties and their influence on construction costs – legal requirements for planning – property law – agency law – benefits in public private partnership -local government
laws for approval – statutory regulations.

Total Hours : 15

REFERENCES:

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. The Indian Contracts Act, 1872,
4. Arbitration and Conciliation Act, 1996.
5. The Tamil Nadu Transparency in Tenders act, 1998.

OUTCOMES:

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

- define the various elements, types and laws related to contract.
- describe the various legal requirements related to construction activities.

CEDY 232	ENERGY EFFICIENT STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course will impart knowledge on

- design of energy efficient buildings which balances all aspects of energy lighting.
- space conditioning
- ventilation by providing a mix of passive solar design strategies
- use of materials with low embodied energy.

MODULE I INTRODUCTION 09

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 09

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 09

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 09

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 09

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 zone – energy audit – certification.

Total Hours –45

REFERENCES:

1. Brown, GZ Sun, Wind and Light: Architectural design strategies, John Wiley,2014.
2. Cook. J, Award –Winning passive Solar Design, Mc-Graw Hill, 1984.
3. Moore F., Environmental Control system, Mc Graw Hill Inc., 1994.

OUTCOMES:

On completion of this course, students will be able to

- identify the required energy for building construction.
- design and analyse the passive solar cooling and heating techniques.
- identify the required amount of daylight and electrical lighting for a building.
- analyse the ventilation and thermal design of a building.
- design a specific type of building for special climatic zones.

CEDY 233	GREEN CONCEPTS IN BUILDING ENVIRONMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course will impart knowledge on

- green buildings concept
- indoor environment quality
- economics of green building

MODULE I DEFINING "GREEN" AND "SUSTAINABILITY" 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 AND THE GREEN DESIGN PROCESS 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 -brownfield redevelopment - alternative transportation -site development –storm water design-heat-island effect - light-pollution reduction -commissioning process -overview -fundamental commissioning –retro commissioning -enhanced commissioning -cost management

MODULE III GREEN MATERIALS AND PRODUCTS 9

General- green building materials - natural versus synthetic - storage and collection of recyclables- low-emitting materials -adhesives, finishes, and sealants -paints and coatings- flooring systems- earthen building materials- windows - miscellaneous building elements- roofing – wood - concrete - building and material reuse - 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- life-cycle cost analysis- third party certification

MODULE IV INDOOR ENVIRONMENTAL QUALITY (IEQ) & WATER EFFICIENCY 10

IEQ- general overview - indoor environmental quality and factors affecting the indoor environment -indoor-air quality -thermal comfort -noise pollution -day lighting and daylight factor (df) -ventilation and filtration -building materials and finishes emittance levels- water efficiency and sanitary waste- general issues- waste-water strategy: water reuse/recycling water- efficient landscaping – innovative wastewater technologies -water-use reduction- construction waste management- water fixtures and conservation strategies- toilets - urinals –faucets -shower heads -baseline water-consumption calculations- retention ponds, bio swales, and other systems

MODULE V ECONOMICS OF GREEN DESIGN 9

General Overview - costs and benefits of green design- the economic benefits of green buildings - cost considerations- life-cycle costing -life-cycle cost method - increased productivity - improved tenant/employee health -enhancement of property value and marketability - other indirect benefits external economic effects - increased recruitment and retention -tax benefits -miscellaneous green-building costs -energy costs- operation, maintenance, and repair costs -replacement costs - other costs - design and analysis tools and methods - present-value analysis - sensitivity analysis -breakeven analysis - computer programs - relevant codes and standards - liability issues - general overview -traditional litigation: pretrial and trial procedures -alternative dispute resolution

Total Hours –45

REFERENCES:

1. “Alternative Building Materials and Technologies”. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao New Age International, 2007.
2. “LEED - Practices, Certification and Accreditation Handbook”. Sam kubba, Butterworth-Heinemann, 2009
3. “Low Energy Cooling For Sustainable Buildings”. John Wiley and Sons Ltd,

2009.

OUTCOMES:

On completion of this course, students will be able to

- identify the basic concepts in green and sustainability.
- design and implement green building concepts in high rise buildings.
- identify various green materials and products in construction.
- analyze the indoor environmental quality and water efficiency of building.
- perform economic analysis of a green building.

GENERAL ELECTIVES

GEDY101	PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of the course would be to make the students

- Learn to evaluate and choose an optimal project and build a project profile.
- Attain knowledge on risk identification and risk analysis
- Gain insight into a project plan and components
- Familiar with various gamut of technical analysis for effective project implementation
- Learn to apply project management techniques to manage resources.

MODULE I INTRODUCTION & PROJECT INITIATION 09

Introduction to project and project management - projects in contemporary organization – The project life cycle - project initiation - project evaluation methods & techniques - project selection criteria - project profile.

MODULE II RISK ANALYSIS 09

Sources of risk: project specific - competitive - industry specific - market and international risk – perspectives of risk – risk analysis: sensitivity analysis - scenario analysis - breakeven analysis - simulation analysis - decision tree analysis – managing/mitigating risk – project selection under risk.

MODULE III PROJECT PLANNING & IMPLEMENTATION 09

Project planning – importance – functions - areas of planning - project objectives and policies - steps in planning process - WBS – capital requirements - budgeting and cost estimation - feasibility analysis - creation of project plan – project implementation: pre-requisites - forms of project organization

MODULE IV TECHNICAL ANALYSIS 09

Technical analysis for manufacturing/construction/infrastructure projects – process/technology - materials and inputs - product mix - plant capacity – plant location and site selection – plant layout - machinery and equipment – structures and civil works – schedule of project implementation – technical analysis for software projects.

MODULE V PROJECT MANAGEMENT TECHNIQUES 09

Project scheduling - network construction – estimation of project completion time – identification of critical path - PERT & CPM – crashing of project network - complexity of project scheduling with limited resources - resource allocation - resource leveling – resource smoothing – overview of project management software.

Total Hours: 45

REFERENCES:

1. Projects: Planning, Analysis, Financing, Implementation and Review, Prasanna Chandra, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
2. Project Management and Control, Narendra Singh, Himalaya Publishing, New Delhi, 2015.
3. A Management Guide to PERT/CPM, Jerome, D. Weist and Ferdinand K. Levy, Prentice Hall of India, New Delhi, 1994.

OUTCOMES:

On successfully completing this course, the student will be able to:

- Evaluate & select a project as well as develop a project profile.
- Identify various risks associated with the project and manage it effectively.
- Prepare a detailed project plan addressing its components.
- Perform technical analysis for effective project implementation
- Apply project management techniques for maximizing resource utilization.

GEDY102 SOCIETY, TECHNOLOGY & SUSTAINABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To aware of new technologies through advances in Science and Engineering.
- To make them realize the profound impact on society.
- To understand the ethical issues raised by technological changes and its effect on society.
- To introduce students a broad range of perspectives on the adoption and use of technologies.
- To make them realize the need of sustainability in the context of emerging technologies.

MODULE I TECHNOLOGY AND ITS IMPACTS 09

Origin and evolution of technologies – Nature of technology- Innovation – Historical Perspective of technology – Sources of technological change - Co-evolution of technology and economy – Scientific knowledge and technological advance – Science and Engineering aspects of Technology – Impact on the Society – Social and Ethical Issues associated with technological change – Social and environmental consequences - Impact of technological change on human life –Technology and responsibility – Technology and social justice.

MODULE II TECHNOLOGY AND ITS ADVANCEMENT 09

Sociological aspects of technology – Ethics and technology – Technology and responsibility – International Economics, Globalisation and Human Rights – Sustainability and Technology – Population and environment - Technology, Energy and Environment – Organisations and technological change.

MODULE III SOCIETY AND TECHNOLOGY 09

Impact of technologies on contemporary society – Role of society in fostering the development of technology – Response to the adaption and use of technology – Impact of technology on developer and consumers – Technological change and globalisation.

MODULE IV IMPACT OF A SPECIFIC TECHNOLOGY ON HUMAN WELFARE 09

Impact of the following technologies on Human life – Medical and Biomedical – Genetics Technology – Electronics and Communications – Electronic media Technology – Information Systems Technology – Nanotechnology – Space Technology and Energy Technology.

MODULE V THE IMPORTANCE OF SUSTAINABILITY 09

Sustainability – A brief history – Concepts and contexts for sustainability – Ecological imbalance and biodiversity loss – Climate change – Population explosion. Industrial ecology – systems approach to sustainability – Green engineering and technology-sustainable design- sustainable manufacturing-Green consumer movements – Environmental ethics – Sustainability of the planet Earth – Future planning for sustainability.

Total Hours: 45

REFERENCES:

1. Volti Rudi, “Society and Technology Change”, 6th Edition, Worth publishers Inc, USA, 2009.
2. Arthur W.A, “The nature of Technology: What it is and how it evolves”, Free Press, NY, USA, 2009.
3. Winston M and Edelbach R, “Society, Ethics and Technology”, 3rd Edition, San Francisco, USA, 2005.
4. Martin A.A Abraham, “Sustainability Science and Engineering: Defining Principles”, Elsevier Inc, USA, 2006.
5. R.V.G.Menon, “Technology and Society”, Pearson Education, India, 2011.

OUTCOMES:

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

- Understand the benefits of modern technology for the well-being of human life.
- Connect sustainability concepts and technology to the real-world challenges.
- Find pathway for sustainable society.

GEDY103	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Expose the history and foundations of artificial intelligence.
- Showcase the complexity of working on real time problems underlying the need for intelligent approaches.
- Illustrate how heuristic approaches provide a good solution mechanism.
- Provide the mechanisms for simple knowledge representation and reasoning.
- Highlight the complexity in working with uncertain knowledge.
- Discuss the current and future applications of artificial intelligence.

MODULE I HISTORY AND FOUNDATIONS 08

History – Scope – Influence from life – Impact of computing domains - Agents in environments - Knowledge representation – Dimensions of Complexity – Sample application domains – Agent structure.

MODULE II SEARCH 10

Problem solving as search – State spaces – Uninformed Search – Heuristic search – Advanced search – Constraint satisfaction - Applications.

MODULE III KNOWLEDGE REPRESENTATION AND REASONING 10

Foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.

MODULE IV REPRESENTING AND REASONING WITH UNCERTAIN KNOWLEDGE 08

Probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.

MODULE V CASE STUDY AND FUTURE APPLICATIONS 09

Design of a game/Solution for problem in student's domain. Natural Language processing, Robotics, Vehicular automation – Scale, Complexity, Behaviour – Controversies.

Total Hours: 45

TEXT BOOK:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2010.
2. David Poole, Alan Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
3. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, Online edition, 2013.
4. Keith Frankish, William M. Ramsey (eds) The Cambridge Handbook of Artificial Intelligence, Cambridge University Press, 2014.

OUTCOMES:

Students who complete this course will be able to

- Discuss the history, current applications, future challenges and the controversies in artificial intelligence.
- Apply principle of AI in the design of an agent and model its actions.
- Design a heuristic algorithm for search problems.
- Analyze and represent the fact using logic for a given scenario
- Represent uncertainty using probabilistic models
- Develop a simple game or solution using artificial intelligence techniques.

GEDY104	GREEN COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To focus on the necessity of green computing technology.
- To expose to various issues with information technology and sustainability.
- To attain knowledge on the technologies for enabling green cloud computing.
- To elaborate on the energy consumption issues
- To illustrate a Green and Virtual Data Center
- To develop into a Green IT Technologist.

MODULE I INTRODUCTION 08

Trends and Reasons to Go Green - IT Data Center Economic and Ecological Sustainment - The Growing Green Gap: Misdirected Messaging, Opportunities for Action - IT Data Center “Green” Myths and Realities - PCFE Trends, Issues, Drivers, and Related Factors - Green Computing and Your Reputation- Green Computing and Saving Money- Green Computing and the Environment

MODULE II CONSUMPTION ISSUES 10

Minimizing power usage – Cooling - Electric Power and Cooling Challenges - Electrical – Power -Supply and Demand Distribution - Determining Energy Usage - From Energy Avoidance to Efficiency - Energy Efficiency Incentives, Rebates, and Alternative Energy Sources - PCFE and Environmental Health and Safety Standards- Energy-exposed instruction sets- Power management in power-aware real-time systems.

MODULE III NEXT-GENERATION VIRTUAL DATA CENTERS 09

Data Center Virtualization - Virtualization beyond Consolidation - Enabling Transparency - Components of a Virtual Data Center - Datacenter Design and Redesign - Greening the Information Systems - Staying Green- Building a Green Device Portfolio- Green Servers and Data Centers- Saving Energy

MODULE IV TECHNOLOGIES FOR ENABLING GREEN AND VIRTUAL DATA CENTERS 08

Highly Effective Data Center Facilities and Habitats for Technology - Data Center Electrical Power and Energy Management - HVAC, Smoke and Fire Suppression -

Data Center Location - Virtual Data Centers Today and Tomorrow - Cloud Computing, Out-Sourced, and Managed Services.

MODULE V SERVERS AND FUTURE TRENDS OF GREEN COMPUTING 10

Server Issues and Challenges - Fundamentals of Physical Servers - Types, Categories, and Tiers of Servers - Clusters and Grids - Implementing a Green and Virtual Data Center - PCFE and Green Areas of Opportunity- 12 Green Computer Companies- What's in Green computer science-Green off the Grid aimed for data center energy evolution-Green Grid Consortium- Green Applications- Green Computing Making Great Impact On Research

Total Hours: 45

REFERENCES:

1. Bud E. Smith,"Green Computing Tools and Techniques for Saving Energy, Money, and Resources", Taylor & Francis Group, CRC Press, ISBN-13: 978-1-4665-0340-3, 2014.
2. Jason Harris, "Green Computing and Green IT Best Practices, On Regulations and Industry Initiatives, Virtualization and power management, materials recycling and Tele commuting, Emereo Publishing .ISBN-13: 978-1-9215-2344-1,2014.
3. Ishfaq Ahmed & Sanjay Ranka, "Handbook of Energy Aware and Green Computing", CRC Press, ISBN: 978-1-4665-0116-4, 2013.
4. Kawahara, Takayuki, Mizuno, "Green Computing with Emerging Memory", Springer Publications, ISBN:978-1-4614-0811-6, 2012
5. Greg Schulz, "The Green and Virtual Data Center", CRC Press, ISBN-13:978-1-4200-8666-9, 2009.
6. Marty Poniatowski, "Foundation of Green IT: Consolidation, Virtualization, Efficiency, and ROI in the Data Center", Prentice Hall, ISBN: 9780-1-3704-375-0, 2009.

OUTCOMES:

Students who complete this course will be able to

- Demonstrate issues relating to a range of available technologies, systems and practices to support green computing.

- Select appropriate technologies that are aimed to reduce energy consumption.
- Address design issues needed to achieve an organizations' green computing objectives.
- Analyze the functionality of Data Centers.
- Critically evaluate technologies and the environmental impact of computing resources for a given scenario.
- Compare the impact of Green Computing with other computing techniques.

GEDY105	GAMING DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To master event-based programming
- To learn resource management as it relates to rendering time, including level-of-detail and culling.
- To become familiar with the various components in a game or game engine.
- To explore leading open-source game engine components.
- To become familiar of game physics.
- To be compatible with game animation.

MODULE I INTRODUCTION 09

Magic Words–What Skills Does a Game Designer Need? –The Most Important Skill - The Five Kinds of Listening-The Secret of the Gifted.

MODULE II THE DESIGNER CREATES AN EXPERIENCE 09

The Game Is Not the Experience -Is This Unique to Games? -Three Practical Approaches to Chasing Rainbows -Introspection: Powers, Perils, and Practice - Dissect Your Feelings -Defeating Heisenberg -Essential Experience.

MODULE III THE EXPERIENCE IN THE PLAYER MIND AND GAME MECHANICS 08

Modeling – Focus -Empathy –Imagination –Motivation – Space – Objects, Attributes, and States – Actions – Rules.

MODULE IV GAMES THROUGH AN INTERFACE 09

Breaking it Down –The Loop of Interaction – Channels of Information – Other Interface.

MODULE V BALANCED GAME MECHANICS 10

Balance –The Twelve Most Common Types of Game Balance –Game Balancing Methodologies - Balancing Game Economies.

Total Hours: 45

REFERENCES:

1. Jesse Schell, "The Art of Game Design: A Book of Lenses", 2nd Edition ISBN-10: 1466598646, 2014.
2. Ashok Kumar, Jim Etheredge, Aaron Boudreaux, “Algorithmic and Architectural Gaming Design: Implementation and Development", 1st edition, Idea Group, U.S ISBN-10: 1466616342, 2012.
3. Katie SalenTekinba, Melissa Gresalfi, Kylie Peppler, Rafi Santo, "Gaming the System - Designing with Gamestar Mechanic" MIT Press , ISBN-10: 026202781X, 2014.
4. James M. Van Verth, Lars M. Bishop "Essential Mathematics for Games and Interactive Applications", Third Edition,A K Peters/CRC Press, ISBN-10: 1482250926, 2015.

OUTCOMES:

Students who complete this course will be able to

- Realize the basic history and genres of games
- Demonstrate an understanding of the overall game design process
- Explain the design tradeoffs inherent in game design
- Design and implement basic levels, models, and scripts for games
- Describe the mathematics and algorithms needed for game programming
- Design and implement a complete three-dimensional video game

GEDY106	SOCIAL COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To create original social applications, critically applying appropriate theories and effective practices in a reflective and creative manner.
- To critically analyze social software in terms of its technical, social, legal, ethical, and functional features or affordances.
- To encourage the development of effective communities through the design, use, and management of social software.
- To give students with a base of knowledge and advances for them to critically examine existing social computing services.
- To plan and execute a small-scale research project in social computing in a systematic fashion.
- To become familiar with the concept of computational thinking.

MODULE I BASIC CONCEPTS 09

Networks and Relations: Relations and Attributes, Analysis of Network Data, Interpretation of network data -New Social Learning – Four Changes that Shift Work - Development of Social Network Analysis: Sociometric analysis and graph theory, Interpersonal Configurations and Cliques – Analysing Relational Data.

MODULE II SOCIAL LINK 09

Individual Actors, Social Exchange Theory, Social Forces, Graph Structure, Agent Optimization Strategies in Networks – Hierarchy of Social Link Motivation- Social Context.

MODULE III SOCIAL MEDIA 08

Trends in Computing – Motivations for Social Computing – Social Media: Social relationships, Mobility and Social context – Human Computation – Computational Models- Business use of social Media.

MODULE IV SOCIAL INFORMATION FILTERING 09

Mobile Location Sharing – Location based social media analysis – Social Sharing and Social Filtering – Automated recommender Systems – Traditional and Social Recommender Systems.

MODULE V SOCIAL NETWORK STRATEGY 10

Application of Topic Models – Opinions and Sentiments – Recommendation Systems – Language Dynamics and influence in online communities – Psychometric analysis – Case Study: Social Network Strategies for surviving the zombie apocalypse.

Total Hours: 45

REFERENCES:

1. Tony Bingham, Marcia Conner, “The New Social Learning, Connect. Collaborate. Work”, 2nd Edition, ATD Press, ISBN-10:1-56286-996-5, 2015.
2. Nick Crossley, Elisa Bellotti, Gemma Edwards, Martin G Everett, Johan Koskinen, Mark Tranmer, “Social Network Analysis for Ego-Nets”, SAGE Publication, 2015.
3. Zafarani, Abbasi and Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014.
4. Christina Prell, “Social Network Analysis: History, Theory and Methodology”, 1st Edition, SAGE Publications Ltd, 2012.
5. John Scott, “Social Network Analysis”, Third Edition,SAGE Publication, 2013.
6. Jennifer Golbeck, “Analyzing the Social Web”, Elsevier Publication, 2013.
7. Huan Liu, John Salerno, Michael J. Young, “Social computing and Behavioral Modeling”, Springer Publication, 2009.

OUTCOMES:

Students who complete this course will be able to

- Realize the range of social computing applications and concepts.
- Analyze data left after in social media.
- Recognize and apply the concepts of computational models underlying social computing.
- Take out simple forms of social diagnostics, involving network and language models, applying existing analytic tools on social information.
- Evaluate emerging social computing applications, concepts, and techniques in terms of key principles.
- Design and prototype new social computing systems.

GEDY107	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The aim of the course is to

- Enumerate the strengths and weakness of soft computing
- Illustrate soft computing methods with other logic driven and statistical method driven approaches
- Focus on the basics of neural networks, fuzzy systems, and evolutionary computing
- Emphasize the role of euro-fuzzy and hybrid modeling methods
- Trace the basis and need for evolutionary computing and relate it with other soft computing approaches

MODULE I SOFT COMPUTING - BASICS 06

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 12

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 09

Fuzzy Logic – Membership functions – Operators – Fuzzy Inference systems – Other sets: Rough sets, Vague Sets – Fuzzy controllers - Applications

MODULE IV NEURO FUZZY SYSTEMS 09

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 V EVOLUTIONARY COMPUTING 09

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 – Evolutionary strategies and applications

Total Hours: 45

TEXTBOOKS:

1. Samir Roy, “Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms”, Pearson, 2013
2. Anupam Shukla, Ritu Tiwari and Rahul Kala, “Real life applications of Soft Computing”, CRC press, 2010.
3. Fakhreddine O. Karray, “Soft Computing and Intelligent Systems Design: Theory, Tools and Applications”, Pearson, 2009

OUTCOMES:

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

- Enumerate the theoretical basis of soft computing
- Explain the fuzzy set theory
- Discuss the neural networks and supervised and unsupervised learning networks
- Demonstrate some applications of computational intelligence
- Apply the most appropriate soft computing algorithm for a given situation

GEDY108	EMBEDDED SYSTEM PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the design of embedded computing systems with its hardware and software architectures.
- To describe entire software development lifecycle and examine the various issues involved in developing software for embedded systems.
- To analyze the I/O programming and Embedded C coding techniques
- To equip students with the software development skills necessary for practitioners in the field of embedded systems.

MODULE I INTRODUCTION OF EMBEDDED SYSTEM 09

Embedded computing –characteristics and challenges –embedded system design process –Overview of Processors and hardware units in an embedded system – Compiling, Linking and locating – downloading and debugging –Emulators and simulators processor – External peripherals – Memory testing – Flash Memory.

MODULE II SOFTWARE TECHNOLOGY 09

Software Architectures, Software development Tools, Software Development Process Life Cycle and its Model, Software Analysis, Design and Maintenance.

MODULE III INPUT/OUTPUT PROGRAMMING 09

I/O Instructions, Synchronization, Transfer Rate & Latency, Polled Waiting Loops, Interrupt – Driven I/O, Writing ISR in Assembly and C, Non Maskable and Software Interrupts

MODULE IV DATA REPRESENTATION IN EMBEDDED SYSTEMS 09

Data representation, Twos complement, Fixed point and Floating Point Number Formats, Manipulating Bits in -Memory, I/O Ports, Low level programming in C, Primitive data types, Arrays, Functions, Recursive Functions, Pointers, Structures & Unions, Dynamic Memory Allocation, File handling, Linked lists, Queues, Stacks.

MODULE V EMBEDDED C 09

Embedded Systems programming in C – Binding & Running Embedded C program in Keil IDE – Dissecting the program -Building the hardware. Basic techniques for

reading & writing from I/O port pins – switch bounce - LED Interfacing using Embedded C.

Total Hours: 45

REFERENCES:

1. Marilyn Wolf, "Computers as components ", Elsevier, 2012.
2. Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems", CMP Books, 2003.
3. Daniel W.Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education
4. Michael Bass, "Programming Embedded Systems in C and C++", Oreilly, 2003.

OUTCOMES:

On completion of this course the student will be able to

- Design the software and hardware components in embedded system
- Describe the software technology
- Use interrupt in effective manner
- Use keil IDE for programming
- Program using embedded C for specific microcontroller
- Design the embedded projects

GEDY109 PRINCIPLES OF SUSTAINABLE DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge in the concepts and dimensions of sustainable development.
- To gain knowledge on the framework for achieving sustainability.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 09

Environment and Development - Population poverty and Pollution –Global and Local environmental issues –Resource Degradation- Greenhouse gases –Desertification-industrialization –Social insecurity, Globalization and environment. History and emergence of the concept of sustainable development-Objectives of Sustainable Development.

MODULE II COMPONENTS AND DIMENSIONS OF SUSTAINABLE DEVELOPMENT 09

Components of Sustainability –Complexity of growth and equity – Social economic and environmental dimensions of sustainable development – Environment– Biodiversity– Natural – Resources– Ecosystem integrity– Clean air and water– Carrying capacity– Equity, Quality of Life, Prevention, Precaution–Preservation and Public Participation Structural and functional linking of developmental dimensions.

MODULE III FRAMEWORK FOR ACHIEVING SUSTAINABILITY 09

Operational guidelines– interconnected prerequisites for sustainable development Empowerment of Women, children, Youth, Indigenous People, Non-Governmental Organizations Local Authorities, Business and industry–Science and Technology for sustainable development – performance indicators of sustainability and assessment mechanism– Constraints and barriers for sustainable development.

MODULE IV SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 09

Demographic dynamics of sustainability – Policies for socio-economic development –Strategies for implementing eco-development programmes Sustainable development through trade –Economic growth –Action plan for implementing sustainable development –Urbanization and sustainable Cities –Sustainable Energy

and Agriculture –sustainable livelihoods.

MODULE V SUSTAINABLE DEVELOPMENT AND INTERNATIONAL RESPONSE 09

Role of developed countries in the development of developing countries– international summits–Stockholm to Johannesburg –Rio principles–Agenda-Conventions–Agreements– Tokyo Declaration –Doubling statement–Tran boundary issues integrated approach for resources protection and management

Total Hours: 45

REFERENCES:

1. Sayer J. and Campbell, B., The Science of Sustainable Development: Local Livelihoods and the Global environment - Biological conservation restoration & Sustainability, Cambridge university Press, London, 2003.
2. M.K. Ghosh Roy. and Timberlake, Sustainable Development, Ane Books Pvt. Ltd, 2011.
3. Mackenthun K.M., Concepts in Environmental Management, Lewis Publications London,1999.
4. APJ Abdul Kalam and Srijan Pal Singh, Target 3 Billion: Innovative Solutions Towards Sustainable Development, Penguin India, 2011

OUTCOMES:

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

- Describe the concepts of sustainable development
- Define the components and dimensions of sustainable development
- Outline the Frame work for achieving sustainability.
- State the policies and strategies for implementing sustainable development for Socio economic programmes.
- Examine the role of developed countries in sustainable development.

GEDY110	QUANTITATIVE TECHNIQUES IN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

To impart knowledge on

- Concepts of operations research
- Inventory control in production management
- Financial management of projects
- Decision theory and managerial economics

MODULE I OPERATIONS RESEARCH 09

Introduction to Operations research – Linear programming –Graphical and Simplex Methods, Duality and Post-Optimality Analysis –Transportation and Assignment Problems

MODULE II PRODUCTION MANAGEMENT 09

Inventory control, EOQ, Quantity Discounts, Safety Stock– Replacement Theory – PERT and CPM – Simulation Models –Quality Control.

MODULE III FINANCIAL MANAGEMENT 09

Working Capital Management–Compound Interest and Present Value methods– Discounted Cash Flow Techniques–Capital Budgeting.

MODULE IV DECISION THEORY 09

Decision Theory–Decision Rules–Decision making under conditions of certainty, risk and uncertainty–Decision trees–Utility Theory.

MODULE V MANAGERIAL ECONOMICS 09

Cost concepts–Breakeven Analysis–Pricing techniques–Game Theory applications.

Total Hours: 45

REFERENCES:

1. Vohra, N.D. , Quantitative Techniques in Management, Tata McGraw Hill Co., Ltd, New Delhi, 2009.
2. Seehroeder, R.G., Operations Management, McGraw Hill, USA, 2002.

3. Levin, R.I, Rubin, D.S., and Stinsonm J., Quantitative Approaches to Management, McGraw Hill Book Co., 2008.
4. Frank Harrison, E., The Managerial Decision Making Process, Houghton Miffin Co. Boston, 2005.
5. Hamdy A. Taha, Operations Research- An Introduction, Prentice Hall, 2002.

OUTCOME:

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

- Apply the concepts of operations research for various applications
- Create models for inventory control in production management
- Compute the cash flow for a project
- Choose a project using decision theory based on the risk criterion.
- Apply the concepts of managerial economics in construction management

GEDY111 PROGRAMMING USING MATLAB & SIMULINK

L	T	P	C
1	0	2	2

OBJECTIVES:

The aim of this course is to:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

MODULE I INTRODUCTION TO MATLAB AND DATA PRESENTATION 10

Introduction to MATLAB-Vectors, Matrices -Vector/Matrix Operations & Manipulation-Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically.

Lab Experiments

1. Study of basic matrix operations and manipulations.
2. Numerical and symbolical solution of linear equations.

MODULE II ROOT FINDING AND MATLAB PLOT FUNCTION 10

Linearization and solving non-linear systems of equations- The Newton-Raphson method- Integers and rational numbers in different bases- Least squares regression - Curve fitting-Polynomial fitting and exponential fitting.

Lab Experiments

1. Solution of non linear equations using Newton-Raphson method.
2. Determination of polynomial fit and exponential fit for the given data.

MODULE III LINEAR AND NON-LINEAR DIFFERENTIAL EQUATIONS 13

Numerical integration and solving first order, ordinary differential equations (Euler's method and Runge-Kutta)- Use of ODE function in MATLAB- Converting second order and higher ODEs to systems of first order ODEs- Solving systems of higher order ODEs via Euler's method and Runge-Kutta)- Solving single and systems of non-linear differential equations by linearization-Use of the function ODE in MATLAB to solve differential equations - Plot Function –Saving & Painting Plots.

Lab Experiments

1. Solution of fourth order linear differential equations using

a. Trapezoidal Rule
b. Euler method

2. Solution of fourth order non-linear differential equations using
   a. Modified Euler method
   b. Runge – Kutta method

MODULE IV INTRODUCTION OF SIMULINK 12

Simulink & its relations to MATLAB – Modeling a Electrical Circuit- Modeling a fourth order differential equations- - Representing a model as a subsystem- Programme specific Simulink demos.

Lab Experiments

1. Solution of fourth order non-linear differential equations using simulink.
2. Programme specific experiment based on simulink.

Total Hours (Including Practical): 45

REFERENCE:

1. Griffiths D V and Smith I M, “Numerical Methods for Engineers”, Blackwell, 1991.
2. LaureneFausett, “Applied Numerical Analysis Using MATLAB”, Pearson 2008.
3. Moin P, “Fundamentals of Engineering Numerical Analysis”, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB”, CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving, “Mathematical Exploration with MATLAB”, Cambridge University Press, 1999.

OUTCOMES:

At the end of this unit students will be able to:

- Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
- Write programs using first principles without automatic use of built-in ones.
- Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
- Be fluent in exploring Matlab’s capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script and

function m-files, function handles, graphical output.

- Make use of Maltab visual capabilities for all engineering applications.
- An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

GEDY112 JAVA PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To study the syntax and necessity of decision making and iterative statements.
- To create a class and invoke the methods with ability handle abnormal conditions.
- To learn to work with various string methods and collection framework.
- To establish a connection to database from java application.
- To understand why Java is useful for the designing web applications.
- To design a graphical user interface (GUI) with Java Swing.

MODULE I INTRODUCTION TO JAVA PROGRAMMING 06

History and Evolution of Java – Overview of Java – Data types, variables and arrays – Operators – Control statements.

MODULE II METHODS AND CLASSES 08

Class fundamentals – Declaring objects – Methods – Constructors – Garbage collection – Overloading methods – Constructor overloading – Access control – Inheritance – Packages - Exception handling.

MODULE III STRING HANDLING AND COLLECTIONS 07

String Handling - Special String Operations - String Literals- String Conversion - Collections Overview - The Collection Interfaces -The Collection Classes - Accessing a collection Via an Iterator - Working With Maps, Comparators.

MODULE IV DATABASE CONNECTIVITY 08

JDBC - JDBC Driver Types - JDBC Packages - Database Connection - Associating the JDBC/ODBC Bridge with the Database - Statement Objects – Result Set - Transaction Processing – Metadata - Exceptions.

MODULE V SERVER PROGRAMMING 09

The Life Cycle of a Servlet - Using Tomcat for Servlet Development -The Servlet API - Handling HTTP Requests and Responses - Using Cookies - Session Tracking - Java Server Pages (JSP)-Session Objects

MODULE VI SWING PROGRAMMING 07

Concepts of Swing - Java Foundation Class (JFC) - Swing Packages and Classes - Working with Swing - Swing Components

L – 45; TOTAL HOURS-45

REFERENCES :

1. Herbert Schildt, “Java The Complete Reference”, 11th Edition, McGraw Hill, 2018, ISBN: 9781260440249.
2. Joshua Bloch , “Effective Java Paperback”,3rd Edition, Addison Wesley,2017,ISBN: 978-0134685991.
3. E Balagurusamy, “Programming with Java”, 6th Edition, Tata Mcgraw Hill, 2019,ISBN: 978-9353162344.

OUTCOMES:

Students who complete this course will be able to

- Understand the fundamentals java programming language
- Use the Java programming language for various programming technologies.
- Perform various string operations on any given text from user.
- Connect any database with java program and manipulate the contents.
- Write a server side programming which can evaluate the input and respond to user request
- Develop user interface using java swings.

GEDY113 PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES :

- To study the control statements and string functions of python.
- To practice python data structures - lists, tuples, dictionaries.
- To organize input/output with files in Python.
- To learn the python tools as well as Unicode process.
- To explore advance python including decorators and meta classes.
- To integrate python with embedded systems.

MODULE I INTRODUCTION TO PYTHON PROGRAMMING 07

Installation and environment set up – syntax used in python – variable types – operators – Loops – decision making – string functions - recursion - GUI basics.

MODULE II LISTS, TUPLES AND DICTIONARIES 08

Lists - list operations - list slices - list methods - list loop – mutability- aliasing - cloning lists - list parameters - Tuples: tuple assignment- tuple as return value- Dictionaries- operations and methods- advanced list processing - list comprehension- selection sort - insertion sort- merge sort- histogram.

MODULE III FILES, MODULES AND PACKAGES 08

Files and exception - text files - reading and writing files - format operator - command line arguments - errors and exceptions - handling exceptions – modules – packages - word count- copy file.

MODULE IV UNICODE AND BYTE STRINGS 07

String basics - coding basic strings –coding Unicode strings- 3.X bytes objects- 3.X/2.6+ byte array object- text and binary files – Unicode files

MODULE V DECORATORS AND METACLASS 08

Decorator basics- coding function decorators- coding class decorators – managing functions and classes –the meta class model- declaring meta classes-coding meta classes-inheritance and instance-meta class methods

MODULE VI EMBEDDED PROGRAMMING USING PYTHON 07

Web interface – system tools – script execution context - Motion-triggered LEDs – Python - Arduino prototyping-storing and plotting Arduino data-Remote home monitoring system.

L – 45;Total Hours : 45

REFERENCES :

1. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016, ISBN-13:978-1491939369.
3. Nick Goddard, “Python Programming”, 2nd edition, ISBN: 1533337772, 2016.
4. Mark Lutz, Learning Python: Powerful Object-Oriented Programming, 5th Edition, O'Reilly Media, 2013.
5. Pratik Desai, “Python Programming for Arduino”, 1st edition, Packt publishing, 2015, ISBN: 9781783285938.
6. Richard H. Barnett, Sarah Cox, Larry O'Cull, “Embedded C Programming and the Atmel AVR”, 2nd edition, 2006.
7. Michael Barr, Anthony Massa, “Programming Embedded Systems”, 2nd Edition, O'Reilly Media, 2006.

OUTCOMES :

Students to complete this course will be able to

- Implement date and time function programming using python.
- Represent compound data using Python lists, tuples, dictionaries
- Read and write data from/to files in Python Programs.
- Instrument the Unicode process using python tools
- Build advance python programs using decorators and metaclass.
- Develop embedded system with python programming.

GEDY114 INTELLECTUAL PROPERTY RIGHTS (IPR)

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study about Intellectual property rights and its need
- To explore the patent procedure and related issues

MODULE I INTRODUCTION 07

Introduction and the need for intellectual property right (IPR) –IPR in India – Genesis and Development – IPR in abroad – Important examples of IPR– Copyrights, Trademarks, Patents, Designs, Utility Models, Trade Secrets and Geographical Indications – Industrial Designs

MODULE II PATENT 08

Concept of Patent – Product / Process Patents & Terminology– Duration of Patents – Law and Policy Consideration Elements of Patentability –- Patentable Subject Matter– Procedure for Filing of Patent Application and types of Applications – Procedure for Opposition – Revocation of Patents – Working of Patents- Patent Agent– Qualification and Registration Procedure – Patent databases and information system – Preparation of patent documents – Process for examination of patent application- Patent infringement– Recent developments in patent system

Total Hours: 15

REFERENCES

1. B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000
2. AjitParulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.
4. E. T. Lokganathan, Intellectual Property Rights (IPRs): TRIPS Agreement & Indian Laws Hardcover, 2012
5. Alka Chawla, P N Bhagwati , Law of Copyright Comparative Perspectives 1st Edition, LexisNexis, 2013

6. V. K. Ahuja, Law Relating to Intellectual Property Rights 2nd Edition, LexisNexis, 2nd Edition, 2013
7. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 2015
8. Jatindra Kumar Das, Law of Copyright, PHI Learning, 2015

OUTCOMES:

Students should be able to

- Identify the various types of intellectual property and their value
- Apply the procedure to file a patent and to deal the related issues
- Search and extract relevant information from various intellectual database

GEDY115 RESEARCH AND PUBLICATION ETHICS

L	T	P	C
2	0	0	2

OBJECTIVES:

- To understand the philosophy of science and ethics, research integrity and publication ethics. To identify research misconduct and predatory publications.
- To understand indexing and citation databases, open access publications, research metrics (citations, h-index, impact Factor, etc.).
- To understand the usage of plagiarism tools.

MODULE I PHILOSOPHY AND ETHICS **4**

Introduction to philosophy – definition - nature and scope – concept - branches – Ethics definition– moral philosophy – nature of moral judgements and reactions.

MODULE II SCIENTIFIC CONDUCT **4**

Ethics with respect to science and research–. Intellectual honest and research integrity–Scientific misconducts – falsification, fabrication, and plagiarism –Redundant publications – duplicate and overlapping publications, salami slicing–Selective reporting and misrepresentation of data.

MODULE III PUBLICATION ETHICS **7**

Publication ethics: definition, introduction and importance–Best practices/standards setting initiatives and guidelines: COPE, WAME, etc.–. Conflicts of interest–Publication misconduct: definition, concept, problems that lead to unethical behavior and vice verse, types–Violation of publication ethics, authorship and contributor ship–Identification of publication misconduct, complaints and appeals–Predatory publishers and journals.

PRACTICALS

OPEN ACCESS PUBLISHING **4**

Open access publications and initiatives – SHERPA/RoMEO online resource to check publisher copyright and self-archiving policies – Software tool to identify predatory publications developed by SPPU – Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

PUBLICATION MISCONDUCT **4**

Group Discussions – Subject specific ethical issues, FFP, authorship – Conflicts of

interest – Complaints and appeals: examples and fraud from India and abroad – Software tools Use of plagiarism software – Turnitin, Urkund – other open source software tools.

DATABASES AND RESEARCH METRICS **7**

Databases –Indexing Databases – Citation Databases– Web of Science Databases Scopus, etc.

Research Metrics –Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score –

Metrics: h-index, g index, i10 index, altmetrics

L – 15 ; P – 15 ; TOTAL HOURS –30

REFERENCES:

1. Bird, A. (2006). *Philosophy of Science.* Routledge.
2. Macintyre, Alasdair (1967) *A Short History of Ethics.* London.
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978- 9387480865
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being*
5. *A Scientist: A Guide to Responsible Conduct in Research: Third Edition.* National Academies Press. Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences,* 1-10. Retrievedfrom

https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm

6. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. https://doi.org/10.1038/489179a
7. Indian National Science Academy (INSA), Ethics in Science Education, Research and Govemance(2019), ISBN:978-81-939482- l-7. http://www.insaindia.res.in/pdf/EthicsBook.pdf

OUTCOMES:

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

- Describe and apply theories and methods in ethics and research ethics
- Understand the overview of important issues in research ethics, like responsibility for research, ethical vetting, and scientific misconduct.
- Present arguments and results of ethical inquiries.

VALUE ADDED COURSES

REVIT ARCHITECTURE	L	T	P	C
	1	0	2	2

OBJECTIVES:

- To impart knowledge on REVIT Architecture Software
- To create 3D Modeling of various structures

MODULE I INTRODUCTION TO REVIT 10

Introduction to BIM & Revit, Parametric relationship, Bidirectional associability, Types of files, GUI, Setting Units, creating levels, placing walls, doors, windows to develop a layout, Draw tools

Instance and Type parameters - defining new basic wall type, door & window with specification, wall editing and adding new materials from material browser, editing wall profile, wall opening

Modification tools-align, offset, mirror draw and pick axis, split element ,split with gap, linear and radial array , move ,rotate ,trim ,copy ,pin & delete

MODULE II WALLS & ROOF 11

Adding wall sweep and reveal - Creating new profiles for sweep and reveal, working with family file for profile Types of wall-stacked, compound, curtain, types of curtain walls placing grids and mullions, Adding door in a curtain wall.

Roof Types- soffit, fascia, gutter, Model line, model text and model group, types of elements - model, detail, datum, and views. Model in place-selecting category, modeling tools- Sweep, revolve, extrusion, blend, swept blend, reference plane, adding type & instance parameters.

Developing roof - By Roof print, flat, sloped, gabled roof, join roof, Roof by extrusion, setting work plane, roof, dormer opening, attach wall to roof

MODULE III ARCHITECTURAL & STRUCTURAL FLOOR 12

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.

Adding Room and Area definitions to develop room and area plan, Applying color scheme, color fill legend, exporting Room & area report. Controlling Visibility, generating furniture plan

Connecting floors with ramps -methods, floor editing by sub elements.

Converting single storey structure to multi storey model with shaft openings Insert- Working with imported/linked cad layout, Autodesk seek

Circulation tools:-Railing, Creating and editing new type of railing with new profiles and balusters, Stairs- types & methods

MODULE IV 3D VIEW & WALK THROUGH 12

Generating 3D view - using camera, editing view, Rendering-artificial, daylight, render-in-cloud, exporting images. Landscaping-Top surface creation and editing, placing site and parking component, property line, building pad, sub region, graded region.

Walkthrough- editing key frames, speed, view range, exporting walkthrough Free form development using massing, In place mass, Place mass, adding walls, floors and roof by face, Curtain system

Creating new family- file for Furniture with family types with constraints and parameters. Creating new views- Plan, Section, elevation, Plan region, callout, legend, view range, underlay, and visibility template.

Creating and exporting schedules - material take off, Export to excel. Export – dwg /dxf/fbx/ifc/gbxml, Creating sheet, title block, editing title block, guide grid, placing views on sheet, view port, moving view title, creating duplicate views, creating new title block. Print, Export

P – 45; Total Hours –45

TEXT BOOKS:

1. Mastering Autodesk Revit 2017 for Architecture 1st Edition, by Marcus Kim , Lance Kirby , Eddy Krygiel

REFERENCES:

1 Autodesk Revit 2018 Architecture Fundamentals - Metric: Autodesk Authorized Publisher Ascent - Center for Technical Knowledge

OUTCOMES:

The student will be able to

- apply the features of REVIT architecture
- create walls & roof using the software
- Connect floors, structural elements & architectural elements using software
- Generate 3D view and animate walkthrough using REVIT architecture.

	L	T	P	C
BUILDING INFORMATION MODELING	**1**	**0**	**4**	**3**

OBJECTIVES:

The course will impart knowledge on

1. Tools of BIM.
2. Architectural modeling of structure
3. structurally analyze and design the architecturally modeled structure
4. To plan the execution of the same structure at site.

MODULE I INTRODUCTION TO BIM TOOL 5

Introduction of AEC Industry - Building Information Modeling & Various levels of Development.

MODULE II DESIGN A RESIDENTIAL BUILDING 20

To 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 20

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 Color Scheme

MODULE IV INTEGRATING WITH STAAD PRO 15

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

MODULE V INTEGRATING WITH PRIMAVERA & NAVIS WORKS 15

Introduction to Software like Primavera-P6/MS Project/Sure track-For schedule development and tracking of it; Prolog-Data Management-RFI's *Request for Information], Submittals-Product Data, Punch list etc.; JDE [JD Edwards]-Financial Management- For use of tracking and developing the cost reports and issuing the change orders, etc.;

Navis works-In this software 3D Auto CAD/Revit model can be imported with a project schedule to review the progress of the Project – Clash Detection of services

L – 15; P – 60; Total Hours –75

REFERENCES:

1 Eastman, C., Teicholz, P., Sacks, R., & Liston, C., BIM handbook: A guide to building information, 2011
2 Hardin, B., & McCool, D., BIM and construction management: proven tools, methods, and workflows.John Wiley & Sons, 2015
3 Krygiel, E., &Nies, B., Green BIM: successful sustainable design with building information modeling, John Wiley & Sons, 2008.
4 Issa, R. R., &Olbina, S., Building Information Modeling: Applications and Practices, American Society of Civil Engineers, 2015

OUTCOMES:

The students will be able to

- Demonstrate concepts of Building Information Modeling.
- Design a building structure using software
- Create new MEP project and link it with RIVET
- Analyze the structure using STAAD PRO.
- Use primavera and develop a schedule for any designed structure and do clash detection using Navis Works by companies from fresh Engineering graduates.