UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science & 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 AND 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 over-all Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To nurture Civil Engineers into ethically strong and responsible leaders to address Global challenges through Quality Education, Application oriented research, innovation, inspiration, motivation and sustainable growth.
- To enrich and enhance knowledge for the best practices in various disciplines of Civil Engineering through Collaborations with Global Institutions of Excellence, Industries and Research organizations.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.Tech. (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, effective communication, accounting, financial and managerial skills.

PROGRAMME OUTCOMES

On successful completion of the programme, the graduates will

- Have the ability to apply knowledge of mathematics, science and engineering to solve problems related to structural engineering and update themselves in the relevant areas.
- Be able to apply knowledge and skill in the analysis and design of structural components and systems using appropriate standards and codes.
- Have the ability to apply modern engineering techniques, skills, and computing tools necessary for structural engineering practice.
- Have the capability to undertake real time research projects in the field of structural engineering with an understanding on the principles of sustainability.
- Be able to perform in inter-disciplinary engineering teams with good communication skills, social responsibility and commitment to ethics
- Have necessary knowledge and skills in financial accounting and management.

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)
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.

REGULATIONS 2013
FOR
M.TECH. DEGREE PROGRAMMES
(WITH AMENDMENTS INCORPORATED TILL JUNE 2015)

B.S. ABDUR RAHMAN UNIVERSITY, CHENNAI 48.
REGULATIONS -2013 FOR M.TECH / MCA / M.Sc. DEGREE PROGRAMMES

(With amendments incorporated till June 2015)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

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

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 of this University.

vi) **"Dean (Academic Affairs)"** means Dean (Academic Affairs) of B.S.Abdur Rahman University.

vii) **"Dean (Student Affairs)"** means Dean(Student Affairs) of B.S.Abdur Rahman University.

viii) **"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.	Full Time
M.Tech.	Part Time – Day / Evening
M.C.A.	Full Time
M. Sc.	Full Time
M. Sc.	Full Time

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 Projectwork in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department, if the student satisfies the clause 2.3.4 of this Regulation. 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 - Day time

In this mode of study, the students are required to attend classes for the courses registered along with full time students.

2.2.4 Part time - Evening

In this mode of study, the students are required to attend normally classes in the evening and on Saturdays, if necessary.

2.2.5 A part time student is not permitted to convert to full time mode of study.

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 A student eligible for admission to M.Tech. Part Time / Day Time programme shall have his/her permanent place of work within a distance of 65km from the campus of this Institution.

2.3.5 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. (Full Time) – (Lateral Entry)	4	8
M.Sc. (Full Time)	4	8

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

i. Core courses
ii. Elective courses
iii. Project work / thesis / dissertation
iv. Laboratory Courses
v. Case studies
vi. Seminars
vii. 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. degree Mech./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)	
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. in ECE / Electronics / EIE / ICE / EEE
		M.Tech.(Signal Processing)	
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)
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 and Predictive Analytics)	
		M.Tech. (Computer Science and Engineering with specialization in Big Data Analytics)	
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)	

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
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. (Full Time) – (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)	
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)	
13	Chemistry	M.Sc.(Chemistry)	B.Sc (Chemistry) of B.Sc. (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 credit range
M.Tech.	75 to 85
M.C.A.	120 to 130
M.Sc.	75 to 85

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
* 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.

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	Non-project Semester	Project semester
M.Tech. (Full Time)	15 to 29	12 to 20
M.Tech. (Part Time)	6 to 18	12 to 16
M.C.A. (Full Time)	15 to 29	12 to 20
M.Sc. (Full Time)	15 to 25	12 to 20

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

3.10 A student may be permitted by the Head of the Department to choose electives offered from other PG programmes either within the Department or from other Departments up to a maximum of three courses during the period of his/her study, provided the Heads of the Departments offering such courses also agree.

3.11 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.

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

3.13 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.

3.14 PROJECT WORK/THESIS/DISSERTATION

3.14.1 Project work / Thesis / Dissertation shall be carried out under the supervision of a qualified teacher in the concerned Department.

3.14.2 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.

3.14.3 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.

3.14.4 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.

3.14.5 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.

3.14.6 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.

3.14.7 A student who has acquired the minimum number of total credits prescribed in the Curriculum for the award of Masters Degree will not be permitted to enroll for more courses to improve his/her cumulative grade point average (CGPA).

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 and enroll for all the courses.

7.2 For the subsequent semesters registration for the courses will be done by the student during a specified week before the semester-end examination 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 Adviser for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Adviser.

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 Adviser. 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 should have registered for all preceding semesters before registering for a particular semester.

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)	18 (III semester)
M.Tech. (Part time)	18 (V semester)
M.C.A. (Full time)	45 (V semester)
M.C.A. (Full time) – (Lateral Entry)	22 (V semester)
M.Sc.(Full time)	30 (IV semester) if project is in IV semester 18 (III semester) if project is in III semester

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.

10.3 Every student should have been certified by the HOD that his / her conduct and discipline have been satisfactory.

11.0 ATTENDANCE

11.1 Attendance rules for all Full Time Programme and Part time - day 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 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.

13.0 ASSESSMENTS AND EXAMINATIONS

13.1 The following rule shall apply to the full-time and part-time 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, in each lecture based course.

13.3 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.

13.4 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

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i} \qquad Where\ \ n = number\ of\ courses$$

where Ci 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:

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.

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)

(FOUR SEMESTERS / FULL TIME)

CURRICULUM

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
1.	MAB6181	Applied Mathematics	3	1	0	4
2.	CEB6101	Research Methodology	3	0	0	3
3.	CEB6102	Theory of Elasticity and Plasticity	3	0	0	3
4.	CEB6103	Advanced Concrete Design	3	0	0	3
5.	CEB6104	Structural Dynamics	3	0	0	3
6.	CEB6105	Experimental Methods and Model Analysis	3	0	0	3
7.	CEB6106	Material Testing Laboratory	0	0	3	1
8.	CEB6107	Seminar	0	0	2	1
						21

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
1.	CEB6211	Prestressed Concrete	3	0	0	3
2.	CEB6212	Design of Substructures	3	0	0	3
3.	CEB6213	Advanced Steel Structures	3	1	0	4
4.	CEB6214	Finite Element Analysis	3	0	0	3
5.		Elective - I	3	0	0	3
6.		Elective - II	3	0	0	3
7.	CEB6215	Earthquake Engineering Laboratory	0	0	3	1
8.	CEB6216	Structural Design Project	0	0	4	2
						22

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C
1.		Elective - III	3	0	0	3
2.		Elective - IV	3	0	0	3
3.		Elective - V	3	0	0	3
4.	CEB7122	Financial Accounting and Management	3	0	0	3
5.	CEB7102	Industrial Internship	0	0	*	2**
6.	CEB7101	Project Work Phase - I	0	0	12	6#
						14

*30 days

** Industrial training will be undertaken during first year summer vacation. The credit will be awarded in the 3rd semester.

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	C
1.	CEB7101	Project Work Phase - II	0	0	36	18
						18#
						18 + 6 = 24

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

TOTAL CREDITS: 81

LIST OF ELECTIVES

Sl. No	Course Code	Course
1.	CEBY 01	Advanced Concrete Technology
2.	CEBY 02	Behaviour and Design of Masonry Structures
3.	CEBY 03	CADD for Structures
4.	CEBY 04	Chemistry of Cement and Concrete
5.	CEBY 05	Composite Materials
6.	CEBY 06	Corrosion of Steel in Concrete
7.	CEBY 07	Design of Bridges
8.	CEBY 08	Design of Steel Concrete Composite Structures
9.	CEBY 09	Design of Structures for Dynamic Loads
10.	CEBY 10	Disaster Mitigation and Management
11.	CEBY11	Earthquake Engineering
12.	CEBY 12	Fatigue & Fracture of Structures
13.	CEBY 13	FRP Composites for RC Structures
14.	CEBY 14	Industrial Structures
15.	CEBY 15	Maintenance and Rehabilitation of Structures
16.	CEBY 16	Modern Earth Buildings
17.	CEBY 17	Natural Building Materials & Techniques
18.	CEBY 18	Optimization in Structural Design
19.	CEBY 19	Plates and Shells
20.	CEBY 20	Soil - Structure Interaction
21.	CEBY 21	Stability of Structures
22.	CEBY 22	Tall Structures
23.	CEBY 23	Wind and Cyclone Effects on Structures
24.	CEBY 24	Behaviour of RC Structures
25.	CEBY 25	Instrumentation and Model Testing Techniques
26.	CEBY 26	Advanced Hydrologic Analysis and Design

27.	CEBY 27	Membrane Technology
28.	CEBY 28	Remote Sensing and GIS for Water Resources
29.	CEBY 29	Quantitative Techniques for Transportation Engineering
30.	SSBY01	Society, Technology and Sustainability

SEMESTER - I

MAB 6181	**APPLIED MATHEMATICS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES:

- To familiarize the students in the field of differential and elliptic equations to solve boundary value problems associated with engineering applications using fourier series and fourier transform methods.
- To expose the students to variational formulation and numerical integration techniques and their applications.
- Students are exposed to the concepts of probability and random variables and estimation theory.

MODULE I FOURIER SERIES **5**

Dirichlet's condition - General Fourier series - odd and even functions - Parseval's identity.

MODULE II TRANSFORM METHODS **8**

Laplace transform methods for one-dimensional wave equation - Displacements in a long string – longitudinal vibration of an elastic bar - Fourier transforms methods for one-dimensional heat conduction problems in infinite and semi-infinite rod.

MODULE III ELLIPTIC EQUATIONS **8**

Laplace equation - Properties of harmonic functions - Fourier transform methods for Laplace equation.

MODULE IV CALCULUS OF VARIATIONS **8**

Variation and its properties - Euler's equation - Functionals dependant on first and higher order derivatives - Functionals dependent on functions of several independent variables - Some applications - Direct methods – Ritz and Kantorovich methods.

MODULE V PROBABILITY AND RANDOM VARIABLES **8**

Probability - Random variables - Moments - Moment Generating Function –

Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions - Functions of random variables - Two dimensional random variables - Correlation and regression.

MODULE VI ESTIMATION THEORY 8

Principles of least squares - Multiple and partial correlation and regression - Estimation of parameters – Maximum Likelihood Estimates - Method of moments.

L – 45; T – 15; Total Hours : 60

REFERENCES:

1. Sneddon, I.N., Elements of Partial Differential Equations, Mc Graw Hill, 1986.
2. Gupta, A.S., Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd, New Delhi, 1997.
3. Kreyszig, E., Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, Inc., Singapore, 2002.
4. Elsgolts, L., Differential Equations and Calculus of Variations, Mir Publishers, Moscow, 1966.
5. Ross S.M. Introduction to Probability theory, Pearson, 2012.

OUTCOMES:

By the end of the course the students will

- be able to apply the concepts of fourier series, fourier transform methods, calculus of variation and estimation theory in engineering field,
- have a fundamental knowledge of the basic probability concepts.
- have a well – founded knowledge of standard distributions which can describe real life phenomena.
- acquire skills in handling situations involving more than one random variable and functions of random variables.

CEB6101	RESEARCH METHODOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to understand the basics of scientific research, broaden their conception of what research involves.

MODULE I RESEARCH PROBLEM FORMULATION 8

Research – objectives – types – Research Process, Solving civil engineering problems, Identification of research topic, Formulation of research problem, Literature Survey and Review.

MODULE II RESEARCH DESIGN 10

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 USE OF STATISTICAL TOOLS IN RESEARCH 10

Importance of statistics in research – concept of probability – popular distributions, sample design. Hypothesis testing, ANOVA, Design of experiments – factorial designs – orthogonal arrays, Multivariate analysis – curve fitting, Correlation and regression.

MODULE IV ANALYSIS AND INTERPRETATION OF DATA 9

Research Data analysis – interpretation of results – correlation with scientific facts, accuracy and precision – error analysis, limitations Use of Optimization Techniques – traditional methods – evolutionary optimization techniques – GA - PSO

MODULE V THE RESEARCH REPORT 8

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

Total Hours : 45

TEXT BOOKS:

1. Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai, 2011.

2. Kothari C.K. Research Methodology- Methods and Techniques, New Age Publishers, International, New Delhi, 2004.

3. Krishnaswamy, K.N., Sivakumar, Appa Iyer and Mathiranjan M., Management Research Methodology; Integration of Principles, Methods and Techniques, Pearson Education, New Delhi, 2006.

REFERENCES:

1. Donald H.McBurney, Research Methods, 5th Edition, Thomson Learning, 2006

2. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi, 2010.

3. Blum, Deborah and Mary Knudson, eds. A field guide for science writers: the official guide of the National Association of Science Writers. New York: Oxford University Press, 1997.

4. Booth, Wayne, Gregory G Colomb, Joseph M. Williams., The craft of Research. Chicago: University of Chicago Press, 1995.

OUTCOMES:

At the end of this course, students will be

- able to do quality research and publish papers in reputed journals.
- able to formulate a research problem and use proper statistical tools to analyze and interpret the data and write a quality research report

CEB 6102 THEORY OF ELASTICITY AND PLASTICITY **L T P C**

3 0 0 3

OBJECTIVES:

- To impart knowledge of the general features of elastic systems and to analyze two-dimensional state of stresses and strains.
- To provide sufficient background on the area of elasticity and plasticity theory.
- To train the students to apply the fundamental concepts to solve problems in beams, torsion of non-circular cross-sections by various approaches.

MODULE I ANALYSIS OF STRESS & STRAIN **9**

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 **9**

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 **9**

Torsion of non circular sections- St.Venants approach – Prandtl'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 **9**

Castigliano's theorem - Principle of Virtual work - Principle of stationary potential energy - Principle of least work - Rayleigh's method - Rayleigh-Ritz method- Finite difference method - Simple applications.

MODULE V PLASTICITY **9**

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 2013.
3. Sadhu Singh, Theory of Plasticity, Khanna Publishers, New Delhi 1988.
4. Wang, C.T, Applied Elasticity, McGraw-Hill Book Company.
5. Hearn , E.J. Mechanics of Materials, Vol.2, Pergamon Press, Oxford, 1985.
6. Fung, Y. C, Foundations of Solid Mechanics, Prentice - Hall Publishers,1965.

OUTCOMES:

On successful completion of this course, students will

- have the knowledge on physical foundations of the continuum mechanics of solids, including deformation and stress measures and constitutive relations.
- possess the ability to apply the basic principles of solid mechanics to solve engineering problems and design systems or components to meet the desired needs.

CEB 6103 ADVANCED CONCRETE DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on the advanced topics including design of RCC beams under combined shear, torsion and bending, limit state of serviceability for structural members.
- To expose the students to design of slender columns, deep beams, flat slab and flat plates.
- To facilitate for development of knowledge in studying the elastic and inelastic response of reinforced concrete structural elements.

MODULE I DESIGN OF RCC BEAMS 9

Overall review on behaviour of RC beams in flexure and shear - Behaviour and Design of RCC beams under combined Shear, Torsion and Bending - Analysis and design of beams circular in plan - Serviceability limit states - Computation of deflections and crack width as per codal provisions.

MODULE II DESIGN OF SLENDER COLUMNS 8

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 10

Design of RC walls – Design of shear walls - Design and detailing of Corbels and deep beams - Approximate analysis and design of Grid floors – Spandrel beams – Strut and tie method.

MODULE IV DESIGN OF FLATSLABS AND PLATES 8

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.

MODULE V INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES 10

Inelastic behaviour of concrete beams - Moment-rotation curves - moment redistribution -Bakers method of analysis and design. Design of cast-in-situ joints in frames.

Total Hours : 45

REFERENCES:

1. Varghese, P.C. Advanced Reinforced Concrete Design, Prentice Hall of India, 2002.
2. Varghese, P.C. Limit State Design of Reinforced Concrete, Prentice Hall of India, 2002.
3. Krishna Raju, N., Advanced Reinforced Concrete Design, CBS Publishers and Distributers, 1986.
4. Sinha.S.N., Reinforced Concrete Design, Tata-McGraw-Hill,1996
5. Purushothaman, P, Reinforced Concrete Structural Elements: Behaviour Analysis and Design, Tata McGraw-Hill, 1986.
6. Park. R., & Paulay .T., Reinforced Concrete Structures, John Wiley & Sons, 1975.
7. Shah V.L., & Karve S.R. Limit state theory and Design of Reinforced Concrete, Structures Publications, Pune 2003.
8. Arthur H.Nilson Design of Concrete Structures, Tata McGraw-Hill, 2003.
9. IS 456-2000, Plain and Reinforced Concrete - Code of Practice.
10. SP 16, Design Aids for IS 456-1978.
11. IS 13920- 1993- Ductile Detailing Of Reinforced Concrete Structures Subjected to Seismic Forces — Code Of Practice.

OUTCOMES:

On successful completion of these modules, students will

- be able to compute serviceability response of structural elements and design the slender RC columns in accordance with the relevant code.
- have the knowledge to appropriately choose the two-way slab system and design for it.
- have the capability to apply concepts of ductility and predict the moment-curvature for any type of beam.
- be able to formulate the conceptual design scheme and detailed design, resulting in sound solution to a realistic and challenging problem.

CEB 6104 STRUCTURAL DYNAMICS L T P C

3 0 0 3

OBJECTIVES:

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

MODULE I SINGLE DEGREE OF FREEDOM SYSTEMS 9

Formulation of equations of motion by different methods, Free and forced vibrations, Effect of damping.

MODULE II MULTI DEGREE OF FREEDOM SYSTEMS 9

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 9

Modeling - free and forced vibration of bars and beams.

MODULE IV DYNAMIC RESPONSE OF MDOF SYSTEMS 9

Mode superposition techniques, Numerical integration procedures.

MODULE V DESIGN AGAINST BLAST AND IMPACT 9

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, 1993.

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, 1981.

4. Anderson R.A., Fundamentals of Vibration, Amerind Publishing Co., 1972.

5. Humar J. L., Dynamics of Structures, Prentice Hall, 1990.

6. Smith J.W., Vibration of Structures – Application in Civil Engineering Design, Chapmat Hill 1988.

7. Dowling, C.H., Blast vibration - Monitoring and Control, Prentice Hall Inc., Englewood Cliffs, 1985.

OUTCOMES:

At the end of the course, students will

- be able to develop the equation of motion for single degree of freedom systems, multi degree of freedom systems and continuous systems.
- have the ability to analyze the dynamic response of multi degree of freedom systems and knowledge to design the buildings for blast and impact forces using BIS codes of practice.

CEB 6105	EXPERIMENTAL METHODS AND MODEL ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on basic concepts of measurements and related instruments, working principle of strain gauges and application areas, types of data acquisition and processing systems.
- To give exposure to the application of photo elasticity, non-destructive testing techniques and theory and principles involved in model analysis.

MODULE I INTRODUCTION TO MEASUREMENTS 9

Measurement - methods - basic principles - errors in measurement - error analysis. Measurement of displacement, pressure, force, torque etc. - strain gauge - classification - mechanical, optical, acoustical, electrical resistance strain gauges etc.

MODULE II STRAIN MEASUREMENTS 9

Transducers - classification. Electrical resistance strain gauges - working principle - types and construction - materials - influencing parameters - measurement of strain - strain gauge circuits - potentiometer and wheat stone bridge - rosette analysis - use of electrical resistance strain gauges in transducer applications - load cell.

MODULE III DATA ACQUISITION AND ANALYSIS 9

Indicating and recording devices - Static strain measurement - dynamic strain measurement - data acquisition and processing systems - signal analysis - related terms. Moire method and analysis.

MODULE IV PHOTO ELASTICITY AND NON DESTRUCTIVE TECHNIQUES 9

Photo elasticity – basic concepts - applications of photo elasticity for stress analysis - polariscope – isoclinics and isochromatics - fringe order - methods of stress separation. Non destructive testing techniques - methods of NDT - liquid penetrate - rebound hammer - ultrasonic pulse velocity - X-ray radiography - half-cell potential measurement etc.

MODULE V MODEL ANALYSIS **9**

Model analysis - methods and materials. Direct model analysis - theory of similitude for modeling - Buckingham Pi theorem for analysis. Indirect model analysis - Eney deformeter - Beggs deformeter etc. Testing large scale structures – wind tunnel - holographic techniques.

Total Hours : 45

REFERENCES:

1. Dally J. W. and Riley W.F., Experimental stress Analysis, McGraw-Hill, Inc. New York, 1991.
2. Srinath L.S., Experimental Stress Analysis, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1984.
3. Rangan C.S., 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.

OUTCOMES:

On successful completion of the course, the students will

- be able to apply concepts of measurements and related instruments in the real time application areas.
- have knowledge about data acquisition and processing systems, application of photo elasticity and non-destructive techniques in structural testing and model analysis.

CEB 6106 MATERIAL TESTING LABORATORY L T P C

0 0 3 1

OBJECTIVES:

- To impart knowledge on mix design of concrete, influence of water-cement ratio and plasticizer on fresh and hardened properties of concrete, significance of durability properties, non-destructive testing techniques and instrumentation for structural testing.

MODULE I STANDARDS AND CONCRETE MIX DESIGN 10

Standards for assessing fresh concrete properties - hardened concrete properties - durability properties - bond strength of steel with concrete - construction chemicals - NDT testing techniques. Mix design for given concrete constituent materials - Material properties and parameters - mix design as per Indian standards and American Concrete Institute (ACI) method - testing and validation.

MODULE II FRESH CONCRETE PROPERTIES 9

Influence of water-cement ratio on workability - slump test, compaction factor test, vee-bee consistometer test and flow table test. Influence of super plasticizer on workability of concrete – determination of optimum dosage - Marsh cone test and Mini slump test.

MODULE III HARDENED CONCRETE PROPERTIES 9

Influence of water-cement ratio and super plasticizer on strength properties - compressive strength, flexural strength test and tensile strength - stress-strain behaviour of concrete with age. Bond strength of steel with concrete – Pull out test as per Indian Standards.

MODULE IV DURABILITY PROPERTIES & NDT TECHNIQUES 9

Water absorption and permeability test - NDT techniques for strength measurement - rebound hammer and Ultra sonic pulse velocity (UPV) test - Half-cell potential measurement on distressed concrete slab.

MODULE V INSTRUMENTATION FOR STRUCTURAL TESTING 8

Introduction to electrical strain gauges, load cells and data acquisition systems

- measurement of strain in cantilever beam using strain gauges - study on response of structural members using strain gauge and load cells. Introduction to vibration measurements.

Total Hours : 45

REFERENCES:

1. Dally J W, and Riley W F, Experimental Stress Analysis, McGraw-Hill, Inc. New York, 1991.
2. Santha Kumar, A.R., Concrete Technology, Oxford University Press, (2007). IS 10262 - 1982, Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards.
3. ACI COMMITTEE 211.1-1991, Standard Practice for Selecting Proportions for Normal, Heavy weight, and Mass concrete, Part 1, ACI Manual of Concrete Practice, 1994.
4. BIS 383-1970 - Specification for Coarse and Fine Aggregates from Natural Sources for Concrete, Bureau of Indian Standards
5. BIS 456-2000 - Plain and Reinforced Concrete-Code of Practice, Bureau of Indian Standards.
6. BIS 516-1968, Methods of Test for Strength of Concrete, Bureau of Indian Standards.
7. BIS 1199-1959, Methods of Sampling and Analysis of Concrete, Bureau of Indian Standards.
8. BIS 1786-1985, Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement, Bureau of Indian Standards.
9. BIS 2386-Part I-1963, Methods of Test for Aggregates for Concrete – Particle Size and Shape, Bureau of Indian Standards.
10. BIS 2386-Part 3-1963, Methods of Test for Aggregates for Concrete – Specific Gravity, Density, Voids, Absorption and Bulking, Bureau of Indian Standards.
11. BIS 2770-Part I-1967, Methods of Testing Bond in Reinforced Concrete – Part I-Pull-out Test, Bureau of Indian Standards.
12. BIS 4031-Part 4-1988, Methods of Physical Tests for Hydraulic Cement – Determination of Consistency of Standard Cement Paste, Bureau of Indian Standards.

13. BIS 4031-Part 5-1988, Methods of Physical Tests for Hydraulic Cement – Determination of Initial and Final Setting Times, Bureau of Indian Standards.

14. BIS 5816-1999, Splitting Tensile Strength of Concrete - Method of Test, Bureau of Indian Standards.

15. IS 13311 - 1992, Non destructive testing of concrete - Method of test, Part - 2: Rebound Hammer, Bureau of Indian Standards.

OUTCOMES:

At the end of course work, the students will

- be able to perform concrete mix design and validation as per project needs.
- understand the importance of water-cement ratio and construction chemicals on modifying fresh, hardened and durability properties of concrete.
- have the capability to use NDT techniques for strength and durability assessment of RCC structures.
- have exposure to instrumentation tools for structural testing.

SEMESTER - II

CEB 6211	PRESTRESSED CONCRETE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Provide an understanding of the behaviour and performance of prestressed concrete structures.
- To impart knowledge to analyze and design prestressed concrete flexural members, design of commonly used prestressed concrete structures such as circular prestressing, composite construction members.

MODULE I BASIC CONCEPTS & ANALYSIS OF STRESSES 9

Basic concepts – Advantages of PSC – Materials required – Systems and methods of prestressing – Analysis of sections – Stress concept – Strength concept – Load balancing concept –Stresses in tendons - Losses of prestress –Deflections of prestressed concrete members - Factors influencing deflections –Effect on tendon profile on deflections - Short term and long term deflections as per codal provisions.

MODULE II DESIGN OF PSC MEMBERS 9

Flexural strength – Strain compatibility method - Simplified procedures as per codes – Shear and Principal Stresses – Ultimate shear resistance of PSC members - Design of shear reinforcement – Behaviour under torsion – Modes of failure - Design for torsion, shear and bending - Design of PSC sections for flexure.

MODULE III TRANSMISSION OF PRESTRESS 9

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 IV STATICALLY INDETERMINATE STRUCTURES 9

Analysis of indeterminate structures – Continuous beams – Concept of concordance and linear transformations – Single storied rigid frames – Choice of cable profiles.

MODULE V PSC SPECIAL STRUCTURES 9

Concept of circular prestressing – Design of prestressed concrete pipes and cylindrical water tanks - Composite construction - types, behaviour, flexural stresses, longitudinal shear transfer, transverse shear – Compression members – Design of poles and piles - Partial prestressing – Principles, analysis and design concepts.

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 Inc, 1981.
4. Sinha, N.C, & S.K.Roy, Fundamentals of Prestressed Concrete, S.Chand & Co, New Delhi, 1985.
5. Ramaswamy G.S., Modern Prestressed Concrete Design, Arnold Heinimen, New Delhi, 1990.
6. IS 1343-1980, Code of Practice for Prestressed concrete
7. IS 3370- 1967 (Part –IV)- Design Tables, Code Of Practice For Concrete Structures for the Storage Of Liquids.
8. IS 456-2000, Code of Practice for Plain and Reinforced Concrete.
9. SP 16, Design Aids for IS 456-1978.

OUTCOMES:

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

- identify and carryout the design of commonly used prestressed concrete systems using fundamental principles.
- propose an appropriate system to prestress a particular structure.

CEB 6212 DESIGN OF SUBSTRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- 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 prepare the students to perform the geotechnical engineering design functions for shallow and deep foundations.

MODULE I SUB SURFACE EXPLORATION 8

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 9

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 9

Drilled shaft foundations and caissons for bridges - Foundations for towers – Chimneys – Silos.

MODULE V MACHINE FOUNDATIONS 9

Types - General requirements and design criteria - General analysis of machine foundations-soil system - Stiffness and damping parameters - Tests for design

parameters - Guide lines 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.

OUTCOMES:

At the end of the course students will be able to

- interpret subsurface information to report soil properties.
- design shallow, deep foundations and machine foundations for various types of structures.

CEB 6213 ADVANCED STEEL STRUCTURES L T P C

3 1 0 4

OBJECTIVES:

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

MODULE I BEHAVIOUR AND DESIGN OF CONNECTIONS 12

Types of connection - importance and behaviour - codal provisions as per IS: 800 - 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 12

Review of loads on structures - dead, live wind and seismic loads as per standards - analysis and design of Industrial buildings and bents - sway and non-sway frames - design of purlins, lovuver rails, gable column and Gable wind girder - analysis and design of gable frames.

MODULE IIII ANALYSIS AND DESIGN OF COLD–FORMED STEEL STRUCTURES 18

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 9

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 9

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 – 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
6. Wie - Wen Yu., Cold-formed Steel Structures, McGraw-Hill Book Company, 1973.
7. N. Subramanian, Steel Structures - Design and practice, Oxford University Press, 2011.
8. BIS: 800-2007, Indian standard code of practice for general construction in steel, Bureau of Indian Standards.
9. BIS 801 : 1975 - Indian standard code of practice for use of cold-formed light gauge steel structural member's in general building construction, Bureau of Indian Standards.

10. SP 6 (1) -1964 – Hand book for structural Engineers, 1. Structural Steel Sections, Indian Standards Institution.

11. SP 6 (5) -1980 – Hand book for structural Engineers, 5. Cold formed, Light-gauge steel structures, Bureau of Indian Standards.

12. BIS 6533 (Part 1): 1989, Design and construction of steel chimney - Code of practice, Part I Mechanical Aspect, Bureau of Indian Standards.

13. BIS 6533 (Part 2): 1989, Design and construction of steel chimney - Code of practice, Part 2 Structural Aspect, Bureau of Indian Standards.

14. BIS 6533 : 1971, Code of practice for design and construction of steel chimney, Bureau of Indian Standards.

OUTCOMES:

At the end of course work, students will be

- able to do the design of steel structures using various codal provisions.
- able to design different types of bolted and welded connections, industrial structural members, cold formed structural elements, water tanks, chimney etc.
- have exposure to plastic analysis of structures.

CEB 6214 FINITE ELEMENT ANALYSIS L T P C

3 0 0 3

OBJECTIVES:

- 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 trained students in matrix techniques and plane stress and plane strain concepts.
- To familiarise the students with the application of finite element concepts to non- linear and vibration problems.

MODULE I CONCEPTS OF FINITE ELEMENT METHOD 9

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 9

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 9

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 9

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 9

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, 3rd Edition, Prentice-Hall of India, Eastern Economy Editions, 2000.
4. David V. Hutton Fundamentals of Finite Element Analysis, Tata McGraw-Hill Edition, 2005.
5. Cook Robert. D., Plesha, Michael. E & Witt, Robert.J. Concepts and Applications of Finite Element Analysis, Wiley Students Edition, 2004.

OUTCOMES:

On the successful completion of these modules, students will be

- capable of analyzing the structural members using finite element method.
- able to model 2D and 3D building systems using geometric and numerical analysis software ANSYS.
- able to solve problems involved in thermal analysis of structures.

CEB 6215 EARTHQUAKE ENGINEERING LABORATORY **L T P C**
0 0 3 1

OBJECTIVES:

- To provide a practical training in understanding the behaviour of the building elements subjected to earthquake.
- To learn the advanced topics in earthquake engineering such as dynamics of motion, dynamics of beams, frames and free standing structures.
- To expose the students to analyse the various types of structures using finite element software.

MODULE I DYNAMICS OF MOTION **9**

Three storeyed building frame subjected to harmonic motion – One storeyed building frame with planar asymmetry subjected to harmonic base motions - Three storeyed building frame subjected to periodic (non-harmonic) base motion.

MODULE II DYNAMICS OF BEAM & FRAME **9**

Dynamics of one-span beams - Dynamics of a four storied building frame with and without an open ground floor.

MODULE III DYNAMICS OF FREE-STANDING STRUCTURES **9**

Earthquake induced waves in rectangular water tanks - Dynamics of free-standing rigid bodies under base motions

MODULE IV ANALYSIS OF TRUSS & BEAMS **9**

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 acting on the beam.

MODULE V NON-LINEAR ANALYSIS OF STRUCTURES **9**

Modal, Harmonic and Transient analysis of a beam and frame.

Total Hours : 45

REFERENCES:

1. Clough R.W, and Penzien J, Dynamics of Structures, Second Edition, McGraw-Hill International Edition, 1993.
2. Mario Paz, Structural Dynamics – Theory and Computations, Third Edition, CBS publishers, 1990.
3. Anderson R.A., Fundamentals of Vibration, Amerind Publishing Co., Pvt. Ltd 1972.
4. Baziar, M. H. and Dobry, R., Liquefaction Ground Deformation Predicted from Laboratory Tests, Proceedings of Second International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, St. Louis, MO. 1991.
5. Revathy J and Gajalakshmi P, Manual for Earthquake Engineering Laboratory 2013.
6. ANSYS Help Menu

OUTCOMES:

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

- understand and appreciate the behaviour of structures subjected to harmonic and periodic motion.
- analyse the structures using finite element software.

CEB 6216	STRUCTURAL DESIGN PROJECT	L	T	P	C
		0	0	4	2

GENERAL GUIDELINES

- The design project aims to provide a platform for students to exhibit their technical skills related to design / fabrication.
- The design/fabrication project allows students to generalize, apply and synthesize the concepts learned over the duration of the course.
- This approach encourages students to work as a team and “learn by doing”, thereby develop the problem-solving skills which is fundamental to industry practice in the field of structural engineering.
- Students, working in groups of four, must identify the design / fabrication project, narrow down the theme, identify the related activities, minute scheduling of activities with completion time, procurement of materials / equipments / collection of design details; and orderly execution to achieve the desired objective.
- The faculty act as facilitator in helping students to acquire the technical knowledge and basic proficiency needed to perform different scheduled activities which comprise the design/ fabrication work.

SEMESTER - III

		L	T	P	C
CEB 7122	**FINANCIAL ACCOUNTING AND MANAGEMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To provide conceptual knowledge on Accounting
- To prepare Financial Statement like Trading Account, P & L Account, Balance Sheet, and Fund flow & Cash flow statements with specific reference to construction industry
- To understand the Financial Statement s & Analyse the same
- To prepare certain functional budgets
- To apply marginal costing technique for managerial decision making

MODULE I INTRODUCTION TO ACCOUNTING **4**

Introduction to Accounting - Meaning of Accounting, Branches of accounting, Objectives of accounting -fundamental concepts-Principles and rules of accounting.

MODULE II FINANCIAL ACCOUNTING **12**

Basic accounting cycles -Journal, ledger and trial balance – preparation of trading account, profit and loss account, balance sheet – Ratio analysis.

MODULE III CASH FLOW AND FUND FLOW **8**

Cash flow statement, Meaning and concepts of fund flow & cash flow, Difference between fund flow statement and income statement. Preparation Fund Flow & Cash flow Statement.

MODULE IV BUDGETS **9**

Types of budgets-Techniques for Budgeting, preparation of Cash Budget and flexible budget.

MODULE V COST ACCOUNTING **12**

Cost - Meaning and objective, Elements of cost - Marginal Costing - Cost-Volume Profit Analysis- Breakeven point. Application of Marginal costing techniques to managerial decision making.

Total Hours: 45

REFERENCES

1. Maheswari S. N., Suneel K Maheswari and Sharad K Maheswari, “A Text Book of Accounting for management”, Vikas publishing house pvt. Ltd., Noida, 2013
2. Shashi K Gupta and Sharma R K, “ Management Accounting – Principles and practice”, Kalyani publishers, Ludiana, 2013
3. Reddy T S and Murthy A, “Financial Accounting” Margham Pucblications, 2012
4. S.P. JainJain and K.L. Narang, “Cost Accounting Principles and Practice” Kalyani publishers, 2012

OUTCOMES

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

- Ascertain profitability of construction company
- Depict the financial position of construction company
- Prepare Cash Budget and flexible budget
- Take managerial decisions by applying Marginal costing techniques

LIST OF ELECTIVES

CEBY01 ADVANCED CONCRETE TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To impart sufficient knowledge to students about properties of various concrete constituent materials, various methods of mix design, fresh and hardened properties of concrete.
- To expose the students to the application oriented special concretes, manufacturing methods and special concreting techniques.

MODULE I CONCRETE CONSTITUENT MATERIALS 9

Cement – Grades and types as per IS and ASTM Classification – Testing of cement for quality assurance – Chemical compounds - Hydrated structure – Special cements. Coarse aggregates – Properties, classification and IS requirement. Fine aggregate – Properties, classification and IS provisions – Manufactured sand as fine aggregate. Water – Quality and IS requirement. Mineral admixtures and chemical admixtures for concrete.

MODULE II CONCRETE MIX DESIGN 9

Principles of concrete mix design. Methods of concrete mix design – Indian standard – ACI - Mix design for High strength and High performance concrete – Ready mix concrete. Quality control and quality assurance of concrete - Acceptance criteria - Inspection and testing of concrete.

MODULE III PROPERTIES OF CONCRETE 9

Properties of fresh concrete – Workability. Hardened concrete properties – Strength – Modulus of elasticity – Creep – Shrinkage. Durability properties – Permeability – Water absorption – corrosion resistance – chemical attack – freeze and thaw.

MODULE IV SPECIAL CONCRETE 9

High strength and High performance concrete – Fibre reinforced concrete – Heavy density concrete – Polymer concrete composites – Self compacting concrete - Light weight concrete – Hot weather concrete – Cold weather concrete – Underwater concrete - Super plasticized concrete – Mass concrete

– Chemical resistant concrete – Ferro cement – High volume fly ash concrete – Reactive powder concrete.

MODULE V CONCRETING METHODS 6

Concrete - Manufacturing process – transportation - placing and curing. Extreme weather concreting. Special concreting methods - Vacuum dewatering - underwater concrete - special form work.

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.

OUTCOMES:

On completion of these modules, students will

- have the ability to understand the various properties of materials used for concrete.
- have the knowledge of various test procedures involved in fresh and hardened concrete.
- have the knowledge of special concrete and their concreting methods used in construction industry.

CEBY02	BEHAVIOUR AND DESIGN OF MASONRY STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide basic knowledge on the various materials used for masonry construction.
- To develop knowledge on the design of masonry elements by strength and allowable stress approaches and movements in masonry structures.

MODULE I LOAD BEARING MASONRY BUILDINGS 9

Advantages and development of load bearing masonry- basic design considerations- Structural safety: limit state design- Foundations - Structural Behavior of Low-Rise, bearing wall buildings- Structural Design of low-rise, masonry Buildings- basic structural configuration.

MODULE II MATERIALS FOR MASONRY CONSTRUCTION 9

Basic Components of Masonry - Masonry Mortar-Masonry Grout-Properties of Fresh and hardened Grout - ASTM Specifications for Masonry Units - Materials, Manufacturing, Characteristics, Visual and Serviceability Characteristics of Clay Masonry Units and Concrete Masonry Units. Characteristics of masonry assemblages-Masonry Accessory Materials - Water penetration resistance of masonry.

MODULE III STRENGTH DESIGN OF MASONRY ELEMENTS 9

Strength Design of Unreinforced and reinforced Panel walls, beams, lintels, curtain walls Bearing walls, anchor bolts, details for bearing walls and shear walls.

MODULE IV STRESS DESIGN OF MASONRY ELEMENTS 9

Allowable stress design and comparison of allowable stress & strength approach of unreinforced and reinforced panel walls, bearing walls, shear walls, anchor bolts and required details for bearing and shear walls.

MODULE V MOVEMENTS IN MASONRY BUILDINGS 9

General – causes of movement in buildings – moisture, temperature

movements, strains resulting from applied load, foundation movements – horizontal and vertical movements in masonry walls.

Total Hours : 45

REFERENCES:

1. Hendry, A.W., Sinha, B.P. , Davies, S.R., Design of Masonry Structures, Taylor & Francis, 2004.
2. Robert G. Drysdale, Ahmad A. Hamid, Lawrie R. Baker, Masonry Structures: Behavior and Design, Masonry Society, 1999.
3. Richard Klingner, Masonry Structural Design, McGraw Hill Professional, 2010.
4. Christine Beall, Masonry Design and Detailing 6/E, McGraw Hill Professional, 2012.

OUTCOMES:

On successful completion of this course, students will

- have the ability to understand the type of materials used for masonry construction.
- be able to design the masonry structures through strength and stress approaches.

CEBY03	CADD FOR STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I COMPUTER GRAPHICS 9

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 9

Computer methods of structural analysis - Finite Element programming - Analysis through application packages.

MODULE III STRUCTURAL DESIGN 9

Computer aided design of steel and RC Structural elements - Detailed drawing - Bill of materials.

MODULE IV OPTIMIZATION 9

Linear programming - Simplex algorithm - Post-optimality analysis - Project scheduling - CPM and PERT applications - Genetic algorithm and applications.

MODULE V EXPERT SYSTEMS 9

Introduction - Heuristic search - knowledge based expert systems - Architecture and applications of KBES - Expert system shells - Principles of neural network.

Total Hours : 45

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. Billy E. Gillet, Introduction to Operations Research, A computer oriented algorithmic approach, Tata McGraw-Hill, 1982.
5. Richard Forsyth (Ed.), Expert System Principles and Case studies, Chapman & Hall, 1989.

OUTCOMES:

At the end of course students will

- Be able to draft the modeling of curves and surfaces.
- Be able to perform simple structural analysis through application packages.
- Have the ability to design of steel and RC structural elements using relevant software packages.

CEBY04 CHEMISTRY OF CEMENT AND CONCRETE L T P C

3 0 0 3

OBJECTIVES:

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

MODULE I HYDRATION, SETTING AND HARDENING OF PORTLAND CEMENT 9

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

MODULE II PHYSIOCHEMICAL AND MECHANICAL PROPERTIES OF CONCRETE 9

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

MODULE III RESISTANCE OF CONCRETE TO DESTRUCTIVE AGENCIES 9

Action of frost – causes, influencing factors and assessment. Thermal expansion and durability of concrete. Resistance to fire. Electrolysis of concrete.

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

MODULE IV EFFECT OF MINERAL ADMIXTURES IN CONCRETE 9

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

MODULE V EFFECT OF CHEMICAL ADMIXTURES IN CONCRETE 9

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

Total Hours : 45

REFERENCES:

1. Peter C. Hewlett, Lea's Chemistry of Cement and Concrete, Elsevier Butterworth Heinemann Publications, U.K., 2006.
2. Nayak, N.V., and. Jain, A.K, Handbook on Advanced Concrete Technology Narosa Publishing Pvt. Ltd., New Delhi, 2012.
3. John P. Broomfield, Corrosion of Steel in Concrete – Understanding, Investigation and Repair, E & FN Spon publishers, Chennai, 1997.
4. Ramachandran, V.S., Concrete Admixtures Handbook – Properties, Science, and Technology (Second Edition), Noyes Publications, USA, 1995.
5. Ramachandran, V.S. and James J. Beaudoin, Handbook of Analytical Techniques in Concrete Science and Technology- Principles, Techniques and Applications, Noyes Publications, USA, 2001.

6. Rixom, M.R. and Noel P. Mailvaganam, Chemical Admixtures for Concrete, E & FN Spon Publishers, USA, 1999.

7. BIS 1489 (Part-I) – 1991, Portland – Pozzolana Cement – Specification, Bureau of Indian Standards, New Delhi.

8. BIS 4031 (Part 1-6) : 1996, Method of Physical Tests for Hydraulic Cement, Bureau of Indian Standards, New Delhi.

9. BIS 8112 – 1989, 43 Grade Ordinary Portland Cement – Specification, Bureau of Indian Standars, New Delhi.

10. BIS 12269 – 1987, Specification for 53 Grade Ordinary Portland Cement, Bureau of Indian Standards, New Delhi.

OUTCOMES:

At the end of course work, the students will be

- able to understand the interior chemistry of cement and concrete in terms of hydration, setting, hardening, physiochemical and mechanical properties of Portland cement.
- able to appreciate the significance of adding mineral and chemical admixtures in concrete and resistance of concrete to destructive agencies.

CEBY05 COMPOSITE MATERIALS L T P C

3 0 0 3

OBJECTIVES:

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

MODULE I CLASSIFICATION AND CHARACTERISTICS OF COMPOSITE MATERIALS 9

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

MODULE II BASIC CONCEPTS 9

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

MODULE III ANALYSIS OF LAMINATED COMPOSITES 9

Governing equations for anisotropic and orthotropic plates – Angle-ply and cross-ply laminates – Static, dynamic and stability analysis for simpler cases of composite plates – Interlaminar stresses.

MODULE IV FAILURE THEORY 9

Netting analysis – Failure criteria – Sandwich construction.

MODULE V MANUFACTURING AND FABRICATION PROCESSES 9

Manufacturing of glass – Boron and carbon fibres – Open mould and closed mould processes.

Total Hours : 45

REFERENCES:

1. Jones R.M., Mechanics of composite materials, McGraw-Hill, Kogakusha Ltd., Tokyo, 1975.

2. Lubin G, Handbook on Fibre glass and advanced plastic composites, Van Nostrand Co., New York, 1989.

3. Agarwal B.D and L.J.Broutman, Analysis and performance of fiber composites, John-wiley and sons, 1980.

4. Calcote L.R, Analysis of limited structures, Van Nostrand Reinhold Co., 1989.

OUTCOMES:

On successful completion of these modules, students will

- be able to classify the composite materials and their use in structures.
- have the knowledge to analyse, manufacture and fabricate the composite materials.

CEBY06 CORROSION OF STEEL IN CONCRETE L T P C

3 0 0 3

OBJECTIVES:

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

MODULE I CORROSION MECHANISM 9

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

MODULE II CORROSION CONTROL IN REINFORCED CEMENT CONCRETE 9

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

MODULE III CONDITION EVALUATION AND CORROSION RATE MEASUREMENT 9

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

MODULE IV REHABILITATION TECHNIQUES 9

Physical and chemical rehabilitation techniques - concrete removal and surface preparation - patches - coatings and sealers - membranes and barriers - encasement and overlays - sprayed concrete - corrosion inhibitors.

Electrochemical repair techniques – basic principles – cathodic protection - chloride removal and realkalization.

MODULE V CODAL REQUIREMENTS FOR DURABILITY 9

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

Total Hours : 45

REFERENCES:

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

OUTCOMES:

At the end of course work, the students will

- obtain appreciable knowledge about corrosion mechanism, its causes and consequences.
- be familiar with various corrosion control measures available worldwide.
- have knowledge on corrosion rate measurement in distressed structures.
- be able to suggest rehabilitation techniques in line with codal provisions.

CEBY07 DESIGN OF BRIDGES L T P C

3 0 0 3

OBJECTIVES:

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

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 9

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

MODULE III PRESTRESSED CONCRETE BRIDGES 8

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 8

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

MODULE V BEARINGS, SUBSTRUCTURE AND FOUNDATION FOR BRIDGES 8

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

OUTCOMES:

At the end of course work, students will

- have sufficient knowledge on classification of bridges, investigation procedures and IRC specifications.
- be able to design short span bridges, T-Beam and slab bridges, prestressed concrete bridges and plate girder bridges using codal provisions.
- have knowledge on design principles of continuous, box girder and balanced cantilever bridges, types of bearings and sub structures.

CEBY08 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the behaviour of composite beams, columns and connections.
- To expose to the behaviour and design concepts of composite box girder bridges and composite trusses.
- To expose to the case studies on steel concrete composite construction in buildings.

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

Introduction to steel-concrete composite construction - Theory of composite structures - Introduction to steel-concrete - Steel sandwich construction.

MODULE II DESIGN OF COMPOSITE MEMBERS **9**

Behaviour of composite beams - Columns - Design of composite beams - Steel - Concrete composite columns - Design of composite trusses.

MODULE III DESIGN OF CONNECTIONS **9**

Types of connections - Design of connections in the composite structures - Shear connections - Design of connections in composite trusses.

MODULE IV COMPOSITE BOX GRIDER BRIDGES **9**

Introduction - Behaviour of box girder bridges - Design concepts.

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

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

Total Hours : 45

REFERENCES:

1. Johnson R.P., Composite Structures of Steel and Concrete, Blackwell Scientific Publications (Second Edition), UK, 1994.

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,.

OUTCOMES:

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

- design the composite beams and columns and connections in composite structures.
- design composite box girder bridges.
- identify the problems involved in composite construction in buildings.

CEBY09 DESIGN OF STRUCTURES FOR DYNAMIC LOADS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the dynamic loads on structures.
- To impart knowledge on design concepts against earthquake, wind and blast as per codal provisions.
- To provide in-depth knowledge on the ductility based design for tall buildings, stacks and chimneys.

MODULE I DYNAMICS OF STRUCTURES **9**

Factors affecting design against dynamic loads - Behaviour of concrete, steel, masonry and soil under impact and cyclic loads - Recap of Structural dynamics with reference to SDOF, MDOF and continuum systems - Ductility and its importance.

MODULE II DESIGN AGAINST EARTHQUAKES **9**

Earthquake characterisation - Response spectra - seismic coeffcient and response spectra methods of estimating loads - Response of framed, braced frames and shear wall buildings - Design as per BIS codes of practice - Ductility based design.

MODULE III DESIGN AGAINST BLAST AND IMPACT **9**

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.

MODULE IV DESIGN AGAINST WIND **9**

Characteristics of wind - Basic and Design wind speeds - Effect of premeability of the structure – pressure coefficient - Aeroelastic and Aerodynamic effects - Design as per BIS code of practice including Gust Factor approach - tall buildings, stacks and chimneys.

MODULE V DUCTILITY DESIGN APPROACHES 9

Energy absorption capacity – Ductility of the material and response on the structure – Detailing for ductility – Passive and active control of vibrations.

Total Hours : 45

REFERENCES:

1. Clarence W. de Silva, Vibration Monitoring, Testing, and Instrumentation, CRC Press, 2010.
2. Bela Goschy, Design of Building to withstand Abnormal Loading, Butterworths, 1990.
3. Paulay, T. and Priestly, M.N.J., A Seismic Design of Reinforced Concrete and Masonry building, John Wiley and Sons, 1991.
4. Dowling, C.H., Blast vibration - Monitoring and Control, Prentice Hall Inc., Englewood Cliffs, 1985.
5. Kolousek, V, Wind effects on Civil Engineering Structures, Elsevier, 1984.
6. Concrete Structures under Impact and Impulsive Loading, Synthesis Report CEB, Lousanne, Germany, 1988

OUTCOMES:

At the end of the course, students will

- have the capability to design the structures against earthquake, wind and blast loads using BIS codes of practice.
- be able to perform the ductility based designing of structures using the concepts of new and favourable materials.

CEBY10 DISASTER MITIGATION AND MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce various environmental hazards and disasters.
- To provide knowledge to understand various concepts and principles to manage disaster and to reduce disaster.
- To expose to the various environmental policies and programs in India for disaster management.

MODULE I INTRODUCTION **9**

Environmental hazards, Environmental Disasters and Environmental stress-Meaning and concepts. Vulnerability and disaster preparedness.

MODULE II NATURAL AND MANMADE HAZARDS **9**

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire. Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion.

MODULE III DISASTER MANAGEMENT **9**

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

MODULE IV NATURAL DISASTER REDUCTION & MANAGEMENT **9**

Provision of Immediate relief measures to disaster affected people, Prediction of Hazards & Disasters, Measures of adjustment to natural hazards.

MODULE V ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA **9**

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural

development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

Total Hours : 45

REFERENCES:

1. Satender, Disaster Management in Hills, Concept Publishing Co.,New Delhi, 2003.
2. Singh R.B (Ed), Environmental Geography, Heritage Publishers New Delhi, 1990.
3. Savinder Singh, Environmental Geography, Prayag Pustak Bhawan, 1997.
4. Kates,B.I & White, G.F., The Environment as Hazards, Oxford, New York, 1978.
5. Gupta H.K. (Ed), Disaster Management, University Press, India, 2003.
6. Singh R.B., Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.
7. Bhandani R.K., An overview on Natural & Manmade Disaster & their Reduction, CSIR, New Delhi.
8. Gupta M.C., Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001.

OUTCOMES:

At the end of this course, students will

- achieve knowledge on the types of hazards and disasters, disaster prevention strategy, early warning system, disaster mitigation and preparedness.
- have the capacity to participate in the socio-economical response of human resource development and relate to risk transfer.

CEBY11	EARTHQUAKE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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 9

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 9

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 9

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 9

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

MODULE V SEISMIC RETROFITTING OF STRUCTURES 9

Base isolation – Seismic dampers – Retrofitting and strengthening of structural members – Response of Buildings – Case study.

Total Hours : 45

REFERENCES:

1. Duggal S.K., Earthquake Resistant Design of Structures. Oxford university press, New Delhi.
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. Guidelines for Improving Earthquake Resistance of Housing, Building Materials and Technology Promotion Council, Ministry of Urban Development and Poverty Alleviation, Department of Urban Employment and Poverty Alleviation, Government of India, New Delhi, 1999 – 2000

OUTCOMES:

At the end of this course, students will

- have the capacity to apply the basic principles of structural dynamics, various theories of earthquake and its effects on the structure.
- be able to design and detailing the structures for ductility.
- be able to relate on the important aspects of seismic damage evaluation and their retrofitting techniques.

CEBY12 FATIGUE & FRACTURE OF STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To educate the students to recognize and analyse the fatigue and damage tolerance problems in structures.
- To provide in-depth knowledge on the stress distribution and energy theories related to fatigue load.

MODULE I INTRODUCTION TO FATIGUE 9

Loads – Cyclic loads – High cycle fatigue – Low cycle fatigue; Stress-life Approach: S-N curve – Size effect – Loading effect – Surface , plating, thermal and mechanical –Temperature – Environment.

MODULE II STRAIN-LIFE APPROACH 9

Introduction – Material behaviour – Monotonic stress-strain behaviour, Basic definition – True and engineering stress-strain relationship, Cyclic stress-strain behaviour, Cyclic strain hardening and softening, Cyclic stress-strain curve determination, Stress-strain power law relation.

MODULE III FATIGUE LIFE CALCULATION 9

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

MODULE IV STRESS DISTRIBUTION & ENERGY THEORIES 9

Stress distribution at discontinuities – Stress concentration factors – Cracks Linear Elastic Fracture Mechanics, Stress intensity factor – monotonic and cyclic loads -Fracture toughness – Energy theories – J-integral; Crack Growth Studies: Fatigue 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 9

Fracture mechanics approach for concrete – Limitations – Non-linear fracture models with tension softening – Fracture energy – size effect – Remaining life prediction – Residual strength evaluation.

Total Hours : 45

REFERENCES:

1. ACI 215R-74, Considerations for Design of Concrete Structures Subjected to Fatigue Loading, ACI Committee.
2. Rahul Bhartiya, Fatigue Analysis of Concrete Structures: Introduction to Fatigue of Concrete, VDM Publishing, Technology & Engineering, 2010.
3. Surendra P. Shah, Fatigue of Concrete Structures, American Concrete Institute, American Concrete Institute, Technology & Engineering,1982.

OUTCOMES:

On successful completion of these modules, students will

- have the capability to apply sufficient engineering knowledge and skills to analyse fatigue and damage tolerance problems in structures.
- have the knowledge on various theories and fracture models related to fatigue response of structures.

CEBY13 FRP COMPOSITES FOR RC STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

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

MODULE I FRP COMPOSITES 9

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

MODULE II BOND BEHAVIOUR BETWEEN FRP AND CONCRETE 9

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

MODULE III SHEAR STRENGTHENING 9

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

MODULE IV FLEXURAL STRENGTHENING OF BEAMS & SLABS 9

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

MODULE V STRENGTHENING OF COLUMNS 9

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

Total Hours : 45

REFERENCES:

1. Chen,J.F., Smitth S.T, FRP-strengthened RC structure, Wiley, Technology & Engineering, 2002.
2. Hota V.S. GangaRao, Narendra Taly,. Vijay P. V, Reinforced Concrete Design with FRP composites, CRC Press, 2006.
3. Leonard C. Hollaway, Michael B. Leeming, Strengthening of Reinforced Concrete Structures: Using Externally-bonded FRP Composites in Structural and Civil Engineering, CRC Woodhead Publishing, 1999.
4. Lawrence C. Bank, Composites for Construction: Structural Design with FRP Materials, John Wiley & Sons, 2006.
5. Perumalsamy Balaguru, Antonio Nanni, James Giancaspro FRP Composites for Reinforced and Prestressed Concrete Structures: A Guide to Fundamentals and Design for Repair and Retrofit, Taylor & Francis US, 2008.

OUTCOMES:

On completion of these modules, students will

- be able to demonstrate the principles of repairing and strengthening various structures.
- have the capability to propose, select, analyse and design appropriate strengthening schemes.
- have the knowledge to understand the state-of-the-art of a specific strengthening related topics, including the method, mechanics, advantages and disadvantages, potential applications and future research.

CEBY14 INDUSTRIAL STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

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

MODULE I GENERAL 9

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

MODULE II FUNCTIONAL REQUIREMENTS 9

Lighting – Illumination levels – Characteristics of Good lighting – Principles of day lighting design – Artificial lighting – Ventilation – Natural and Mechanical Ventilation – Evaporate cooling design – Measurement – Contaminant control – Installation and Operation - Acoustics – Fire safety – Guidelines from factories act.

MODULE III INDUSTRIAL BUILDINGS 9

Industrial building frames - Analysis of Industrial bents – Design of gable frames - Industrial Roofs - Crane girders - Machine foundations.

MODULE IV SPECIAL STRUCTURES 9

Design of corbels and nibs - Analysis and Design of bunkers and silos – Design of chimneys –– Design of cooling towers.

MODULE V POWER TRANSMISSION STRUCTURES 9

Tower configuration and bracings – Loads acting on towers – Analysis and Design of Lattice Towers – Transmission Line Towers – Tower foundations.

Total Hours : 45

REFERENCES:

1. SP 32: 1986, Handbook on Functional Requirements of Industrial buildings.
2. Manohar S.N., Tall Chimneys; Design and Construction, Tata McGraw Hill, 1985.
3. Santhakumar A.R. and Murthy S.S, Transmission Line Structures, McGraw-Hill, 1990.
4. Krishna Raju, Advanced Concrete Structures, McGraw Hill, New Delhi, 2000.
5. Ramchandra, Design of Steel Structures, Vol . I & II Standard Book House, New Delhi, 1996.
6. Dayaratnam P., Design of Steel Structures, Wheeler and Co., New Delhi, 1999.

OUTCOMES:

Upon successful completion of the course, students

- will be able to plan for general requirements of various industrial structures.
- have the knowledge to design the Steel and RCC structures widely used in industrial projects.
- have the ability to design the transmission tower structures.

CEBY15	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart 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 give exposure to rehabilitation of real time distressed structures through case studies.

MODULE I CAUSES FOR FAILURES 9

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 9

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 9

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 9

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 REHABILITATION OF STRUCTURES - CASE STUDIES 9

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.

OUTCOMES:

At the end of course work, the students will

- have sufficient knowledge on various causes of failures and detailed procedure for evaluating a distressed structure.
- be familiar with materials available for repair and techniques for rehabilitating structural elements.
- obtain field knowledge on rehabilitation of real time distressed structures through case studies.

CEBY16	MODERN EARTH BUILDINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on Modern Earth buildings and its design concepts.
- To introduce the properties & forms of earth materials.
- To familiarise the students with construction techniques for earth buildings.

MODULE I INTRODUCTION TO MODERN EARTH BUILDINGS 9

Overview of modern earth building – Hygrothermal behaviour and occupant comfort in modern earth building – Fabric insulation, thermal bridging and acoustics in modern earth buildings – Modern earth building codes, standards and normative development – Passive house design: a benchmark for thermal mass fabric.

MODULE II EARTH MATERIALS 9

Soil materials for earth construction: properties, classification and suitability testing – Alternative and recycled materials for earth construction – Soil mechanics and earthen construction – Strength and mechanical behavior.

MODULE III SOIL STABILIZATION AND EARTH CONSTRUCTION 9

Soil stabilisation and earth construction: materials, properties, and techniques– Integral admixtures and surface treatments for modern earth buildings – Weathering and durability of earthen materials and structures.

MODULE IV EARTH BUILDING TECHNOLOGIES AND EARTH CONSTRUCTION TECHNIQUES 9

History of earth building techniques – Stabilised soil blocks for structural masonry in earth construction – Modern rammed earth construction techniques – Pneumatically impacted stabilized earth (PISE) construction techniques – Conservation of historic earth buildings.

MODULE V MODERN EARTH STRUCTURAL ENGINEERING 9

Earth masonry structures: arches, vaults and domes – Structural steel elements within stabilised rammed earth (SRE) walling – Natural disasters and earth

buildings – resistant design and construction – Embankments and earthfill dams: construction materials and techniques.

Total Hours : 45

REFERENCES:

1. Matthew R. Hall, Rick Lindsay, Meror Krayenhoff Modern Earth Buildings: Materials, Engineering, Construction and Applications, Woodhead Publishing Limited, 2012.

2. Ronald Rael, Earth Architecture , Princeton Architectural Press, 2009

3. Laurence Keefe - Taylor & Francis, Earth Building: Methods And Materials, Repair And Conservation, 2005.

4 Earth construction handbook: The building material earth in modern architecture - Gernot Minke, Wit Press, 2000.

OUTCOMES:

At the end of the course students will

- have the ability to recognise the Modern Earth buildings and its design.
- be able to apply their skills on the properties & forms of earth materials and the construction techniques for earth buildings.

CEBY17 NATURAL BUILDING MATERIALS & TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To educate about the design & planning of natural buildings.
- To introduce the properties & requirements of classical & modern materials for natural buildings.
- To elucidate on the foundations, floors, roofs for natural buildings.

MODULE I DESIGNING AND PLANNING **9**

Design – Vitality – intuition – Healthy house – responsive design – combing natural materials for energy efficiency – R-Value comparison chart – designing with the Sun – siting a natural building - permaculture house – natural Insulation – Regenerative building – ecological approach.

MODULE II CLASSICAL MATERIALS FOR NATURAL BUILDINGS **9**

Abode building – Bamboo construction – COB Building (Ancient & Modern) – Compressed Earth Blocks – Cordwood Masonry – Light-clay buildings (German technique) – Rammed Earth.

MODULE III ALTERNATIVE MATERIALS FOR NATURAL BUILDINGS **9**

Buildings with Earthbags – Earthships (Eccentric Model) – Mechanizing Straw-clay production buildings with hemp – Paper house (papercrete, Fibode) – straw bale buildings.

MODULE IV SPECIAL MATERIALS FOR NATURAL BUILDINGS **9**

Timber framing – Wattle & Daub – Aluminum can & Bottle homes – Can & bottle construction – cork – salvaged materials & components – wool carpet

MODULE V FOUNDATIONS, FLOORS AND ROOFS FOR NATURAL BUILDINGS **9**

Foundations for natural buildings – Rubble trench foundations – Earthen floors – tamped road base floor – Roof for natural Buildings – Green Roofs with sod, turf and straw – Thatchings – Earth Plasters & Aliz – working with lime – natural paints & finishes – Recycled materials & Waste or Agricultural materials.

Total Hours : 45

REFERENCES:

1. Joseph F. Kennedy, Catherine Wanek, Michael G. Smith, The Art of Natural Building: Design, Construction, Resources New Society Publishers, 2002.
2. Ianto Evans, Linda Smiley, Michael G. Smith, Michael Smith, The Hand-Sculpted House: A Philosophical and Practical Guide to Building a Cob Cottage Chelsea Green Publishing, 2002.
3. Matthew Stein, When Technology Fails: A Manual for Self-Reliance, Sustainability, and Surviving the Long Emergency Chelsea Green Publishing, 31-Aug-2008.
4. Joseph F. Kennedy, The Art of Natural Building: Design, Construction, Technology, NetWorks Productions, 1999.

OUTCOMES:

At the end of the course students will

- be able to design & plan the natural buildings.
- be able to apply their knowledge on the properties & requirements of classical & modern materials and the foundations, floors, roofs for natural buildings.

CEBY18 OPTIMIZATION IN STRUCTURAL DESIGN L T P C

3 0 0 3

OBJECTIVES:

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

MODULE I BASIC CONCEPTS IN OPTIMIZATION 9

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

MODULE II QUEUING THEORY 9

Queuing model, poisson and exponential distributions. Queues with combined arrivals and departures, random and series queues.

MODULE III OPTIMIZATION TECHNIQUES AND ALGORITHMS 9

Linear programming, Integer Programming, Quadratic Programming, Dynamic Programming and Geometric Programming methods for optimal design of structural elements.

MODULE IV COMPUTER SEARCH METHODS 9

Linear Programming methods for plastic design of frames, Computer search methods for univariate and multivariate minimization.

MODULE V OPTIMIZATION THEOREMS 9

Optimization by structural theorems, Maxwell, Mitchell and Heyman's Theorems for trusses and frames, fully stresses - design with deflection constraints, optimality criterion methods.

Total Hours : 45

REFERENCES:

1. Quang Liang, Q., Performance-based Optimization of Structures: Theory and Applications, Taylor & Francis, 2005.
2. Rao S.S., Optimisation – Theory and Applications, Wiley Eastern Ltd.,1984.
3. Ratan Prakash Agarwal, Ravi P. Agarwal, Recent Trends in Optimization theory and applications, World Scientific, 1995.
4. David G. Luerbeggan, Introduction to linear and non linear programming, Addition Wesley publishing Co., 1973.
5. Richard Bronson, Operation Research, Schaum's Outline Series, McGraw-Hill Book Co., Singapore, 1983.
6. Uri Krisch, Optimum Structural Design, McGraw-Hill Book Co., 1981.

OUTCOMES:

At the end of the course work, students will

- have the capability to apply the basic concept of optimization and classical methods.
- be able to understand the different parameters involved in various optimization techniques for the design of structural elements.

CEBY19 PLATES AND SHELLS L T P C

3 0 0 3

OBJECTIVES:

- To impart students with a rational basis on the analysis and design of reinforced concrete plate and shell members through advanced understanding of material and structural behaviour.
- To make the students understand the behaviour of reinforced concrete plate and shell elements at material level, element level and system level.

MODULE I THIN AND THICK PLATES 9

Plate equation and behaviour of thin plates in cartesian, polar coordinates; Isotropic and orthotropic plates, bending and twisting of plates.

MODULE II ANALYSIS & DESIGN OF PLATES 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 8

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

MODULE IV ANALYSIS OF SHELLS 8

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. Rudolph Szilard, Theory and Analysis of Plates; Classical and Numerical Methods, Prentice – Hall,1973.

7. Widra, G.E.O, Chung.H., D.Hui, Design and Analysis of Plates and Shells, Amer Society of Mechanical, 1986.

8. Philip L Gould, Analysis of Shells and Plates, Prentice Hall, 1998.

OUTCOMES:

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

- solve and apply classical solutions to determine plate and shell structural behaviour.
- exploit various modeling avenues for structural engineering components and obtaining exact and/or approximate solutions.

CEBY20	SOIL -STRUCTURE INTERACTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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 9

Introduction to soil-foundation interaction problems – Soil behaviour, Foundation behaviour, Interface behaviour-Scope of soil foundation interaction analysis-Soil response models-Winkler, Elastic continuum, two parameter elastic models - Elastic plastic behaviour-Time dependent behaviour.

MODULE II BEAM ON ELASTIC FOUNDATION- SOIL MODELS 9

Infinite beam, two parameters, Isotropic elastic half-space - Analysis of beams of finite length - Classification of finite beams in relation to their stiffness.

MODULE III PLATE ON ELASTIC MEDIUM 9

Infinite plate, Winkler, Two parameters - Isotropic elastic medium -Thin and thick plates - Analysis of finite plates - rectangular and circular plates -Numerical analysis of finite plates -Simple solutions.

MODULE IV ELASTIC ANALYSIS OF PILE 9

Elastic analysis of single pile-Theoretical solutions for settlement and load distributions - Analysis of pile group, Interaction analysis - Load distribution in groups with rigid cap.

MODULE V LATERALLY LOADED PILE 9

Load deflection prediction for laterally loaded piles - Sub grade reaction and elastic analysis - Interaction analysis - Pile raft system - Solutions through influence charts.

Total Hours : 45

REFERENCES:

1. 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.

OUTCOMES:

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

- understand the scope of soil foundation interaction analysis.
- perform elastic analysis of foundation and consider soil structure interaction in design.

CEBY21	STABILITY OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I STABILITY OF COLUMNS 9

Concepts of Elastic Structural stability- Analytical approaches to stability - characteristics of stability analysis- Elastic Buckling of columns- Equilibrium; Energy and Imperfection approaches – Non-prismatic columns- Built up columns- orthogonality of buckling modes- Effect of shear on buckling load - Large deflection theory.

MODULE II METHODS OF ANALYSIS AND IN ELASTIC BUCKLING 9

Approximate methods – Rayleigh and Galerkin methods – numerical methods – Finite difference and finite Element - analysis of columns – Experimental study of column behaviour – South well plot - Column curves - Derivation of Column design formula - Effective length of Columns - Inelastic behaviour- Tangent modulus and Double modulus Theory.

MODULE III BEAM COLUMNS AND FRAMES 9

Beam column behaviour- standard cases- Continuous columns and beam columns – Column on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Approximate evaluation of critical loads in multistoried frames – Use of Wood's charts.

MODULE IV BUCKLING OF BEAMS 9

Lateral buckling of beams – Energy method- Application to Symmetric and simply symmetric I beams – simply supported and Cantilever beams - Narrow rectangular cross sections- – Numerical solutions – Torsional buckling –

Uniform and non uniform Torsion on open cross section - Flexural torsional buckling – Equilibrium and energy approach.

MODULE V BUCKLING OF THIN PLATES 9

Isotropic rectangular plates - Governing Differential equations - Simply Supported on all edges – Use of Energy methods – Plates with stiffeners – Numerical Techniques.

Total Hours : 45

REFERENCES:

1. Ashwini Kumar, Stability of Structures, Allied Publishers Ltd, 1998.
2. NGR Iyengar, Structural Stability of Columns and Plates, Affiliated East- West Press Pvt. Ltd, 2007.
3. Stephen P. Timoshenko and Gere Theory of Elastic Stability, McGraw-Hill Company, 1961.
4. Allen, H.G and Bulson, P.S., Background to Buckling, McGraw-Hill Book Company,1980.
5. Gambhir, M.L, Stability Analysis and Design of Structures, Springer, 2004.
6. Chai H Yoo, Sung Lee, Stability of Structures - Principles and Applications, Elsevier, 2011.

OUTCOMES:

At the end of the course work, the students will

- have the capacity to apply the basic concepts of structural stability, various approaches to analysis stability of columns, analysis of inelastic buckling of columns; FEM approach.
- be able to develop stability analysis of various structural members and methods of analysis of buckling of thin plates.

CEBY22	TALL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I DESIGN CRITERIA & LOADING 9

General - Factors affecting growth, height and structural form - Design philosophy - Loading - Gravity loading - Wind loading - Earthquake loading - Combinations of loading - Strength and Stability - Stiffness and Drift limitations - Human comfort criteria- Creep effects - Shrinkage effects - Temperature effects - Fire - Foundation settlement - Soil-structure interaction.

MODULE II STRUCTURAL FORMS 9

Structural forms – braced frame, rigid frame, 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 9

Modeling for analysis - Assumptions - Modeling for approximate analyses - Modeling for accurate analysis - Reduction technique. Types, Behaviour and analysis methods of braced frames - Behaviour and analysis of Rigid frame structures - Behaviour, analysis & design of Infilled frame structures - Behaviour and analysis of Shear wall, Coupled shear wall and Wall-frame structures - Behaviour of Tubular structures, Core structures and Outrigger-braced structures.

MODULE IV STABILITY OF TALL BUILDINGS 9

Overall buckling analysis of frames (approximate methods) - Overall buckling analysis of wall frames - Second order effects of gravity loading - Translational - Torsional instability - Out-of-plumb effects - Effects of foundation rotation - Creep and Shrinkage effects - Temperature effects.

MODULE V DYNAMIC ANALYSIS 9

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, Delhi, 1996
5. Angus J MacDonald, Wind Loading on Buildings, Wiley,1975.
6. Lawson T V, Wind Effects on Buildings, Applied Science Publishers, 1980.
7. Alan Garnett Davenport, Wind Loads on Structures, National Research Council Canada, 1960.

OUTCOMES:

On successful completion of these modules, students will

- be able to apply the principles and procedures to design the tall structure.
- have the knowledge on the stability of tall structures and their response to wind and earthquake motions.

CEBY23 WIND AND CYCLONE EFFECTS ON STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I INTRODUCTION **9**

Spectral studies, Gust factor, Wind velocity, Methods of measurements, variation of speed with height, shape factor, aspect ratio, drag effects.

MODULE II WIND TUNNEL STUDIES **9**

Wind Tunnel Studies, Types of tunnels, Modeling requirements, Interpretation of results, Aero-elastic models.

MODULE III WIND EFFECT **9**

Wind on structures - Rigid structures, Flexible structures. Static and Dynamic effects - tall buildings, chimneys.

MODULE IV DESIGN PRINCIPLES **9**

Application to design, IS 875 code method, Buildings, Chimneys, Roofs, Shelters.

MODULE V CYCLONE EFFECTS **9**

Cyclone effect on structures, cladding design, window glass design.

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, 1984.
3. Peter Sachs, Wind Forces in Engineering, Pergamon Press, New York, 1972.

4. Lawson T.V., Wind Effects on Building Vol. I and II, Applied Science Publishers, London, 1980.

OUTCOMES:

On successful completion of this course, students

- will have the ability to analyse and model the structures for wind and cyclone effects.
- have the capability to design the structures for wind as per the codal provisions and gain sufficient knowledge on the principles of cyclone effects on structures.

CEBY24	BEHAVIOUR OF RC STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide students sound understanding on the behaviour, characteristics and design aspects of reinforced concrete with respect to flexure, shear and torsion.
- To impart students adequate knowledge on serviceability issues of reinforced concrete structures.

MODULE I MATERIAL PROPERTIES AND DESIGN CONCEPTS 9

Stress- strain relationships of concrete- compressive stress behaviour - tensile stress behaviour - combined stress behaviour - biaxial stress behaviour - triaxial compressive stress behaviour -creep and shrinkage of concrete - stress-strain relationships for steel - monotonic stress behaviour - repeated stress behaviour - reversed stress behaviour - design philosophies - strength and serviceability provisions.

MODULE II BEHAVIOUR OF CONCRETE IN FLEXURE 9

Concrete in uncracked phase-cracked phase - Stages leading to limit state of collapse - Analysis at service loads- Analysis at ultimate state - Moment-curvature relationships.

MODULE III BEHAVIOUR OF CONCRETE IN SHEAR 9

Mechanism of shear resistance with and without web reinforcement - Critical sections for shear - Interaction of flexure and shear - Interaction of flexure, shear and axial forces - Effects of repeated and cyclic loading on shear strength.

MODULE IV BEHAVIOUR OF CONCRETE IN TORSION 9

Equilibrium and compatibility torsion - Combined flexure and torsion - Combined shear and torsion - Torsional stiffness. Bond and anchorage - Mechanisms of bond resistance - Type of bond - Bond failure mechanisms - Anchorage requirements - Splicing of reinforcement.

MODULE V DEFLECTION AND CRACKING 9

Factors influencing deflection- Short-term deflection - Control of deflection - calculation of deflection-Long term deflection-Deflection due to temperature, creep and shrinkage - Limits on deflection -Causes of cracking-Factors influencing crack width in flexure - Mechanisms of flexural cracking - Control of flexural cracking in design.

Total Hours: 45

REFERENCES:

1. Robert Park and Thomas Paulay, Reinforced Concrete Structures, John Wiley & Sons, New York, 1975.
2. Unni krishna Pillai S. and Devdas Menon, Reinforced Concrete Design, Tata McGraw Hill, New Delhi, 1999.
3. Chu-Kia Wang and Charles G. Salmon, Reinforced Concrete Design", John Willey & Sons, New Delhi, 2002.
4. Allan Williams, Design of Reinforced Concrete Structures, 2nd Edition, Engineering Press, Austin, Texas, 2000.
5. James K. Wight, James G. MacGregor, Reinforced Concrete: Mechanics and Design, 6th Edition, Prentice Hall, New Delhi, 2011.

OUTCOMES:

On successful completion of the course, students will

- be able to employ basic principles of mechanics in the analysis and design of reinforced concrete structures.
- obtain proficiency in serviceability limit state methods pertaining to deflection and cracking.

CEBY 25	INSTRUMENTATION AND MODEL TESTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart basic knowledge on theory of structural models, elastic and inelastic models and its construction techniques.
- To give exposure to instrumentation techniques and its application in testing models.

MODULE I THEORY OF STRUCTURAL MODELS 9

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

MODULE II MATERIALS FOR ELASTIC AND INELASTIC MODELS 9

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

MODULE III MODEL FABRICATION TECHNIQUES 9

Basic cutting, shaping and machining operation - basic fastening and gluing techniques - Construction of structural steel models - Construction of concrete models - Fabrication of concrete masonry models - Construction of plastic models.

MODULE IV INSTRUMENTATION - PRINCIPLES AND APPLICATIONS 9

Quantities to be measured - Strain measurements - mechanical strain gauges, electrical strain gauges - Displacement measurements - mechanical dial gauges, Linear variable differential transformer, linear resistance potentiometers - Full field strain measurement and crack detection methods - brittle coating- photo elastic coating, other crack detection methods - Stress

and force Measurements - load cells, embedded stress meters and plugs - Data Acquisition and reduction - Types of data recording, various data acquisition systems - Fibre optic sensors for smart structures.

MODULE V STRUCTURAL MODEL TESTING FOR DYNAMIC LOADS 9

Types of loads - Discrete versus distributed loads - Materials for dynamic models -properties of steel and concrete - Loading systems for dynamic modeling - Vibration and resonant testing, wind tunnel testing, shock tubes and blast chambers, shaking tables, drop hammers and impact pendulums - Case studies - shake table tests on concrete and steel buildings.

Total Hours : 45

REFERENCES:

1. Harry, G. Harris and Gajanan M. Sabnis, Structural Modeling and Experimental Techniques, 2nd Edition,CRC Press, New York, 1999.
2. Havskov, J. and Gerardo Alguacil, Instrumentation in Earthquake Seismology, Springer, The Netherlands, 2010.
3. Agarwal, Pankaj and Shrikhande, Manish, Earthquake Resistant Design of Structures, PHI Learning Pvt. Ltd, Eastern Economy Edition, New Delhi, 2006.

OUTCOMES:

Upon successful completion of the modules, students

- will be able to understand the principles of structural models, behaviour of model materials and construction techniques.
- have the capability to fabricate models and conduct investigation using suitable instrumentation techniques for dynamic loading conditions.

CEBY26 ADVANCED HYDROLOGIC ANALYSIS AND DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce different hydrologic and hydraulic models and their applicability in hydrology.
- To provide knowledge on the prediction and forecasting of hydrologic data with different mathematical analysis.

MODULE I HYDROLOGIC AND HYDRAULIC MODELS **9**

Hydrologic investigation - systems approach - concept of a model. Classification of hydrological models, Chow-Kulandaiswamy model. Time-area methods - Unit Hydrograph - Instantaneous Unit Hydrograph. Synthetic Unit Hydrographs. Clark model, Nash model, Tank model.

MODULE II HYDROLOGIC SIMULATION AND STREAM FLOW SYNTHESIS **9**

Classification of Hydrologic Simulation Models. Single-Event Rainfall - Runoff Models. Continuous Simulation Models. Groundwater Flow Simulation Models. Stream flow Synthesis.

MODULE III HYDROLOGIC DESIGN **9**

Hydraulic Structure Design Methods - Risk Analysis - Design Storms and its synthesis. Design Flows. Urban Storm Drainage Design, Airport Drainage Design, Detention Storage Design.

MODULE IV RANDOM PROCESSES **9**

Classification - Stationary Random process - Components of time series - Trend Analysis - Regression - Multiple Linear Regression - Diagnostic tools.

MODULE V FORECASTING MODELS **9**

Box Jenkins' models - Correlation - Auto correlation - Partial auto correlation - Yule Walker equations - AR(p) - MA(q) - ARMA(p,q) - ARIMA (p,d,q) models - model formulation - Validation - Applications.

Total Hours : 45

REFERENCES:

1. Singh, V. P., Hydrologic Systems, Prentice-Hall Englewood Cliffs, New Jersey, 1989.

2. Jayarami Reddy P., Stochastic Hydrology, Laxmi Publications, New Delhi, 1995.

3. Viessman W Jr., Introduction to Hydrology, 5th Edition, Pearson Education Inc., New Delhi, 2003.

4 Haan C.T., Statistical Methods in Hydrology, 2nd Edition, Iowa State Press, United States of America, 2002.

OUTCOMES:

On completion of the course, the students will

- have the capability to identify and employ different models for various applications related to hydrology.
- have the potential knowledge on the prediction and forecasting of hydrologic data with different mathematical analysis.

CEBY27 MEMBRANE TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To impart appropriate knowledge on biological membranes and principles of membrane processes in water and waste water treatment; by engineering appropriate materials and systems.

MODULE I INTRODUCTION 9

Membranes-membrane process. membrane transport theory, solution-diffusion model, structure-permeability relationships. pore-flow membranes.

MODULE II TYPE OF MEMBRANES 9

Membranes and modules - isotropic membranes- anisotropic membranes - metal membranes and ceramic membranes - liquid membranes - hollow fibre membranes - membrane modules.

MODULE III PERVAPORATION 9

Liquid separation process - gas separation process - cross flow - co-flow and counter flow. Reverse osmosis: Theoretical background -membrane selectivity-module -fouling.

MODULE IV ULTRACENTRIFUGATION 9

Characterization of ultra filtration membranes - modules - System design. Micro filtration: Background and applications. Pervaporation membrane materials - process design. Ion exchange membrane: chemistry of ion-exchange membranes - transport in electro dialysism membrane-system design.

MODULE V PREPARATION OF MEMBRANES 9

Preparation of synthetic membranes - Preparation of phase inversion membranes - Preparation techniques for immersion precipitation - Preparation techniques for composite membranes - Influence of various parameters on membrane morphology - Preparation of inorganic membranes.

Total Hours : 45

REFERENCES:

1. Richard W.Baker, Membrane Technology and Applications, 2nd Edition, John Wiley & Sons, West Sussex, England, 2004.
2. Munir Cheryan, Ultrafiltration and Microfiltration - Hand Book, 2nd Edition, CRC Press, Florida, USA, 1998.
3. E.S. Perry, Progress in Separation and Purification, Vol. I, Inter Science Publishers, New York, 1971.
4. R. E. Kesting, Synthetic Polymeric Membranes - A Structural Perspective, 2nd Edition, Wiley-Interscience, England, 1985.
5. Wolf R.Vieth, Membrane Systems : Analysis and Design - Applications in Biotechnology, Biomedicine and Polymer Science, Wiley Interscience, England, 1994.

OUTCOMES:

At the end of the course, students

- will be able to suggest biological membranes for water and waste water treatment by understanding the principles of biological processes.
- will be able to appreciate the significance of engineering appropriate materials and systems for water and waste water treatment.

CEBY 28	REMOTE SENSING AND GIS FOR WATER RESOURCES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about the concepts of remote sensing, GIS analysis tools and techniques for application in water resources engineering.

MODULE I REMOTE SENSING **9**

Physics of remote sensing, Electromagnetic radiation (EMR), Interaction of EMR with atmosphere, earth surface, soil, water and vegetation. Remote sensing platforms - Monitoring atmosphere, land and water resources - LANDSAT, SPOT, ERS, IKONOS and others. Indian Space programme.

MODULE II DIGITAL IMAGE PROCESSING **9**

Satellite Data analysis - Visual interpretation - Digital image processing - Image pre-processing - Image enhancement - Image classification - Data Merging.

MODULE III GEOGRAPHIC INFORMATION SYSTEM **9**

Definition - Basic components of GIS - Map projections and co-ordinate system - Spatial data structure: raster, vector - Spatial Relationship - Topology - Geo database models: hierarchical, network, relational, object oriented models - Integrated GIS database - common sources of error - Data quality: Macro, micro and usage level components - Meta data - Spatial data transfer standards.

MODULE IV SPATIAL ANALYSIS **9**

Thematic mapping - Measurement in GIS: length, perimeter and areas - Query analysis - Reclassification - Buffering - Neighbourhood functions - Map overlay: vector and raster overlay - Interpolation - Network analysis - Digital elevation modeling. Analytical hierarchy process, - Object oriented GIS - AM/FM/GIS - Web Based GIS.

MODULE V WATER RESOURCES APPLICATIONS **9**

Spatial data sources - 4M GIS approach - Thematic maps - Rainfall-runoff modeling - Groundwater modeling - Water quality modeling - Flood inundation mapping and modeling - Drought monitoring - Cropping pattern change

analysis - Performance evaluation of irrigation commands. Site selection for artificial recharge - Reservoir sedimentation.

Total Hours : 45

REFERENCES:

1. Lillesand, T.M. and Kiefer, R.W., Remote Sensing and Image Interpretation, 3rd Edition. John Wiley and Sons, New York, 1993.
2. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems, Oxford University Press, New York, 1998.
3. Ian Heywood Sarah, Cornelius and Steve Carver, An Introduction to Geographical Information Systems, Pearson Education, New Delhi, 2002.

OUTCOMES:

On successful completion of the course work, students

- will have enough knowledge about the concepts of Remote sensing and GIS.
- will be able to analyse and model water resources related problems incorporating Remote sensing and GIS concepts.

CEBY 29	QUANTITATIVE TECHNIQUES FOR TRANSPORTATION ENGINEERING	L T P C 3 0 0 3

OBJECTIVES:

- To impart knowledge on various quantitative techniques employed in transportation engineering.
- To expose students to various statistical and analytical techniques for application in traffic and transportation engineering.

MODULE I SAMPLING AND SURVEY METHODS 9

Types of random sample - Central limit -Sampling distribution -Estimation of sample size -Sampling error- Design of survey questionnaire -Data collection -Data processing and analysis - Application in transportation Engineering.

MODULE II PROBABILITY DISTRIBUTIONS 9

Probability distributions - Discrete and continuous distribution - Binomial - Poisson - Normal - Exponential distributions - Application in Traffic Engineering - Grouping of data presentation.

MODULE III SIGNIFICANCE TESTING 9

Hypotheses of testing - Types of error- One tailed tow tailed test - Small sample and large sample test - Selection of significance level - Chi square test.

MODULE IV LINEAR REGRESSION MODELS 9

Simple and multiple linear regression - Coefficient correlation - Stepwise regression -Tests on significance of the regression -T and F tests - Basics and significance of non-linear regression analysis.

MODULE V NET WORK ANALYSIS 9

Network flow problems - Transportation problems - Maximal flow - Shortest route algorithm - Minimal spanning tree problem - Applications in transportation network planning.

Total Hours: 45

REFERENCES:

1. John W. Dickey and M. Watts, Analytic Techniques in Urban and Regional Planning, Mcgraw Hill,1978.
2. Ravindran, Phillips and Solberg, Operations Research - Principles and Practice, John Wiley and sons, New York, 2000.
3. William G. Cochran, Sampling Techniques, John Wiley Series in Probability and Mathematical Statics - Applied , New York, 1999.
4. Richard, I. Levin and David S. Rubin, Statics for Management, Prentice Hall Publication, New Delhi, 1997.
5. Kadiyali, L.R., Traffic Engineering and Transportation, Khanna Publishers, New Delhi, 2006.

OUTCOMES:

On completion of the course, students will be

- able to apply quantitative techniques for various applications in transportation engineering.
- able to employ statistical and analytical techniques in different applications of traffic and transportation engineering.

SSBY01 SOCIETY, TECHNOLOGY AND SUSTAINABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- Aware of new technologies through advances in Science and Engineering.
- To make them realise the profound impact on society.
- 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 **9**

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 **9**

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 **9**

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 9

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 9

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.