CURRICULUM AND SYLLABI

REGULATIONS - 2016

(As approved by the 9th Academic Council)

M. Tech.

STRUCTURAL ENGINEERING

B.S.ABDUR RAHMAN UNIVERSITY

B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd. u/s 3 of the UGC Act, 1956)

(FORMERLY B.S. ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Rated with A Grade by National Assessment and Accreditation Council
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048
www.bsauniv.ac.in

REGULATIONS, CURRICULUM AND SYLLABI

M. Tech.
STRUCTURAL ENGINEERING

(As approved by the 9th Academic Council)

JULY 2016

B.S.ABDUR RAHMAN
UNIVERSITY
B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd. u/s 3 of the UGC Act, 1956)
(FORMERLY B.S. ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Rated with A Grade by National Assessment and Accreditation Council
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048
www.bsauniv.ac.in

UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science and Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned University
- To empower the youth through quality education and to provide professional leadership
- 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

VISION & MISSION OF THE DEPARTMENT OF CIVIL ENGINEERING

VISION

To be a leading department for Education, Training and Research in Civil Engineering for a better future and overall 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 future 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

- To impart knowledge and develop analytical skills to design structural components and systems based on codal provisions and create an urge for lifelong learning.
- To impart skills in the usage of state of the art software tools for modeling and evaluation of structural systems.
- To improve the analytical skills of the graduates through supportive teaching tools and methodologies as solution providers.
- To develop research skills with full exposure to appropriate real time projects in the field of structural engineering.
- To educate graduates in the use of sustainable, cost effective construction materials and practices.
- To inculcate in students the ethical attitude, team work and effective communication skills.

PROGRAMME OUTCOMES

Structural Engineering Graduates will be able to

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- Use research – based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
- Create, select, and apply appropriate techniques, resources, and modern engineering including prediction and modelling to complex engineering

activities with an understanding of the limitations.

- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

- Analyse and design structural components & systems using appropriate software and standards.
- Apply engineering techniques and relevant software tools for solving structural engineering problems.
- Undertake real time projects and research in the field of structural engineering.

REGULATIONS – 2016
FOR
M. Tech. / MCA / M.Sc. DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

i. **"Programme"** means a Post Graduate Degree Programme (M. Tech. / MCA / M.Sc.)

ii. **"Course"** means a theory or practical subject that is normally studied in a semester, like Applied Mathematics, Structural Dynamics, Computer Aided Design, etc.

iii. **"University"** means B.S. Abdur Rahman University, Chennai, 600048.

iv. **"Institution"** unless otherwise specifically mentioned as an autonomous or off campus institution means B.S. Abdur Rahman University.

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

vi. **"Dean (Academic Affairs)"** means Dean (Academic Affairs) of B.S. Abdur Rahman University, who administers the academic matters.

vii. **"Dean (P.G. Studies)"** means Dean (P.G. Studies) of B.S. Abdur Rahman University who administers all P.G Programmes of the University in coordination with Dean (Academic Affairs)

viii. **"Dean (Student Affairs)"** means Dean (Student Affairs) of B.S. Abdur Rahman University, who looks after the welfare and discipline of the students.

ix. **"Controller of Examinations"** means the Controller of Examinations of B.S. Abdur Rahman University who is responsible for conduct of examinations and declaration of results.

2.0 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

2.1 P.G. Programmes Offered

The various P.G. Programmes and their modes of study are as follows:

Degree	Mode of Study
M. Tech. /M.C.A. / M.Sc.	Full Time & Part Time – Day / Evening / Weekends

2.2 Modes of Study

2.2.1 Full-time

Students admitted under "Full-Time" shall be available in the Institution during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

2.2.2 A full time student, who has completed all non-project courses desiring to do the Project work in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department. Permission may be granted based on merits of the case. Such conversion is not permitted in the middle of a semester.

2.2.3 Part-time

In this mode of study, the students are required to attend classes for the courses in the time slots selected by them, during the daytime (or) evenings (or) weekends.

2.3 Admission Requirements

2.3.1 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 University as specified in the Table shown for eligible entry qualifications for admission to P.G. programmes or any other degree examination of any University or authority accepted by this University as equivalent thereto.

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

2.3.3 All part-time students should satisfy other conditions regarding experience, sponsorship etc., which may be prescribed by this Institution from time to time.

2.3.4 Student eligible for admission to M.C.A under lateral entry scheme shall be required to have passed three year degree in B.Sc (Computer Science) / B.C.A / B.Sc (Information Technology)

3.0 DURATION AND STRUCTURE OF THE P.G. PROGRAMME

3.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M. Tech. (Full Time)	4	8
M. Tech. (Part Time)	6	12
M.C.A. (Full Time)	6	12
M.C.A. (Part Time)	9	18
M.C.A. (Full Time) – (Lateral Entry)	4	8
M.C.A. (Part Time) – (Lateral Entry)	6	12
M.Sc. (Full Time)	4	8
M. Sc. (Part Time)	6	12

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

i. Core courses
ii. General Elective courses
iii. Professional Elective courses
iv. Project work / thesis / dissertation
v. Laboratory Courses
vi. Case studies
vii. Seminars
viii. Mini Project
ix. Industrial Internship

3.3 The curriculum and syllabi of all PG. programmes shall be approved by the Academic Council of this University.

3.4 The minimum number of credits to be earned for the successful completion of the programme shall be specified in the curriculum of the respective specialization of the P.G. programme.

3.5 Each academic semester shall normally comprise of 80 working days. Semester-end examinations will follow immediately after the last working day.

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
01	Civil Engineering	M. Tech. (Structural Engineering)	B.E / B. Tech. (Civil Engineering) / (Structural Engineering)
		M. Tech. (Construction Engineering and Project Management)	
02	Mechanical Engineering	M. Tech. (Manufacturing Engineering)	B.E. / B. Tech. (Mechanical / Auto / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering)
		M. Tech. (CAD/CAM)	
03	Polymer Engineering	M. Tech. (Polymer Technology)	B. E. / B. Tech. Mechanical / Production /Polymer Science or Engg or Tech / Rubber Tech / M.Sc (Polymer Sc./ Chemistry Appl. Chemistry)
04	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 & Drives)	B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation)
05	Electronics and Communication Engineering	M. Tech. (Communication Systems)	B.E / B.Tech (EEE/ ECE / E&I / I&C / Electronics / Instrumentation)
		M. Tech. (VLSI and Embedded Systems)	B.E. / B. Tech. (ECE / Electronics / E&I / I&C / EEE)
06	ECE Department jointly with Physics Dept.	M. Tech. (Optoelectronics and Laser Technology)	B.E. / B. Tech. (ECE / EEE / Electronics / EIE / ICE) M.Sc (Physics / Materials Science / Electronics / Photonics)
07	Electronics and Instrumentation Engineering	M. Tech. (Electronics and Instrumentation Engineering)	B.E. / B. Tech. (EIE / ICE / Electronics / ECE / EEE)

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
08	Computer Science and Engineering	M. Tech. (Computer Science and Engineering)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
		M. Tech. (Software Engineering)	B.E. / B. Tech. (CSE / IT) MCA
		M. Tech. (Network Security)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
		M. Tech. (Computer Science and Engineering with specialization in Big Data Analytics)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
09	Information Technology	M. Tech. (Information Technology)	B.E / B. Tech. (IT / CSE / ECE / EEE / EIE / ICE / Electronics) MCA
		M. Tech. (Information Security & Digital Forensics)	B.E / B. Tech. (IT / CSE / ECE / EEE / EIE / ICE / Electronics) MCA
10	Computer Applications	M.C.A.	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level
		M.C.A. – (Lateral Entry)	B.Sc Computer Science / B.Sc Information Technology / B.C.A
		M. Tech. (Systems Engineering and Operations Research)	BE / B. Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A.
		M. Tech. (Data & Storage Management	BE / B. Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A.
11	Mathematics	M.Sc. (Actuarial Science)	Any Degree with Mathematics / Statistics as one of the subjects of study.
		M.Sc. Mathematics	B.Sc. (Mathematics)
12	Physics	M.Sc.(Physics)	B.Sc.(Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation)
		M.Sc. (Material Science)	B.Sc.(Physics / Applied Science / Electronics / Electronics

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
			Science / Electronics & Instrumentation)
13	Chemistry	M.Sc.(Chemistry)	B.Sc (Chemistry / Applied Science)
14	Life Sciences	M.Sc. Molecular Biology & Biochemistry	B.Sc. in any branch of Life Sciences
		M.Sc. Genetics	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.Sc. Bioscience	B.Sc. in any branch of Life Sciences
		M. Tech. Biotechnology	B. Tech. (Biotechnology / Chemical Engineering) / M.Sc. in any branch of Life Sciences

3.6 The curriculum of PG 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	Minimum prescribed credits
M. Tech.	73
M.C.A.	120
M.Sc.	72

3.7 Credits will be assigned to the courses for all P.G. programmes as given below:

- One credit for one lecture period per week (or) 15 periods per semester
- One credit for one tutorial period per week
- One credit each for seminar/practical session/project of two or three periods per week
- One credit for two weeks of industrial internship
- One credit for 15 periods of lecture (can even be spread over a short span of time)

3.8 The number of credits registered by a student in non-project semester and project semester should be within the range specified below:

P.G. Programme	Full Time		Part Time	
	Non-project Semester	Project semester	Non-project Semester	Project semester
M. Tech.	9 to 28	12 to 28	6 to 12	12 to 28
M.C.A.	9 to 29	12 to 29	6 to 12	12 to 29
M.Sc.	9 to 25	12 to 20	6 to 12	12 to 20

3.9 The student may choose a course prescribed in the curriculum from any department depending on his / her convenient time slot. All attendance will be maintained course-wise only.

3.10 The electives from the curriculum are to be chosen with the approval of the Head of the Department.

3.11 A student may be permitted by the Head of the Department to choose electives from other PG programmes either within the Department or from other Departments up to a maximum of nine credits during the period of his/her study, with the approval of the Head of the Departments offering such courses.

3.12 To help the students to take up special research areas in their project work and to enable the department to introduce courses in latest/emerging areas in the curriculum, "Special Electives" may be offered. A student may be permitted to register for a "Special Elective" up to a maximum of three credits during the period of his/her study, provided the syllabus of this course is recommended by the Head of the Department and approved by the Chairman, Academic Council before the commencement of the semester, in which the special elective course is offered. Subsequently, such course shall be ratified by the Board of Studies and Academic Council.

3.13 The medium of instruction, examination, seminar and project/thesis/ dissertation reports will be English.

3.14 Industrial internship, if specified in the curriculum shall be of not less than two weeks duration and shall be organized by the Head of the Department.

3.15 Project Work / Thesis / Dissertation

3.15.1 Project work / Thesis / Dissertation shall be carried out under the supervision of a Faculty member in the concerned Department.

3.15.2 A student may however, in certain cases, be permitted to work for the project in an Industrial/Research Organization, on the recommendation 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 and the student shall be instructed to meet the faculty periodically and to attend the review committee meetings for evaluating the progress.

3.15.3 Project work / Thesis / Dissertation (Phase - II in the case of M. Tech.) shall be pursued for a minimum of 16 weeks during the final semester, following the preliminary work carried out in Phase-1 during the previous semester.

3.15.4 The Project Report/Thesis / Dissertation report / Drawings prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

3.15.5 The deadline for submission of final Project Report / Thesis / Dissertation is within 30 calendar days from the last working day of the semester in which Project / Thesis / Dissertation is done.

3.15.6 If a student fails to submit the Project Report / Thesis / Dissertation on or before the specified deadline he / she is deemed to have not completed the Project Work / Thesis / dissertation and shall re-register the same in a subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 Class Advisor

A faculty member will be nominated by the HOD 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 of the students will 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 every semester.

5.0 CLASS COMMITTEE

5.1 Every class of the PG Programme will have a Class Committee constituted by the Head of the Department as follows:

i. Teachers of all courses of the programme

ii. One senior faculty preferably not offering courses for the class, as

Chairperson.

iii. Minimum two students of the class, nominated by the Head of the Department.

iv. Class Advisor / Faculty Advisor of the class - Ex-Officio Member

v. Professor in-charge of the PG Programme - Ex-Officio Member.

5.2 The Class Committee shall be constituted by the respective Head of the Department of the students.

5.3 The basic responsibilities of the Class Committee are to review periodically the progress of the classes to discuss problems concerning curriculum and syllabi and the conduct of classes. The type of assessment for the course will be decided by the teacher in consultation with the Class Committee and will be announced to the students at the beginning of the semester. Each Class Committee will communicate its recommendations to the Head of the Department and Dean (Academic Affairs). The class committee, **without the student members,** will also be responsible for finalization of the semester results and award of grades.

5.4 The Class Committee is required to meet at least thrice in a semester, first within a week of the commencement of the semester, second, after the first assessment and the third, after the semester-end examination to finalize the grades.

6.0 COURSE COMMITTEE

Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers teaching 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 teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

7.0 REGISTRATION AND ENROLMENT

7.1 For the first semester every student has to register for the courses within one week from the commencement of the semester

7.2 For the subsequent semesters registration for the courses will be done by the student one week before the last working day of the previous semester. The curriculum gives details of the core and elective courses, project and

seminar to be taken in different semester with the number of credits. The student should consult his/her Faculty Advisor for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Advisor.

7.3 From the second semester onwards all students shall pay the prescribed fees and enroll on a specified day at the beginning of a semester.

7.4 A student will become eligible for enrolment only if he/she satisfies clause 9 and in addition he/she is not debarred from enrolment by a disciplinary action of the Institution. At the time of enrolment a student can drop a course registered earlier and also substitute it by another course for valid reasons with the consent of the Faculty Advisor. Late enrolment will be permitted on payment of a prescribed fine up to two weeks from the date of commencement of the semester.

7.5 Withdrawal from a course registered is permitted up to one week from the date of the completion of the first assessment test.

7.6 Change of a course within a period of 15 days from the commencement of the course, with the approval of Dean (Academic Affairs), on the recommendation of the HOD, is permitted.

7.7 Courses withdrawn will have to be taken when they are offered next if they belong to the list of core courses.

7.8 A student undergoing a full time PG Programme should have enrolled for all preceding semesters before registering for a particular semester

7.9 A student undergoing the P.G. programme in Part Time mode can choose not to register for any course in a particular semester with written approval from the head of the department. However the total duration for the completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1)

8.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

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. Such student has to rejoin only in the same semester from where he left. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / THESIS / 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. (Full time / Part time)	18
M.C.A. (Full time / Part time)	45
M.C.A. (Full time / Part time) – (Lateral Entry)	22
M.Sc.(Full time / Part time)	18

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

10.0 DISCIPLINE

10.1 Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the Institution.

10.2 Any act of indiscipline of a student reported to the Head of the Institution will be referred to a Discipline and Welfare Committee for taking appropriate action.

11.0 ATTENDANCE

11.1 Attendance rules for all Full Time Programme and Part time Programmes are given in the following sub-clause.

11.2 Ideally every student is expected to attend all classes and earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% for genuine reasons like on medical grounds, representing the University 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. If the course is a core course, the student should register for and repeat the course when it is offered next. If the course is an elective, either he/she can register and repeat the same elective or can register for a new elective.

11.3 The students of Full Time mode of study, who have not attended a single hour in all courses in a semester and awarded ‘I’ grade are not permitted to

write the examination and also not permitted move to next higher semester. Such students should repeat all the courses of the semester in the next Academic year.

12.0 SUMMER TERM COURSES

12.1 Summer term courses may be offered by a department on the recommendation of the Departmental Consultative Committee and approved by the Dean (Academic Affairs). No student should register for more than three courses during a summer term.

12.2 Summer term courses will be announced by the Head of the department at the end of the even semester before the commencement of the end semester examinations. A student will have to register within the time stipulated in the announcement. A student has to pay the fees as stipulated in the announcement.

12.3 The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters.

Students with U grades will have the option either to write semester end arrears exam or to redo the courses during summer / regular semesters, if they wish to improve their continuous assessment marks subject to the approval of the Head of the department.

12.4 Withdrawal from a summer term course is not permitted. No substitute examination will be conducted for the summer term courses.

12.5 The summer term courses are not applicable for the students of Part Time mode.

13.0 ASSESSMENTS AND EXAMINATIONS

13.1 The following rule shall apply to all the PG programmes (M. Tech. / M.C.A. / M.Sc.)

For lecture-based courses, normally a minimum of two assessments will be made during the semester. The assessments may be combination of tests and assignments. The assessment procedure as decided in the Class Committee will be announced to the students right from the beginning of the semester by the course teacher.

13.2 There shall be one examination of three hours duration, at the end of the semester.

13.3 In one (or) two credit courses that are not spread over the entire semester, the evaluation will be conducted at the completion of the course itself. Anyhow approval for the same is to be obtained from the HoD and the Dean of Academic Affairs.

13.4 The evaluation of the Project work will be based on the project report and a Viva-Voce Examination by a team consisting of the supervisor concerned, an Internal Examiner and External Examiner to be appointed by the Controller of Examinations.

13.5 At the end of industrial internship, the student shall submit a certificate from the organization and also 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.

14.0 WEIGHTAGES

14.1 The following shall be the weightages for different courses:

i) Lecture based course

Two continuous assessments	50%
Semester-end examination	50%

ii) Laboratory based courses

Laboratory work assessment	75%
Semester-end examination	25%

iii) Project work

Periodic reviews	50%
Evaluation of Project Report by	
External Examiner	20%
Viva-Voce Examination	30%

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

14.3 The markings for all tests, tutorial, assignments (if any), laboratory work and examinations will be on absolute basis. The final percentage of marks is calculated in each course as per the weightages given in clause 13.1.

15.0 SUBSTITUTE EXAMINATION

15.1 A student who has missed for genuine reasons any one of the three assessments including semester-end examination of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident or admissions to a hospital due to illness, etc.

15.2 A student who misses any assessment in a course shall apply in a prescribed form to the Dean (Academic Affairs) through the Head of the department within a week from the date of missed assessment. However

the substitute tests and examination for a course will be conducted within two weeks after the last day of the semester-end examinations.

16.0 COURSEWISE GRADING OF STUDENTS AND LETTER GRADES

16.1 Based on the semester performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and the corresponding grade points are as follows, but grading has to be relative grading

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

- Flexible range grading system will be adopted
- **“W”** denotes withdrawal from the course.
- **"I"** denotes inadequate attendance and hence prevention from semester-end examination
- **"U"** denotes unsuccessful performance in a course.
- **“AB”** denotes absent for the semester end examination

16.2 A student is considered to have completed a course successfully if he / she secure five grade points or higher. A letter grade ‘U’ in any course implies unsuccessful performance in that course.

16.3 A course successfully completed cannot be repeated for any reason.

17.0 AWARD OF LETTER GRADE

17.1 A final meeting of the Class Committee without the student member(s) will be convened within ten days after the last day of the semester end examination. The letter grades to be awarded to the students for different courses will be finalized at the meeting.

17.2 After finalization of the grades at the class committee meeting the Chairman will forward the results to the Controller of Examinations, with copies to Head of the Department and Dean (Academic Affairs).

18.0 DECLARATION OF RESULTS

18.1 After finalization by the Class Committee as per clause 16.1 the Letter grades awarded to the students in the each course shall be announced on the departmental notice board after duly approved by the Controller of Examinations.

18.2 In case any student feels aggrieved about the results, he/she can apply for revaluation after paying the prescribed fee for the purpose, within one week from the announcement of results.

A committee will be constituted by the concerned Head of the Department comprising of the Chairperson of the concerned Class Committee (Convener), the teacher concerned and a teacher of the department who is knowledgeable in the concerned course. If the Committee finds that the case is genuine, it may jointly revalue the answer script and forward the revised marks to the Controller of Examinations with full justification for the revision, if any.

18.3 The “U” and “AB” grade once awarded stays in the grade sheet of the students and is not deleted when he/she completes the course successfully later. The grade acquired by the student later will be indicated in the grade sheet of the appropriate semester.

19.0 COURSE REPETITION AND ARREARS EXAMINATION

19.1 A student should register to re-do 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 taken.

19.2 A student who is awarded “U” or “AB” grade in a course shall write the semester-end examination as arrear examination, at the end of the next semester, along with the regular examinations of next semester courses.

19.3 A student who is awarded “U” or “AB” grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course whenever the course is offered. Marks earned during the redo period in the continuous assessment for the course, will be used for grading along with the marks earned in the end-semester (re-do) examination.

19.4 If any student obtained "U" or "AB" grade, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

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

20.0 GRADE SHEET

20.1 The grade sheet issued at the end of the semester to each student will contain the following:

(i) the credits for each course registered for that semester.

(ii) the performance in each course by the letter grade obtained.

(iii) the total credits earned in that semester.

(iv) the Grade Point Average (GPA) of all the courses registered for that semester and the Cumulative Grade Point Average (CGPA) of all the courses taken up to that semester.

20.2 The GPA will be calculated according to the formula

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

where n = number of courses

where C_i is the number of credits assigned for i^{th} course

GP_i - Grade point obtained in the i^{th} course

for the cumulative grade point average (CGPA) a similar formula is used except that the sum is over all the courses taken in all the semesters completed up to the point of time.

'I' and 'W' grades will be excluded for GPA calculations.

'U', 'AB' 'I' and 'W' grades will be excluded for CGPA calculations.

20.3 Classification of the award of degree will be as follows:

20.3.1 For students under full time mode of study

CGPA	Classification
8.50 and above, having completed all courses in first appearance	First class with Distinction
6.50 and above, having completed within a period of 2 semesters beyond the programme period	First Class
All others	Second Class

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 study and should have completed the PG Programme within a minimum period covered by the minimum duration (clause 3.1) plus authorized break of study, if any (clause 8). To be eligible for First Class, a student should have passed the examination in all 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 will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will 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.

20.3.2 For students under part time mode of study

CGPA	Classification
8.50 and above, having completed all courses in first appearance	First class with Distinction
6.50 and above	First Class
All others	Second Class

For the purpose of classification, the CGPA will be rounded to two decimal places.

21.0 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

21.1 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.

21.2 The award of the degree must be approved by the University.

22.0 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.

CURRICULUM & SYLLABI FOR
M. Tech. (Structural Engineering)

CURRICULUM

Sl. No.	Course Code	Course Title	L	T	P	C
		SEMESTER I				
1	MAC6184	Probability, Matrix Theory and Linear Programming	**3**	**1**	**0**	**4**
2	CEC6101	Theory of Elasticity and Plasticity	**3**	**0**	**0**	**3**
3	CEC6102	Advanced Concrete Design	**3**	**1**	**0**	**4**
4	CEC6103	Structural Dynamics	**3**	**0**	**0**	**3**
5	CEC6104	Advanced Concrete Technology	**3**	**0**	**2**	**4**
6	CEC6105	Design of Substructures	**3**	**0**	**0**	**3**
						21
		SEMESTER II				
1	GEC6201	Research Methodology for Engineers	**3**	**0**	**0**	**3**
2	CEC6211	Finite Element Analysis in Structural Engineering	**3**	**0**	**0**	**3**
3	CEC6212	Advanced Steel Structures	**3**	**1**	**0**	**4**
4	CEC6213	Experimental Techniques and Instrumentation	**2**	**0**	**2**	**3**
5		Professional Electives #				**6**
6	CEC6214	Seminar	**0**	**0**	**2**	**1**
						20
		SEMESTER III				
1		General Elective ###	**3**	**0**	**0**	**3**
2		Professional Electives ##				**9**
3	CEC7101	Project Phase I ***	**0**	**0**	**12**	**6**
4	CEC7102	Internship*/Mini Project**	**0**	**0**	**2**	**1**
						13
		SEMESTER IV				
1	CEC7101	Project Phase II	**0**	**0**	**36**	**18**
					6+18=24	
		Total				**78**

Student has to take a minimum of 6 credits from even semester professional elective courses

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

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

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

** Mini project will be taken by working Professionals only.

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

ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
		LIST OF ODD SEMESTER ELECTIVES				
1	CECY101	Design of Bridges	**3**	**0**	**0**	**3**
2	CECY102	Industrial Structures	**3**	**0**	**0**	**3**
3	CECY103	Maintenance and Rehabilitation of Structures	**3**	**0**	**0**	**3**
4	CECY104	Plates and Shells	**3**	**0**	**0**	**3**
5	CECY105	Stability of Structures	**3**	**0**	**0**	**3**
6	CECY106	Tall Structures	**3**	**0**	**0**	**3**
7	CECY107	Wind and Cyclone Effects on Structures	**3**	**0**	**0**	**3**
8	CECY108	Design of Offshore Structures	**2**	**0**	**0**	**2**
9	CECY109	Design of Steel Concrete Composite Structures	**2**	**0**	**0**	**2**
10	CECY110	Case studies on Performance and Evaluation of Structures	**1**	**0**	**0**	**1**
		LIST OF EVEN SEMESTER ELECTIVES				
1	CECY201	Composite Materials	**3**	**0**	**0**	**3**
2	CECY202	Corrosion of Steel in Concrete	**3**	**0**	**0**	**3**
3	CECY203	Earthquake Engineering	**3**	**0**	**0**	**3**
4	CECY204	Fatigue & Fracture of Structures	**3**	**0**	**0**	**3**
5	CECY205	Matrix Methods of Structural Analysis	**3**	**0**	**0**	**3**
6	CECY206	Optimization in Structural Design	**3**	**0**	**0**	**3**
7	CECY207	Prestressed Concrete	**3**	**0**	**0**	**3**
8	CECY208	Soil - Structure Interaction	**3**	**0**	**0**	**3**
9	CECY224	Green Building and Energy Efficient Structures	**3**	**0**	**0**	**3**
10	CECY209	Computer Aided Analysis for Structures	**2**	**0**	**0**	**2**
11	CECY210	Prefabricated Structures	**2**	**0**	**0**	**2**
12	CECY211	Analysis of Structures using FEA software	**1**	**0**	**0**	**1**

GENERAL ELECTIVES FOR M.TECH PROGRAMMES

Sl. No.	Course Code	Course Title	L	T	P	C
1	GECY101	Project Management	**3**	**0**	**0**	**3**
2	GECY102	Society, Technology & Sustainability	**3**	**0**	**0**	**3**
3	GECY103	Artificial Intelligence	**3**	**0**	**0**	**3**
4	GECY104	Green Computing	**3**	**0**	**0**	**3**
5	GECY105	Gaming Design	**3**	**0**	**0**	**3**
6	GECY106	Social Computing	**3**	**0**	**0**	**3**
7	GECY107	Soft Computing	**3**	**0**	**0**	**3**
8	GECY108	Embedded System Programming	**3**	**0**	**0**	**3**
9	GECY109	Principles of Sustainable Development	**3**	**0**	**0**	**3**
10	GECY110	Quantitative Techniques in Management	**3**	**0**	**0**	**3**
11	GECY111	Programming using MATLAB & SIMULINK	**1**	**0**	**2**	**2**
12	GECY112	JAVA Programming	**1**	**0**	**2**	**2**
13	GECY113	PYTHON Programming	**1**	**0**	**2**	**2**
14	GECY114	Intellectual Property Rights	**1**	**0**	**0**	**1**

SEMESTER – I

		L	T	P	C
MAC6184	**PROBABILITY, MATRIX THEORY AND LINEAR PROGRAMMING**	**3**	**1**	**0**	**4**

OBJECTIVE:

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 Normal distributions.

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 09+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 dependant on first and higher order derivatives – functional dependant 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).

OUTCOME:

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 eigenvalues 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.

CEC6101 THEORY OF ELASTICITY AND PLASTICITY

L	T	P	C
3	0	0	3

OBJECTIVE:

- To impart knowledge on the general features of elastic systems and to analyze two-dimensional state of stresses and strains.
- To familarise 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 09

Basic equations - stress and strain at a point - generalized Hookes law - plane stress and plane strain - equilibrium conditions - compatibility conditions.

MODULE II TWO DIMENSIONAL PROBLEMS 09

Two dimensional problems in Cartesian and polar coordinates - solution of two-dimensional problems with different loading conditions by using polynomials.

MODULE III TORSION OF PRISMATIC BARS 09

Torsion of non circular sections- St.Venants approach – Parndtl,s approach - methods of analysis - membrane analogy - torsion of thin rectangular section and hollow thin walled sections - bars with Elliptical Cross Section – torsion of thin walled and multiple cell closed sections.

MODULE IV ENERGY METHODS 09

Castiglianos theorem - principle of Virtual work - principle of stationary potential energy - principle of least work - Rayleighs method - Rayleigh-Ritz method- finite difference method - simple applications.

MODULE V PLASTICITY 09

Plastic deformation - mechanism - factors affecting plastic deformation - strain hardening - theory of plastic flow - concept of plastic potential - yield criteria - yield conditions - experimental evidence - geometric representation of yield criteria-plastic bending of beams and Plastic torsion

Total Hours : 45

REFERENCES:

1. Timoshenko and Goodier, Theory of Elasticity, 3rd Edition, McGraw Hill, 2010.
2. Sadhusingh, Theory of Elasticity, Khanna Publishers, New Delhi 2012
3. Kachanov L M, Fundamentals of the Theory of Plasticity, Dover Publications, 2013.

OUTCOME:

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.

CEC6102 ADVANCED CONCRETE DESIGN

L	T	P	C
3	1	0	4

OBJECTIVE:

- 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, yield line analysis and flat plates.
- To expand the knowledge in studying the inelastic response of reinforced concrete structural members.

MODULE I DESIGN OF BEAMS 09+03

Overall review on behaviour of RC beams in flexure and shear - behaviour and design of RCC beams under combined Shear, Torsion and Bending - serviceability limit states - computation of deflections and crack width as per codal provisions.

MODULE II DESIGN OF SLENDER COLUMNS 09+03

Behaviour of slender RCC Columns - failure modes - calculation of design moments for braced and unbraced columns - design of slender columns.

MODULE III DESIGN OF SPECIAL RC ELEMENTS 09+03

Design of RC walls – ordinary and shear walls - strut and tie method of analysis for corbels and deep beams

MODULE IV DESIGN OF FLAT SLABS AND PLATES 09+03

Yield line theory and Hillerberg method of design of slabs - design of flat slabs and flat plates according to BIS method - shear in flat slabs and flat plates - design of Grid floors

MODULE V INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES 09+03

Inelastic behaviour of concrete beams - moment-rotation curves - moment redistribution - concept of Ductility – detailing for ductility – design of beams, columns for ductility - design of cast-in-situ joints in frames.

L – 45; T – 15; Total Hours - 60

REFERENCES:

1. Varghese, P.C. Advanced Reinforced Concrete Design, Prentice Hall of India, 2005.
2. Gambhir.M.L, Design of Reinforced Concrete Structures, Prentice Hall of India, 2012.
3. Subramanian. N, Design Of Reinforced Concrete Structures, Oxford University Press, 2013.
4. Varghese, P.C. Limit State Design of Reinforced Concrete, Prentice Hall of India, 2007.
5. Sinha.S.N., Reinforced Concrete Design, Tata-McGraw-Hill,1996.
6. Purushothaman, P, Reinforced Concrete Structural Elements: Behaviour Analysis and Design, Tata McGraw-Hill, 1986.
7. Park. R., & Paulay .T, Reinforced Concrete Structures, John Wiley & Sons, 2009.
8. Shah V.L., & Karve S.R, Limit state theory and Design of Reinforced Concrete, Structures Publications, Pune 2003.
9. Arthur H.Nilson, Design of Concrete Structures, Tata McGraw-Hill, 2003.
10. IS 456-2000, Plain and Reinforced Concrete - Code of Practice.
11. SP 16, Design Aids for IS 456-1978.
12. IS 13920- 1993- Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces — Code Of Practice.

OUTCOME:

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

- describe the behavior of reinforced concrete structural members and compute serviceability response of structural elements.
- employ the Indian code of practice for the design the slender RC columns.
- design the special structural elements such as RC walls, deep beams and corbels
- appropriately choose and design the two-way slab system for buildings.
- critically describe the inelastic behaviour of structures and ductile detailing of RC structures.

CEC6103 STRUCTURAL DYNAMICS

L	T	P	C
3	0	0	3

OBJECTIVE:

- 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 SINGLE DEGREE OF FREEDOM SYSTEMS 09

Formulation of equations of motion by different methods - free and forced vibrations, effect of damping.

MODULE II MULTI DEGREE OF FREEDOM SYSTEMS 09

Formulation of structure property matrices, eigen value problems, mode shapes and orthonormality of modes, approximate methods of extraction of eigen values.

MODULE III CONTINUOUS SYSTEMS 09

Modeling - free and forced vibration of bars and beams. Rayleigh –Ritz method – formulation using conservation of energy –formulation using virtual work

MODULE IV DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE 09

Damping in MDOF systems - Nonlinear MDOF systems - Wilson Theta method, Newmark’s beta method - step-by-step numerical integration techniques.

MODULE V DESIGN AGAINST BLAST AND IMPACT 09

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.

Total Hours : 45

REFERENCES:

1. Clough R.W, and Penzien J, Dynamics of Structures, Second Edition, McGraw-Hill International Edition, 1996.
2. Mario Paz, Structural Dynamics – Theory and Computations, Third Edition, CBS Publishers, 1990.

3. Roy R Craig, Structural Dynamics – An Introduction to Computer Methods, John Wiley and Sons, 2005.
4. Humar J. L., Dynamics of Structures, Prentice Hall, 1990.

OUTCOME:

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

- develop the equation of motion for single degree of freedom
- analyze the dynamic response of multi degree of freedom systems
- analyze the free and forced vibration of bars and beams
- find the dynamic response of structures using numerical integration procedure
- design the buildings for blast and impact forces using BIS codes of practice.

CEC6104 ADVANCED CONCRETE TECHNOLOGY

L	T	P	C
3	0	2	4

OBJECTIVE:

- To impart sufficient knowledge to students about properties of various concrete constituent materials, mix design for different types of concrete, fresh and hardened properties of concrete.
- To provide students knowledge on durability properties of concrete and different types of special concretes.

MODULE I CONCRETE CONSTITUENT MATERIALS 09+06

Cement - Grades and types - properties and testing as per Indian standards. Fine aggregate - coarse aggregate - classification - properties - testing as per Indian standards. Water - quality, properties and requirements. Mineral admixtures - fly ash, silica fume, metakaoline, ground granulated blast furnace slag, rice husk ash, titanium dioxide. Chemical admixtures - Super plasticizers, water reducers, set accelerators, set retarders, air entraining agents, viscosity modifying agents, corrosion inhibiting admixtures - working mechanism and application areas.

MODULE II CONCRETE MIX DESIGN 09+06

Principles of concrete mix design- mix design for different types of concrete - control concrete, self compacting concrete, high performance concrete and ready mix concrete - Indian standards - ACI method - relevant standards. Design concrete mix for a desired application and subsequent validation.

MODULE III PROPERTIES OF FRESH AND HARDENED CONCRETE 09+06

Fresh concrete properties of control concrete, self compacting concrete and high performance concrete – workability related tests - slump, compaction factor, vee bee consistometer, flow test, L-box test, U-box test, V-funnel test, J-ring test. Hardened concrete properties – strength – modulus of elasticity – creep – shrinkage - bond strength.

MODULE IV DURABILITY PROPERTIES OF CONCRETE 09+06

Deteriorating mechanism : sulphate attack, alkali aggregate reaction, corrosion of steel rebar - mechanism, causes and consequences. Tests related to durability properties - 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 V SPECIAL CONCRETE 09+06

High performance concrete – fibre reinforced concrete – self compacting concrete - polymer concrete composites - light weight concrete – pervious concrete – ferrocement – shotcrete – coloured concrete – heavy density concrete.

L – 45; P – 30; Total Hours - 45

REFERENCES:

1. Nayak, N.V, and Jain, A.K, Handbook on Advanced Concrete Technology, Narosa Publishing House Pvt. Ltd., New Delhi, 2012.
2. Neville, A.M., Properties of Concrete, Fourth Edition, John Wiley & Sons, London, 1996.
3. Shetty, M.S., Concrete Technology, S. Chand and Company Ltd., New Delhi, 2003.
4. Santhakumar,A.R., Concrete Technology, Oxford University Press, New Delhi, 2007
5. Krishnaraju,N., Design of Concrete Mixes, CBS Publishers, New Delhi, 2007.
6. Mehta P.K., and Paulo J.M. Monteiro, Concrete: Microstructure, Properties, and Materials, McGraw-Hill Professional, USA, 2005.
7. Yoshihiko Ohama, Hand Book of Polymer-modified Concrete and Mortars – Properties and Process Technology, Noyes Publications, 1995.
8. BIS 10262 – 1999, “Recommended Guidelines for Concrete Mix Design”, Bureau of Indian Standards, New Delhi.
9. ACI Committee 211.1 – 1991, “ Standard Practice for Selecting Proportions for Normal, Heavy weight, and Mass concrete (Part – I)”, ACI Manual of Concrete Practice, 1994.
10. ACI Committee 549.1R – 2009, “Guide for the Design, Construction and Repair of Ferro Cement”, American Concrete Institute, USA.
11. BIS 383 – 1970, “Specification for Coarse and Fine Aggregates from Natural Sources for Concrete”, Bureau of Indian Standards, New Delhi.
12. BIS 516 – 1968, “Methods of Tests for Strength of Concrete”, Bureau of Indian Standards, New Delhi.
13. BIS 1199 – 1959, “Methods of Sampling and Analysis of Concrete”, Bureau of Indian Standards, New Delhi.
14. BIS 2386 (Part I & 3) - 1963, “Methods of Test for Aggregates for Concrete”, Bureau of Indian Standards, New Delhi.
15. BIS 4031 (Part 1-6) : 1996, “Method of Physical Tests for Hydraulic Cement”, Bureau of Indian Standards, New Delhi.

16. BIS 5816-1999, Splitting Tensile Strength of Concrete - Method of Test, Bureau of Indian Standards.
17. BIS 13311 - 1992, Non destructive testing of concrete - Method of test, Part -2 : Rebound Hammer, Bureau of Indian Standards.

OUTCOME:

On completion of these modules, students will be able to

- conduct tests to assess the properties of concrete constituent materials and its validation for the desired application.
- perform mix design for normal concrete, self compacting concrete and high performance concrete as per specified standards.
- conduct tests as per codal provisions to assess the fresh and hardened concrete properties.
- carryout durability studies on different types of concrete.
- suggest type of concrete based on application and durability requirements.

GEC6201	RESEARCH METHODOLOGY FOR ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- 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 07

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 08

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 10

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 08

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 defence, ethics in research, Patenting, Intellectual Property Rights.

Total Hours: 45

REFERENCES:

1. Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai, 2011.
2. Ernest O., Doebelin, Engineering Experimentation: planning, execution, reporting, McGraw Hill International edition, 1995.
3. George E. Dieter., Engineering Design, McGraw Hill – International edition, 2000.
4. Madhav S. Phadke, Quality Engineering using Robust Design, Printice Hall, Englewood Cliffs, New Jersey, 1989.
5. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
6. Kalyanmoy Deb., “Genetic Algorithms for optimization”, KanGAL report, No.2001002.
7. Holeman, J.P., Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2007.
8. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2010.
9. University of New South Wales, “How to write a Ph.D. Thesis” Sydney, Australia, Science @ Unsw.
10. Shannon. R.E., System Simulation: the art and science, Printice Hall Inc, Englewood Cliffs, N.J.1995.
11. Scheffer. R.L. and James T. Mc Clave, Probability and Statistics for Engineers, PWS – Kent Publishers Co., Boston, USA, 1990.

OUTCOME:

Students who complete this course will be able to

- identify the research problem.
- become capable of analyzing the data using mathematical techniques.
- learn to apply the statistical concepts in research.
- demonstrate the different research methods applicable to a specific problem.

CEC6105 DESIGN OF SUBSTRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVE:

- To familiarize the students with various site investigation programme, geotechnical terminology and important concepts for design of shallow and deep foundations.
- To help the students to utilize their knowledge in soil mechanics and to perform various types of engineering calculations
- To perform the geotechnical engineering design functions for shallow and deep foundations.

MODULE I SUB SURFACE EXPLORATION 08

Engineering properties of soil - Purpose of soil exploration- Programme and Procedures – Interpretation of bore logs, soil data and exploration reports.

MODULE II SHALLOW FOUNDATIONS 10

Types of foundations and their specific applications – depth of foundation – bearing capacity and settlement estimates – structural design of isolated, strip, rectangular and trapezoidal and combined footings – strap – balanced footings – raft foundation – Approximate flexible method of raft design - Compensated foundations.

MODULE III DEEP FOUNDATIONS 09

Types of piles and their applications - load capacity - settlements - group action - design of piles and pile caps.

MODULE IV FOUNDATIONS FOR BRIDGES AND OTHER MISCELLANEOUS STRUCTURES 09

Drilled shaft foundations and caissons for bridges - foundations for towers – chimneys – silos.

MODULE V MACHINE FOUNDATIONS 09

Types - general requirements and design criteria - general analysis of machine foundations-soil system - stiffness and damping parameters - tests for design parameters - guidelines for design of reciprocating engines, impact type machines, rotary type machines, framed foundations.

Total Hours : 45

REFERENCES:

1. Tomlinson, M.J. and Boorman. R., Foundation Design and Construction, ELBS Longman, 6th edition, 2013.
2. Nayak, N.V., Foundation Design manual for Practicing Engineers, Dhanpat Rai and Sons, 2012.
3. Winterkorn H.F, and Fang H.Y., Foundation Engineering Hand Book, Van Nostrard – Reinhold, 1991.
4. Brain J. Bell and M.J. Smith, Reinforced Concrete Foundations, George Godwin Ltd., 1981.
5. Braja M. Das, Principles of Foundations Engineering, Thomson Asia (P) Ltd., 2012.
6. Bowels J. E., Foundation Analysis and Design, Mc Graw-Hill International Book Co., 1996.

OUTCOME:

At the end of the course students will be able to

- interpret subsurface information to report soil properties.
- determine bearing capacity and design shallow foundations for various types of structures.
- recommend a suitable type of pile foundation and determine the load carrying capacity of pile foundations.
- design foundations for bridges
- design a suitable type of machine foundation for a machine,

CEC6211	FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the fundamental concepts of finite element method, specifically the conception of an idea that involved in the finite element analysis of a structure.
- To incorporate overview of matrix techniques and plane stress and plane strain concepts.
- To expose the finite element software to analyse the structural members

MODULE I CONCEPTS OF FINITE ELEMENT METHOD 09

General description of the finite element method – overview of matrix techniques - basic equations from solid mechanics - variational formulation - approximate methods – Rayleigh Ritz, Weighted residual (Galerkin) and finite difference methods.

MODULE II PLANE STRESS AND PLANE STRAIN 09

The concept of an element - derivation of Elemental Equations – assembly - imposition of boundary Conditions - solution of the equations – basic functions and shape functions – one dimensional elements - two dimensional problems in plane stress and plain strain.

MODULE III AXISYMMETRIC STRESS ANALYSIS AND 3D STRESS ANALYSIS 09

Axisymmetric problems - triangular and quadrilateral Elements - natural coordinates - isoparametric formulation - numerical Integration - plate bending and shell elements - brick elements - Higher Order Elements.

MODULE IV MESHING AND SOLUTION PROBLEMS 09

Pre and post processor interpretations - p and h methods of refinement - iil conditioned elements - discretisation errors – patch test - auto and adaptive mesh generation techniques - error evaluation - finite element programming and FEA Software – ANSYS.

MODULE V NONLINEAR AND VIBRATION PROBLEMS 09

Material and geometric non-linearity - consistent system matrices – dynamic condensation - eigen value extraction - modal methods – integration methods - application to thermal analysis.

Total Hours : 45

REFERENCES:

1. Seshu, P., Text Book of Finite Element Analysis, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
2. Reddy, J.N., An Introduction to the Finite Element Method, McGraw-Hill International Editions (Engineering Mechanics Series), 1993.
3. Chandrupatla & Belagundu, Introduction to Finite Elements in Engineering,
4. Edition, Prentice-Hall of India, Eastern Economy Editions, 2000.
5. David V. Hutton Fundamentals of Finite Element Analysis, Tata McGraw-Hill Edition, 2005.
6. Cook Robert. D., Plesha, Michael. E & Witt, Robert.J. Concepts and Applications of Finite Element Analysis, Wiley Students Edition, 2004.

OUTCOME:

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

- solve the boundary value problems using approximate methods.
- derive and elemental equations and shape function for one and two dimensional elements.
- form the isparametric 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.

CEC6212 ADVANCED STEEL STRUCTURES

L	T	P	C
3	1	0	4

OBJECTIVE:

- 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 BEHAVIOUR AND DESIGN OF CONNECTIONS 09+03

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

MODULE II ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS 09+03

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 base plates.

MODULE III ANALYSIS AND DESIGN OF COLD–FORMED STEEL STRUCTURES 12+05

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 IV ANALYSIS AND DESIGN OF SPECIAL STRUCTURES 09+03

Design of self supporting chimney (lined and unlined) - codal provisions of IS 6533 - stresses due to wind and earthquake forces – design of base plate, anchor bolts

and foundation - check for deflection - design for dynamic effects - wind effects on chimney - gust factor Method - design of guyed chimneys.

MODULE V PLASTIC ANALYSIS OF STRUCTURES 06+01

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 – problems. Connections - requirement - design of straight and haunched connections.

L-45; T-15; Total Hours :60

REFERENCES:

1. Dayaratnam, P., Design of Steel Structures, Wheeler Publishing, 1990.
2. Teaching Resource for Structural Steel Design, INSDAG, Kolkatta, 2010.
3. Rhodes, J, Design of Cold-Formed Steel Members, Elsevier Science Publishers, 1991.
4. Ramchandra, S., Design of Steel Structures, Vol.-II, Standard Publications, New Delhi, 2010.
5. Salmon, C.G., and Johnson, J.E., Steel Structures-Design and Behaviour, Harper and Row, 1980 73.
6. Subramanian N, Steel Structures - Design and practice, Oxford University Press, 2011.
7. BIS : 800-2007, Indian standard code of practice for general construction in steel , Bureau of Indian Standards.
8. BIS 801 : 1975 - Indian standard code of practice for use of cold-formed light gauge steel structural members in general building construction, Bureau of Indian Standards.
9. SP 6 (1) -1964 – Hand book for structural Engineers, 1. Structural Steel Sections, Indian Standards Institution.
10. SP 6 (5) -1980 – Hand book for structural Engineers, 5. Cold formed, Light-gauge steel structures, Bureau of Indian Standards.
11. BIS 6533 (Part 1) **:** 1989**,** Design and construction of steel chimney - Code of practice, Part I Mechanical Aspect, Bureau of Indian Standards.
12. BIS 6533 (Part 2) **:** 1989**,** Design and construction of steel chimney - Code of practice, Part 2 Structural Aspect, Bureau of Indian Standards.
13. BIS 6533 **:** 1971**,** Code of practice for design and construction of steel chimney, Bureau of Indian Standards.

OUTCOME:

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

- design connections for the expected shear force and bending moment
- 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 self supporting and guyed chimney for the various loading conditions.
- describe the concepts of plastic design, methods of plastic analysis and plastic collapse mechanism.

CEC6213	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	L	T	P	C
		2	0	2	3

OBJECTIVE:

- To impart knowledge on basic concepts of measurements and related instruments.
- To offer theoretical knowledge and hands on training in the usage of strain gauge, load cell, LVDT and data acquisition systems.
- To impart students knowledge on working principle of non-destructive testing techniques and its usage in real time conditions.
- To expose students the theory and principles involved in model analysis.

MODULE I MEASUREMENT AND INSTRUMENTS 08+07

Measurement - methods - basic principles - errors in measurement - error analysis. Measurement of displacement, pressure, force, torque etc. - Transducers - classification - working principle and construction of load cell, sensitive dial gauge and LVDT including practical training on their usage.

MODULE II STRAIN MEASUREMENTS 07+08

Strain gauge - general classification - electrical resistance strain gauges - working principle - types and construction - materials - influencing parameters - hands on training on measurement of strain - strain gauge circuits - potentiometer and wheat stone bridge - rosette analysis - use of electrical resistance strain gauges in transducer applications.

MODULE III DATA ACQUISITION AND ANALYSIS 07+08

Indicating and recording devices - static strain measurement - dynamic strain measurement - data acquisition and processing systems - hands on training on acquiring load - deflection behaviour and load - strain behaviour using data acquisition system.

MODULE IV NON- DESTRUCTIVE TECHNIQUES & MODEL ANALYSIS 08+07

Non destructive testing techniques - methods of NDT - working principle of liquid penetrate - rebound hammer - ultrasonic pulse velocity - half-cell potential measurement technique etc. including hands on training. Model analysis - methods and materials. Direct model analysis - theory of similitude for modeling - Buckingham Pi theorem for analysis. Testing large scale structures – wind tunnel.

L-30; P- 30; Total Hours - 60

REFERENCES:

1. Dally J. W. and Riley W.F., Experimental stress Analysis, McGraw-Hill, Inc. New York, 1991.
2. Srinath L.S. et al., Experimental Stress Analysis, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1984.
3. Rangan C.S. et al., Instrumentation – Devices and Systems, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1983.
4. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.
5. Renganathan S, Transducer Engineering, Allied Publishers Limited, Chennai, 1999.

OUTCOME:

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

- employ load cell, sensitive dial gauges and LVDT for different application areas and interpret the results.
- measure static and dynamic strain using electrical resistance strain gauges by understanding principles of rosette analysis.
- acquire load-deflection and load-strain behaviour using data acquisition systems.
- employ NDT techniques such as rebound hammer, UPV test, half-cell potential technique and interpret the test results.
- describe the importance of model analysis in predicting structural behaviour of large scale structures.

CEC6214	SEMINAR	L	T	P	C
		0	0	2	1

GENERAL GUIDELINES:

- Seminar is an important component of learning where the student gets acquainted with preparing and presentation of a technical report.
- The students are advised to collect peer reviewed journal papers relevant to their proposed project work and prepare a report in consultation with a faculty having expertise in that field.
- Presentation schedules will be prepared by the course faculty in line with the academic calendar.
- The students shall be required to present a technical report in PPT and submit a relevant report.
- At the end of each presentation, the class students are encouraged to ask questions to clarify their queries and finally the course faculty give his/her comments to improve the quality in subsequent presentations.
- The marks will be awarded based on technical content, report preparation and presentation skills and in depth knowledge of the student in the subject.
- The marks awarded shall be intimated to the students at the completion of one cycle of presentation by all the students and communicated to the Class Advisor in the specified format.
- Each student shall be given at least two opportunities to exhibit his/her presentation skills.

LIST OF ODD SEMESTER PROFESSIONAL ELECTIVES

CECY101	DESIGN OF BRIDGES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart students knowledge on classification of bridges & investigation procedures, IRC specification for road bridges and load distribution theories.
- To offer knowledge on design of short span bridges, design of T-Beam and slab bridges, prestressed concrete bridges and plate girder bridges.
- To give exposure to design principles of continuous, box girder and balanced cantilever bridges, types of bearings and design of sub structures.

MODULE I SHORT SPAN BRIDGES 12

Classification - investigation and planning - choice of type - I.R.C. specifications for road bridges - standard live loads - other forces acting on bridges - general design considerations - load distribution theories - analysis and design of slab culverts. Design of T-beam and slab bridges - deck slab - cantilever slab - longitudinal girder - cross girder- end beams.

MODULE II LONG SPAN GIRDER BRIDGES 09

Design principles of continuous bridges - box girder bridges - balanced cantilever bridges.

MODULE III PRESTRESSED CONCRETE BRIDGES 08

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

MODULE IV PLATE GIRDER BRIDGES 08

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

MODULE V BEARINGS, SUBSTRUCTURE AND FOUNDATION FOR BRIDGES 08

Bridge bearings – types - design principles – design of steel rocker roller bearing. Design of pile cap and pier - foundation – types – construction procedure - design of well foundation – design of pile foundation.

Total Hours : 45

REFERENCES:

1. Johnson Victor D., "Essentials of Bridge Engineering", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2008.
2. Raina V.K. "Concrete Bridge Practice" , Tata McGraw Hill Publishing Company, New Delhi, 1994.
3. Krishnaraju, N., "Design of Bridges" Oxford and IBH Publishing Co., New Delhi, 2010.
4. Bakht, B. and Jaegar, L.G., "Bridge Analysis simplified", McGraw Hill Publishing Compny, New Delhi, 1985.
5. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill Publishing Company, New Delhi, 1989.
6. Petros P. Xanthakos, " Theory and Design of Bridges", .John Wiley & Sons, 2007.
7. Edwin H.Gaylord Jr., Charles N.Gaylord, James, E.,Stallmeyer "Design of Steel Structures", McGraw Hill International Editions, 1992

OUTCOME:

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

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

CECY102 INDUSTRIAL STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVE:

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

MODULE I GENERAL 09

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 09

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 09

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

MODULE IV SPECIAL STRUCTURES 09

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

MODULE V POWER TRANSMISSION STRUCTURES 09

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, Vol . I & II Standard Book House,
6. New Delhi, 1996.
7. Dayaratnam P., Design of Steel Structures, Wheeler and Co., New Delhi,
8. 1999.

OUTCOME:

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 measures 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.

CECY103	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart students sound knowledge on various causes of failures, detailed assessment procedure for evaluating a distressed structure, materials available for effecting repair and techniques for effective rehabilitation.
- To offer knowledge to students on rehabilitation of real time distressed structures through case studies.

MODULE I CAUSES FOR FAILURES 09

Effects due to climate, temperature, chemicals, wear and erosion - design and construction errors- corrosion – mechanism, causes, consequences and remedial measures - effect of cover thickness and cracking on durability of concrete.

MODULE II MAINTENANCE AND ASSESSMENT PROCEDURE 09

Definition : maintenance, repair and rehabilitation - facets of maintenance - importance of maintenance- assessment procedure for evaluating a damaged structure - various aspects of inspection - destructive and non–destructive testing techniques.

MODULE III MATERIALS FOR REPAIR 09

Special concretes and mortar - concrete chemicals - elements for accelerated strength gain - expansive cement - polymer concrete composites - ferro cement - fibre reinforced concrete- fibre reinforced polymer composites - micro concrete. methods of corrosion protection - corrosion inhibitors - protective coating materials for rebar and concrete - corrosion resistant steel - cathodic protection.

MODULE IV TECHNIQUES FOR REPAIR 09

Rust converters and polymer coating for rebars during repair - repair mortar for cracks - bonding agents - epoxy injection - guniting and shotcrete - FRP and ferro cement jacketing - vacuum concreting - bonding plates - overlays - protective coatings - shoring and underpinning technique.

MODULE V REHABILITTION OF STRUCTURES - CASE STUDIES 09

Case studies on repairs to overcome low member strength - deflection - cracking - chemical attack - damage due to wear - leakage - fire - marine exposure and

corrosion- engineered demolition techniques for dilapidated structures - case study.

Total Hours : 45

REFERENCES:

1. Santha Kumar A.R., Concrete Technology, Oxford University Press, 2007.
2. Shetty M.S., Concrete Technology – Theory and Practice, S. Chand & Company Limited, 2008.
3. Orchard D.F., Concrete Technology -Vol. I - Properties of Materials, Wiley Publishers, 2010.
4. Yoshihiko Ohama, Hand Book of Polymer – Modified Concrete and Mortars, Noyes Publications, 1995.
5. Philip H. Perkins, Repair, Protection and Waterproofing of Concrete Structures, Elsevier Applied Science Publishers, 1986.
6. Ransom W.H., Building Failures - Diagnosis and Avoidnce, E.& F.N. Spon Publishers, 1987.
7. Michael T. Kubal, Waterproofing the Building Envelope, Mc-Graw Hill Inc., 1993.

OUTCOME:

At the end of course work students will be able to

- Specify the various causes for distress in reinforced concrete structures.
- Conduct 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.
- Specify rehabilitation procedure for fire affected, corrosion affected and other structurally distressed members and engineered demolition techniques

CECY104 PLATES AND SHELLS

L	T	P	C
3	0	0	3

OBJECTIVE:

- 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 09

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 10

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 08

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

MODULE IV ANALYSIS OF SHELLS 08

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 10

Design of spherical, conical, paraboloid, ellipsoid, cylindrical hyperbolic paraboloid, northlight shells.

Total Hours : 45

REFERENCES:

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

4. Bairagi N.K, Plate Analysis, Khanna Publishers, 1981.
5. Reddy, J.N., Mechanics of Laminated Composites Plates and Shells, CRC Publishers, 2nd Edition, 2003.
6. Philip L Gould, Analysis of Shells and Plates, Prentice Hall, 1998.

OUTCOME:

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 shells structures.

CECY105 STABILITY OF STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVE:

- 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 09

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 IN ELASTIC BUCKLING 09

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 09

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 09

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 OF THIN PLATES 09

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.

OUTCOME:

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.
- develop stability analysis by different approaches for various types of beams.
- establish differential equations for thin plates under different edge conditions.

CECY106 TALL STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand the problems associated with large heights of structures 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 09

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 09

Structural forms – braced frame, rigid frame, infilled 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 09

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

MODULE IV STABILITY OF TALL BUILDINGS 09

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 DYNAMIC ANALYSIS 09

Response to wind loading - along-wind response - across-wind response - estimation of natural frequencies & damping - types of excitation - design to minimise 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 Alex Coull, 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.

OUTCOME

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.

CECY107	WIND AND CYCLONE EFFECTS ON STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

MODULE I INTRODUCTION 09

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 09

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 09

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

MODULE IV DESIGN OF STRUCTURES FOR WIND LOAD 09

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 09

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.

OUTCOME:

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.

CECY108 DESIGN OF OFFSHORE STRUCTURES

L	T	P	C
2	0	0	2

OBJECTIVE:

- To impart knowledge on wave generalized process and wave theories.
- To understand the forces on offshore structure.
- To expand the idea on foundation and structural modeling and familiarize with foundation analysis on offshore structures
- To design of offshore structures with failure probability

MODULE I WAVE THEORIES 06

Wave generation process-small- finite amplitude and nonlinear wave theories.

MODULE II FORCES OF OFFSHORE STRUCTURES 06

Wind forces- wave forces on small bodies and large bodies current forces and use of morison equation.

MODULE III OFFSHORE SOIL AND STRUCTURE MODELLING 06

Different types of offshore structures- foundation modeling- fixed jacket platform structural modeling.

MODULE IV ANALYSIS OF OFFSHORE STRUCTURES 06

Static method of analysis-foundation analysis and dynamics of offshore structures.

MODULE V DESIGN OF OFFSHORE STRUCTURES 06

Design of platforms –helipads- Jacket tower- analysis and design of mooring cables and pipe lines.

Total Hours : 30

REFERENCES:

1. Cakrabarti, S.K. Hydrodynamics of Offshore Structures, Computational Mechanics Publications, 1987.
2. Dawson.T.H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983
3. Brebia, C.A and Walker, S., Dynamic Analysis of Offshore Structures, New Butterworths, U.K. 1979.

4. API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication, RP2A, Dalls, Tex, 2000.
5. Reddy, D.V. and Arockiasamy, M., Offshore Structures, Vol.1 and Vol.2, Krieger Publishing Company, Florida, 1991

OUTCOME:

On completion of this course students will be able to

- determine the constants involved in the wave theories.
- solve various types of forces due to ocean waves.
- describe the foundation for offshore structures.
- perform and analyze the dynamics of offshore structures.
- design offshore structures like platform, helipads, jackets, towers etc.,

CECY109	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	C
		2	0	0	2

OBJECTIVE:

- 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 07

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

MODULE II DESIGN OF COMPOSITE MEMBERS 08

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

MODULE III DESIGN OF CONNECTIONS 08

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

MODULE IV COMPOSITE BOX GRIDER BRIDGERS 07

Introduction - behaviour of box girder bridges - design concepts.

Total Hours : 30

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, 1992.
3. Course Notes, Institute of Steel Development and Growth (INSDAG), Kolkatta,.

OUTCOME:

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.

CECY110	CASE STUDIES ON PERFORMANCE AND EVALUATION OF STRUCTURES	L	T	P	C
		1	0	0	1

OBJECTIVE:

- To impart knowledge on the various causes of deterioration of structures
- To expand the knowledge on repair, retrofit and strengthening of structures through case studies.

MODULE I CASE STUDIES ON PERFORMANCE OF STRUCTURES 07

Durability assessment of structures - seismic performance of configuration of buildings – seismic performance of concrete, steel and composite structures- blast and wind resistant structures

MODULE II CASE STUDIES ON REPAIR AND REHABILITATION OF STRUCTURES 08

Degradation of concrete structures in marine environment - durability problems on heritage structures - structural appraisal and evaluation of fire damaged structures- engineered demolition techniques for dilapidated structures – retrofit on non-engineered buildings - strengthening of concrete and steel structures.

Total Hours : 15

OUTCOME:

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

- identify different types of damages and repair strategies on structures
- apply the suitable repair and rehabilitation techniques to evaluate the performance of structures.

LIST OF EVEN SEMESTER PROFESSIONAL ELECTIVES

CECY201	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVE:

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

MODULE I CLASSIFICATION AND CHARACTERISTICS OF COMPOSITE MATERIALS 09

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

MODULE II BASIC CONCEPTS 09

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 09

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 09

Netting analysis – failure criteria – sandwich construction.

MODULE V MANUFACTURING AND FABRICATION PROCESSES 09

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

Total Hours : 45

REFERENCES:

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

4. Agarwal B.D and L.J.Broutman, Analysis and performance of fiber composites, John-wiley and sons, 1980.
5. Calcote L.R, Analysis of limited structures, Van Nostrand Reinhold Co., 1989.

OUTCOME:

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

- classify the composite materials and their use in structures.
- identify the priniciple 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.

CECY202 CORROSION OF STEEL IN CONCRETE

L	T	P	C
3	0	0	3

OBJECTIVE:

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

MODULE I CORROSION MECHANISM 09

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 09

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 cementious coatings - stainless steel reinforcement - sealers and membranes - cathodic protection.

MODULE III CONDITION EVALUATION AND CORROSION RATE MEASUREMENT 09

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 09

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 09

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.

OUTCOME:

At the end of course work, 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.

CECY203 EARTHQUAKE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To provide the basic understanding on the theory of vibrations.
- 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, various structural systems, design and detailing aspects of structures subject to earthquake loading.
- To provide insight knowledge on the seismic retrofitting techniques of structures.

MODULE I THEORY OF VIBRATIONS 09

Concepts of vibrations – response of the system – simple harmonic motion – damped and undamped -free and forced vibration- natural frequencies and modes shapes.

MODULE II ENGINEERING SEISMOLOGY 09

Earthquake characterizations – causes of earthquake - types of earthquake – seismic waves – magnitude and intensity – measurement of earthquake – seismic zones – architectural features – indian seismic codes– liquefaction of soil - indian and world seismicity

MODULE III SEISMIC BEHAVIOUR OF STRUCTURES 09

Seismic design philosophy – earthquake resistant design of RC members – beams – columns – beam column joints – slabs – staircases – shear wall – seismic coefficient – load combinations - response spectrum method - steel frames – steel panel zones – bracing members–connection design and joint behavior.

MODULE IV DUCTILE DETAILING 09

IS 13920 codal provisions for detailing – beams – columns – beam column joints – footing – staircases – shear wall – special confining reinforcements.

MODULE V SEISMIC RETROFITTING OF STRUCTURES 09

Base isolation – seismic dampers – retrofitting and strengthening of structural members.

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, 1991.
3. Anil K.Chopra, Dynamics of Structures Theory and Applications to Earthquake Engineering Prentice Hall of India (P) Ltd., New Delhi 1996.
4. Allen R.T., Edwards S.C., Repair of Concrete Structures, Blackie and Sons, U.K. 1992.
5. Paulay,T. and Priestly, M.N.J., “Aseismic Design of Reinforced Concrete and Masonry Building”, John Wiley and Sons, 1991.

OUTCOME:

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

- evaluate the natural frequencies and modes shapes for structures.
- identify the types of seismic waves and measure the magnitude of earthquake.
- perform seismic analysis of structures using various methods.
- describe and design the ductile detailing for structures.
- suggest retrofitting and strengthening methods for structural members.

CECY204	FATIGUE & FRACTURE OF STRUCTURES	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 09

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 09

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 09

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 & ENERGY THEORIES 09

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 crack growth -constant amplitude loading – variable amplitude loading – crack growth models –remaining life-prediction – residual strength evaluation – plastic collapse condition, yield condition, remaining life approach

MODULE V FRACTURE OF CONCRETE STRUCTURES 09

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 S P, 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 Rao A G, 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.

OUTCOME:

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

CECY205	MATRIX METHODS OF STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To understand the difference between matrix based flexibility and stiffness approaches in structural analysis.
- 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 09

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 10

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 10

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 8

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

MODULE V DIRECT STIFFNESS METHOD 08

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. Rajasekaran S and Sankarasubramanian G, Computational Structural Mechanics, Prentice Hall of India, 2001.
3. Beaufait, F.W., Computer Methods of Structural Analysis Analysis, Prentice Hall, 1970.
4. Holzer, S.M., Computational Analysis of Structures, Elsevier Science Publishing Co., Inc, 1988.
5. Meek J. L., Computer methods in structural Analysis, Taylor and Francis, 1991.
6. Nelsm J.K., Nelson K James and Mc Cormac J C., Structural analysis using Classical and Matrix methods, John Wiley &sons, 2002.
7. Kanchi M. B., Matrix methods of Structural analysis, New Age International, 1993.

OUTCOME:

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.

CECY206 OPTIMIZATION IN STRUCTURAL DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- 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 09

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

MODULE II QUEUING THEORY 09

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

MODULE III OPTIMIZATION TECHNIQUES AND ALGORITHMS 09

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

MODULE IV COMPUTER SEARCH METHODS 09

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

MODULE V OPTIMIZATION THEOREMS 09

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, 1995.

3. Iyengar. N.G.R and Gupta.S.K, Structural Design Optimisation, Affiliated East West Press Ltd, New Delhi, 1997
4. Richard Bronson, Operation Research, Schaum's Outline Series, McGraw-Hill Book Co., Singapore, 1983.

OUTCOME:

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 the analysis of structures.
- describe the various optimization theorems for the analyzing of structures.

CECY207 PRESTRESSED CONCRETE

L	T	P	C
3	0	0	3

OBJECTIVE:

- 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 & ANALYSIS OF STRESSES 09

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 OF PSC MEMBERS 09

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.

MODULE III STATICALLY INDETERMINATE STRUCTURES 09

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

MODULE IV DESIGN OF TENSION AND COMPRESSION MEMBERS 09

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

MODULE V DESIGN OF COMPOSITE MEMBERS 09

Composite beams - analysis and design, ultimate strength - their applications - partial prestressing - its 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.
5. Sinha, N.C, & S.K.Roy, Fundamentals of Prestressed Concrete, S.Chand & Co, New Delhi, 2000.
6. Ramaswamy G.S., Modern Prestressed Concrete Design, Arnold Heinimen, New Delhi, 1990.
7. IS 1343-1980, Code of Practice for Prestressed concrete
8. IS 3370 (Part –IV) – 1967, Design Tables, Code of Practice for Concrete Structures for the Storage of Liquids.
9. IS 456-2000, Code of Practice for Plain and Reinforced Concrete.
10. SP 16, Design Aids for IS 456-1978.

OUTCOME:

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.

CECY208 SOIL -STRUCTURE INTERACTION

L	T	P	C
3	0	0	3

OBJECTIVE:

- To provide graduate students and practicing engineers with the fundamental concepts and theory of dynamic soil-structure interaction(SSI), with special focus on analysis, influence of SSI in the design parameters.
- To expose the students to various design charts.

MODULE I SOIL- FOUNDATION INTERACTION 09

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 09

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 09

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 09

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 09

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. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
2. Poulos, H.G., and Davis, E.H., Pile Foundation - Analysis and Design, John Wiley, 1980.

3. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
4. Structure-Soil Interaction - State of Art Report, Institution of Structural Engineers, 1978.
5. ACI 336, Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute, Delhi, 1988

OUTCOME:

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

- analyse the soil foundation interaction 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

CECY224	GREEN BUILDING AND ENERGY EFFICIENT STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

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 I INTRODUCTION 09

Energy required for building construction - heat transfer – measuring conduction – thermal storage – measurement of radiation – the green house effect – psychrometry 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 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 odour 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 zones – energy audit – certification.

Total Hours: 45

REFERENCES:

1. Moore F., Environmental Control system, Mc Graw Hill Inc., 1994.
2. Brown, GZ Sun, Wind and Light: Architectural design strategies, John Wiley,2013.
3. Cook. J, Award –Winning passive Solar Design, Mc-Graw Hill, 1984.

OUTCOME:

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 a special climatic zones.

CECY209	COMPUTER AIDED ANALYSIS FOR STRUCTURES	L	T	P	C
		2	0	0	2

OBJECTIVE:

- To impart required knowledge about modeling of curves and surfaces and solid modeling
- To familiarise on the use of typical software packages and computer methods of analysis such as FEM and computer aided design of steel and RC structural elements.
- To provide exposure on computer aided project scheduling such as CPM and PERT applications.
- To understand the concepts on the knowledge based expert systems and principles of neural network.

MODULE I COMPUTER GRAPHICS 06

Graphic primitives - transformations - basics of 2-D drafting - modeling of curves and surfaces – solid modeling - graphic standards - drafting software packages and usage.

MODULE II STRUCTURAL ANALYSIS 06

Computer methods of structural analysis - finite element programming - analysis through application packages.

MODULE III STRUCTURAL DESIGN 06

Computer aided design of steel and RC structural elements - detailed drawing - bill of materials.

MODULE IV OPTIMIZATION 06

Linear programming - simplex algorithm - post-optimality analysis - project scheduling - CPM and PERT applications - genetic algorithm and applications.

MODULE V EXPERT SYSTEMS 06

Introduction - heuristic search - knowledge based expert systems - architecture and applications of KBES - expert system shells - principles of neural network.

Total Hours : 30

REFERENCES:

1. Krishnamoorthy, C.S.,and Rajeev, S.,Computer Aided Design, Narosa Publishing House, New Delhi, 1991.
2. Ian M. Smith, D. V. Griffiths Programming the Finite Element Method, John Wiley & Sons, 2005.
3. Harrison,H.B., Structural Analysis and Design Vol. I & II, Pergamon Press, 1991.
4. Richard Forsyth (Ed.), Expert System Principles and Case studies,
5. Chapman & Hall , 1989.

OUTCOME:

At the end of course, students will be able to

- apply the drafting techniques with the use of software packages
- analyse the structural members through FEA software packages.
- design the steel and RC structural elements using computer aided analysis packages.
- apply various optimization techniques in project management systems
- describe and apply the expert systems for the analysis of structural members.

CECY210 PREFABRICATED STRUCTURES

L	T	P	C
2	0	0	2

OBJECTIVE:

- 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 06

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 06

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 AND ROOFS 06

Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, description of joints, their behaviour and reinforcement requirements, deflection control for short term and long term loads, ultimate strength calculations in shear and flexure.

MODULE IV WALLS 06

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

MODULE V INDUSTRIAL BUILDINGS AND SHELL ROOFS 06

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, Akademiai Kiado, 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 Precase Concrete, Netherland Betor Verlag, 2009.
5. Warszawski, A., Industrialization and Robotics in Building - A managerial approach, Harper and Row, 1990.

OUTCOME:

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 and roofs and describe their behaviour of structures.
- Critically describe the various of types wall panels of prefabricated structures.
- Construct a prefabricated structural components for industrial buildings.

CECY211	ANALYSIS OF STRUCTURES USING FEA SOFTWARE	L	T	P	C
		1	0	0	1

OBJECTIVE:

- To expand the knowledge on the preparation of structural design and drawings for concrete and steel structures using STAAD Pro software.
- To impart knowledge on the various structural systems and general behavior of structures using ETABS.
- To provide a practical training to analyse the various types of structures using ANSYS.

MODULE I ANALYSIS OF STRUCTURES USING STAAD PRO SOFTWARE 05

Analysis and design of beams subjected to various loading systems - analysis of plane and space frames - design of foundation for the structure

MODULE II ANALYSIS OF STRUCTURES USING ETABS SOFTWARE 05

Working with analytical model view - introducing grid system - object based meshing tools - creating building and applying gravity, wind and seismic loads - buckling analysis - p-delta analysis - generating live mode shapes

MODULE III ANALYSIS OF STRUCTURES USING ANSYS SOFTWARE 05

Introduction to ANSYS - problem formulation– pre & post - processing - plane pin-jointed truss – redundant truss - cantilever beam - simply supported and continuous beam with different types of loads – dynamic analysis of a beam and frame.

Total Hours : 15

REFERENCES:

1. Krishna Raju N, Structural Design & Drawing (Reinforced Concrete & Steel), Universities Press, 2004.
2. ETABS, Three Dimensional Analysis and Design of Building Systems, Computers and structures, 2003.
3. Sivakumar Naganathan, Learn Yourself Staad.Pro V8i, Lap Lambert Academic Publishing GmbH KG, 2012.

4. Srinivas P, Sambana K C, Datti Rajesh Kumar, Finite Element Analysis using Ansys 11.0, PHI Learning Pvt. Ltd., 2010.
5. Revathy J, Gajalakshmi P and Vinu S.K, Manual for Analysis of Structures Using FEA Software, 2016.

OUTCOME:

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

- analyse and design steel /concrete structural components and prepare relevant structural drawings as per I.S Specifications using STAAD Pro software.
- design and analyze high rise buildings using ETABS software .
- analyse the non-linear behaviour of structures using ANSYS software.

GENERAL ELECTIVES

GECY101	PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of the course would be to make the students

- Learn to e valuate 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.

GECY102 SOCIETY, TECHNOLGY & SUSTAINABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To aware of new technologies through advances in Science and Engineering.
- To make them realise 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.

GECY103 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.

GECY104 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", Printice 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.

GECY105 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 Salen Tekinba, 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

GECY106 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.

GECY107 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

GECY108 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

GECY109 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.

GECY110	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 – Break even 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

GECY111 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 Practicals): 45

REFERENCE:

1. Griffiths D V and Smith I M, “Numerical Methods for Engineers”, Blackwell, 1991.
2. Laurene Fausett, “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

GECY112 JAVA PROGRAMMING

L	T	P	C
1	0	2	2

OBJECTIVES:

- To learn the fundamentals of Java programming such as data types, variables and arrays.
- To study the syntax and necessity of decision making and iterative statements.
- To create a class and invoke the methods.
- To instigate programming in overloading of methods.
- To emphasize the concept of packages.
- To learn the exception handling routines.

MODULE I INTRODUCTION TO JAVA PROGRAMMING 08

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

MODULE II METHODS AND CLASSES 07

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

L: 15, P: 30, Total Hours: 15

REFERENCES:

1. Herbert Schildt, “Java The Complete Reference”, 9th Edition, Oracle Press, 2014, ISBN: 978007180855-2.
2. Nicholas S. Williams, **“**Professional Java for Web Applications: Featuring WebSockets, Spring Framework, JPA Hibernate and Spring Security (WROX)”, John Wiley & Sons, 2014, ISBN: 978111865651-8.
3. E Balagurusamy, “Programming with Java”, 5th Edition, Tata Mcgraw Hill, 2014.
4. Yashavant Kanetka**, “**Let Us Java”, 2nd Edition, BPB Publications, 2012**.**

OUTCOMES:

Students who complete this course will be able to

- Implement basic Java programming.
- Create a class and invoke methods for real world problems.

- Construct simple overloading of methods programs.
- Implement various types of inheritance concepts.
- Describe the access control mechanism.
- Handle exception thrown while implementing programming.

GECY113 PYTHON PROGRAMMING

L	T	P	C
1	0	2	2

OBJECTIVES:

- To learn the list and records of python programming.
- To study the control statements and string functions of python.
- To instigate the fundamental python programming.
- To emphasize GUI in python.
- To integrate python with embedded systems.
- To implement programs in python.

MODULE I INTRODUCTION TO PYTHON PROGRAMMING 08

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

MODULE II 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: 15, P: 30, Total Hours: 15

REFERENCES:

1. Nick Goddard, “Python Programming”, 2nd edition, ISBN: 1533337772, 2016.
2. Pratik Desai, “Python Programming for Arduino”, 1st edition, Packt publishing, 2015, ISBN: 9781783285938.
3. Mark Lutz, Learning Python: Powerful Object-Oriented Programming, 5th Edition, O'Reilly Media, 2013.
4. Richard H. Barnett, Sarah Cox, Larry O'Cull, “Embedded C Programming and the Atmel AVR”, 2nd edition, 2006.
5. Michael Barr, Anthony Massa, “Programming Embedded Systems”, 2nd Edition, O'Reilly Media, 2006.

OUTCOMES:

Students who complete this course will be able to

- Implement date and time function programming using python.

- Write formatted file programming.
- Construct simple python programs.
- Create web interface using python programming
- Develop embedded system with python programming.
- Build Arduino prototype using python programming.

GECY114 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. Ajit Parulekar 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

COURSE 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