R G M COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
NANDYAL-518501, KURNOOL DIST., A.P., INDIA

DEPARTMENT OF
CIVIL ENGINEERING (CE)

STRUCTURAL ENGINEERING

(ESTD-1995)

M.TECH SYLLABUS 2019

Applicable for students admitted into
M.Tech (Regular) from 2019-20
REGULATIONS, Course Structure & Detailed Syllabus

ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABI
M.Tech. (Regular) from 2019-20

For pursuing Two year Master (post graduate) Degree of study in Engineering (M.Tech.), offered by Rajeev Gandhi Memorial College of Engineering and Technology, Nandyal - 518501 under Autonomous status and herein referred to as RGMCET (Autonomous).

All the rules specified herein approved by the Academic Council will be in force and applicable to students admitted from the Academic Year **2019-20** onwards. Any reference to "Institute" or "College" in these rules and regulations shall stand for Rajeev Gandhi Memorial College of Engineering and Technology (Autonomous).

All the rules and regulations, specified hereafter shall be read as a whole for the purpose of interpretation as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. As per the requirements of statutory bodies, the Principal, Rajeev Gandhi Memorial College of Engineering and Technology shall be the Chairman, Academic Council.

Academic Regulations 2019 for M.Tech. (Regular)

(Effective for the students admitted into first year from the Academic Year 2019-20)

The M.Tech Degree of Jawaharlal Nehru Technological University Anantapur, Ananthapuramu shall be conferred on candidates who are admitted to the M.Tech. Program at RGMCET, Nandyal and they shall fulfil all the requirements for the award of the Degree.

1.0 Eligibility for Admissions:

Admission to the above program shall be made subject to the eligibility, qualifications and specialization prescribed by Andhra Pradesh State Council of Higher Education (APSCHE) from time to time.
Admissions shall be made on the basis of merit rank obtained in GATE examination or PGCET conducted by any University of Andhra Pradesh designated by Govt. of A. P., or on the basis of any other order of merit prescribed by APSCHE, subject to the reservations prescribed by the Government of A. P. from time to time.

2.0 Award of M.Tech. Degree:

2.1 The student shall be declared eligible for the award of the M.Tech. degree, if he/she pursues a course of study and completes it successfully for not less than prescribed course work duration and not more than double the prescribed course work duration.

2.2 The student, who fails to fulfill all the academic requirements for the award of the degree within double the course work duration from the year of his admission, shall forfeit his seat in M.Tech. course.

2.3 The minimum clear instruction days for each semester shall be 95.

3.0 Courses of Study:

The following specializations are offered at present for the M.Tech. course of study.

1) Computer Science (CSE)
2) Embedded Systems (ECE)
3) Machine Design (Mechanical Engineering)
4) Power Electronics (EEE)
5) Structural Engineering (CE)

And any other course as approved by the appropriate authorities from time to time.

4.0 Course pattern:

4.1 The entire course of study is of four semesters. During the first and second semesters the student has to undergo course work and during the third and fourth semesters the student has to carry out project work.

4.2 The student shall be eligible to appear for the End Examination in a subject, but absent at it or has failed in the End Examination may appear for that subject at the supplementary examination.

COURSE STRUCTURE & DETAILED SYLLABUS

I – Semester

Subject Code	CAT Code	Subject	L	T	P	Contact hrs./wk.	Credits
D2001191	Core 1	Structural Dynamics	3			3	3
D2002191	Core 2	Theory of Elasticity	3			3	3
D2003191 D2004191 D2005191	Program specific elective	**Program specific elective-I** 1) Advanced Metal Structures 2) Engineering Mathematics 3) Low Cost Housing Techniques	3			3	3
D2006191 D2007191 D2008191	Program specific elective	**Program specific elective-II** 1) Analysis of Shells and Folded Plates 2) Stability of Structures 3) Bridge Engineering	3			3	3
D0001191	Subject	Research Methodology & IPR	3			3	3
D0002191	Audit Course	English for Research Paper Writing and Documentation (Audit Course)	3				
D2009191	Lab 1	Structural Design Lab-I			3	3	1.5
D2010191	Lab 2	Structural Engineering Lab-I			3	3	1.5
D2011191	CCE	Continuous Comprehensive Evaluation			4	2	2
Total			18		10	23	20

II – Semester

Subject Code	CAT Code	Subject	L	T	P	Contact hrs./wk	Credits
D2012192	Core 3	Finite Element Method in Structural Engineering	3			3	3
D2013192	Core 4	Advanced Concrete Technology	3			3	3
D2014192 D2015192 D2016192	Program specific elective	**Program specific elective-III** 1) Maintenance and Rehabilitation of Structures 2) Building Construction and Management 3) Earthquake and Wind Analysis of Structures	3			3	3
D2017192 D2018192 D2019192 D2020192	Program specific elective/ MOOCs	**Program specific elective/MOOCs-I** 1) Structural Optimization 2) Fracture Mechanics 3) Advanced Design of Foundations 4) Reliability of Structures	3			3	3
D0003192	Audit Course	Professional Ethics (Audit Course)	3				
D2021192	Lab 3	Structural Design Lab-II			3	3	1.5
D2022192	Lab 4	Structural Engineering Lab-II			3	3	1.5
D2023192	Mini Project	Mini Project			3	3	1.5
D2024192	CCE	Continuous Comprehensive Evaluation			4	4	2
Total			15		13	25	18.5

III – Semester

Subject Code	CAT Code	Subject	L	T	P	Contact hrs./wk.	Credits
D2025193 D2026193 D2027193	Program specific elective	**Program specific elective-IV** 1) Pre-stressed Concrete 2) Plastic Analysis and Design 3) Theory and Applications of Cement Composites	3			3	3
D2029193 D2030193 D2031193	Open Elective/ MOOCs	**Open Elective/MOOCs-II** 1) Disaster Management 2) Composite Materials 3) Structural Health Monitoring	3			3	3
D2032193	CCE	Continuous Comprehensive Evaluation			4	4	2
D2033193	Main Project	Main Project (Phase 1)			18	18	09
Total			6		22	28	17

Audit course 1 & 2

1) English for Research Paper Writing,
2) Disaster Management,
3) Sanskrit for Technical Knowledge
4) Value Education,
5) Constitution of India,
6) Pedagogy Studies,
7) Stress Management by Yoga
8) Personality Development through Life Enlightenment Skills.

IV – Semester

Subject Code	CAT Code	Subject	L	T	P	Contact hrs. /wk.	Credits
D2034194	Technical Seminar						1.5
D2035194	Main Project	Phase 2	0	0	26	26	13
Total:						26	14.5

Table 1: Credits

Subject	Semester			
	Periods /Week	Credits	Internal marks	External marks
Theory	03	03	40 (25 Internal Test + 15 Assignment)	60
Practical	03	1.5	40	60
Seminar		2	50	
Continuous Comprehensive Evaluation	04	02	40	60
Project Phase-1	18	09		
Project Phase-2	26	13		

Table2: Course pattern

Semester	No.of Subjects	Number of Labs	Total credits	
First	02-Subjects 02-Program Specific Electives 01-Research Methodology	 02 - Labs CCE	2x3=6 2x3=6 1x3=3 2x1.5=3 1x2=2	**20**
Second	02-Subjects 01-Program Specific Elective 01-MOOC/Elective	 02 – Labs Mini project CCE	2x3=6 1x3=3 1x3=3 2x1.5=3 1x1.5=1.5 1x2=2	**18.5**
Third	01Program Specific Elective 01 Open Elective	 Main Project Phase-1 CCE	1x3=3 1x3=3 1x9=9 1x2=2	**17**
Fourth		Technical Seminar Main Project Phase-2	1x1.5=1.5 1x13=13	**14.5**
			Total credits	**70**

5.0 Attendance:

5.1 The candidate shall be deemed to have eligibility to write end semester examinations, if he has secured a minimum of 75% of attendance in aggregate of all the subjects.

5.2 Condonation of shortage of attendance up to 10%, i. e. 65% and above and below 75% may be given by the College academic committee consisting of Principal, Head of the Department and a senior faculty member.

5.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.

5.4 **Shortage of attendance below 65% shall in no case be condoned.**

5.5 The candidate shall not be promoted to the next semester unless he fulfils the attendance requirements of the previous semester.

5.6 Attendance in each subject will be recorded in the marks memo.

5.7 **The attendance in each subject will be recorded in the Marks memo.**

6.0 Evaluation:

6.1 For theory subjects the distribution shall be 40 marks for Internal Evaluation (25 marks for Internal test and 15 marks for assignments/ field work) and 60 marks for the End-Examination.

6.2 Each Internal Test question paper shall contain 5 questions, of which the First question is compulsory and three questions are to be answered from the remaining four. Compulsory question carries 10 marks (It contains 5 short answer questions). The remaining 3 questions carry 5 marks each. Each question shall have a,b,c.... parts. The duration of internal test will be for 2 hours. First test to be conducted in 3 units in the middle of the semester and second test to be conducted in the remaining 3 units of each subject at end the semester. There shall be two assignments in each subject (problem based/ field work) for the award of 15 marks so that internal component (marks) will be 40 marks (25 marks for internal test+15 marks for assignments / field work). For awarding of 25 Internal marks the performance of the student in two internal examinations conducted will be considered by giving a weightage of 0.75 for the better score and 0.25 for the other score.

6.3 The End Examination question paper will have 7 questions and students have to answer 5 questions. However, the first question is compulsory and it consists of 6 short answer questions, each carrying 2 marks. The next 4 questions are to be answered from the remaining 6 questions and each carries 12 marks. Each 12 marks question shall have a, b, c . parts. For all PG (M.Tech, MBA and MCA) courses for all the subjects the valuation of answer scripts will be done by external Examiners form the other institute and as well as Internal Examiners of the institute who are teaching the subject. If the difference of marks in external and Internal evaluation is more than 15% of external marks, then the papers will be sent to third Examiner for valuation purpose. Then average of closely spaced marks will be considered as final marks in that subject. List of Examiners for external evaluation will be finalized by CE, with the approval of the principal.

6.4 Elective subjects will commence from 1st semester. Out of the electives offered in 2nd / 3rd semester, one elective will be MOOC / Electives offered by the department. Any student who is interested can opt for the MOOC/ Electives offered by the department and acquire the required credits. Even if the student opts MOOC, he has to write two internal tests besides the end examination conducted by the institute like other subjects. However, he has to obtain the certificate from the organization in which he has registered. Any MOOC selected by the student should be of more than 45 hours duration and also from the reputed organization. Attendance of the student who has opted for MOOC will be taken from the remaining subjects and labs only in that semester while finalizing the attendance for fulfilling the minimum requirements of attendance for promotion to next semester. Attendance will

not be recorded for MOOC. Where ever MOOC is opted by the student, the evaluation procedure will be similar to any subject offered by the department.

6.5 For practical subjects, 40 marks shall be for the End Semester Examinations and 60 marks will be for internal evaluation based on the day-to-day performance. Laboratory examination for M.Tech.. Course shall be conducted with two Examiners, one of them being Laboratory Class Teacher and second Examiner shall be outside from the institute (External examiner).

6.6 Student has to undergo a Continuous Comprehensive Evaluation pertaining to his specialization which carries 100 marks out of which 40 marks for internal and 60 marks for external examination in each semester. The internal marks shall be awarded based on performance of the student evaluated weekly by the departmental committee. He has to secure 50% marks to obtain required credits. Continuous Comprehensive Evaluation (CCE) end examination will be conducted at the end of 1st, 2nd and 3rd semester by the committee consisting of HOD, senior faculty member and external Examiner from outside the institute. For this, HOD of the Department shall submit a panel of 4 Examiners, who are eminent in that field. One from the panel will be selected by the principal of the institute as external Examiner for comprehensive viva.

6.7 For Technical Seminar 50 marks shall be for internal evaluation. The candidate has to secure a minimum of 25 marks to be declared successful. The assessment will be made by a board consisting of HOD and two internal experts at the end of 4th semester.

6.8 The candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Examination and Internal evaluation taken together. In case if there is no End Examination in subject/practical/seminar/CCE etc. student has to get minimum of 50% in the Internal Examination alone.

6.9 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.0), he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the course when next offered or do any other specified subject as may be required.

7.0 Re-registration for improvement of Internal marks:

Following are the conditions to avail the benefit of improvement of internal marks.

7.1 The candidate should have completed the course work and obtained examinations results for 1st, 2nd and 3rd semesters.

7.2 He should have passed all the subjects for which the internal marks secured are more than 50%.

7.3 Out of the subjects the candidate has failed in the examination due to Internal marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of three Theory subjects for Improvement of Internal marks.

7.4 The candidate has to re-register for the chosen subjects and fulfil the academic requirements as and when they are offered.

7.5 For each subject, the candidate has to pay a fee equivalent to one tenth of the semester tuition fee and the amount is to be remitted in the form of D. D. in favour of the Principal, RGMCET payable at RGMCET, Nandyal branch along with the requisition through the HOD of the respective Department.

7.6 In case of availing the Improvement of Internal marks, the internal marks as well as the End Examinations marks secured in the previous attempt (s) for the re-registered subjects stand cancelled.

8.0 Evaluation of Project / Dissertation work :

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Department.

8.1 Registration of Project work: The candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses.

8.2 An Internal Department Committee (I.D.C.) consisting of HOD, Supervisor and One Internal senior expert shall monitor the progress of the project work.

8.3 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

8.4 The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C. before submission of the Project Report.

8.5 The candidate shall be allowed to submit the thesis/dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva voce examination of the project. The viva - voce examination may be conducted once in two months for all the candidates submitted during that period.

8.6 Three copies of the Thesis/Dissertation certified in the prescribed form by the supervisor & HOD shall be submitted to the institute.

8.7 The Department shall submit a panel of 4 experts for a maximum of 4 students at a time. However, the thesis/dissertation will be adjudicated by the board consists of HOD, concerned supervisor and one external Examiner from other institute nominated by the principal from a panel of Examiners submitted by the Department HOD to the Controller of Examinations.

8.8 If the report of the board is favourable in viva voce examination, the board shall jointly report candidates work as:

1. Good
2. Satisfactory
3. Not satisfactory

If the report of the viva voce is not satisfactory the candidate will retake the viva voce examination after three months. If he fails to get a satisfactory report at the second viva voce examination he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit the thesis.

9.0 Award of Degree and Class:

After the student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following classes:

Table 3: Award of division/Class

Class Awarded	% of marks to be secured	Division/ Class	CGPA	
First Class with Distinction	70% and above	First Class With Distinction	≥ 7.5	CGPA obtained from the 48 Credits. (Excluding Project Phase-I and Phase-II credits)
First Class	Below 70% but not less than 60%	First Class	≥ 6.5 *and* < 7.5	
Second Class	Below 60% but not less than 50%	Second Class	≥ 5.5 *and* < 6.5	

10.0 ***Grading:***

After each subject is evaluated for 100 marks, the marks obtained in each subject will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student falls.

Table 4: Conversion into Grades and Grade points assigned

Range in which the % of marks in the subject fall	Grade	Grade point Assigned	Performance	Performance in Project work
90 to 100	O	10	Outstanding	Performance in project will be reported as i) Good ii) Satisfactory iii) Un Satisfactory. The credits obtained in Project will not be considered for the award of Class.
80 to 89.9	A+	09	Excellent	
70 to 79.9	A	08	Very good	
60 to 69.9	B+	07	good	
50 to 59.9	B	06	Pass	
<50	F	00	Fail	
Ab	AB	00	Fail	

10.1 Requirement for clearing any subject: The students have to obtain a minimum of 40% in End Examination and they have to score minimum of 50% marks from Internal and external exam marks put together to clear the subject. Otherwise they will be awarded fail grade.

10.2 F is considered as a fail grade indicating that the student has to reappear for the end supplementary examination in that subject and obtain a non-fail grade for clearing that subject.

10.3 To become eligible for the award of degree the student must obtain a minimum CGPA of 5.5.

11.0 Supplementary Examinations:

Apart from the regular End Examinations the institute may also schedule and conduct supplementary examinations for all subjects for the benefit of students with backlogs. Such students writing supplementary examinations as supplementary candidates may have to write more than one examination per day. The student is not permitted to improve his performance in any subject in which he has obtained pass grade.

12.0 ***Grade Point Average (GPA) and Cumulative Grade Point Average(CGPA)***

The Grade Point Average (GPA) for each semester and Cumulative Grade Point Average (CGPA) up to any semester are calculated as follows:

i) Semester Grade Point Average will be computed as follows:

$$GPA = \frac{\sum_1^n C_i \times GP_i}{\sum_1^n C_i}$$

Where, n is the number of subjects in that semester. C_i is Credits for the subjects. GP_i is the grade point obtained for the subject and the summation is over all the subjects in that semester.

ii) A Cumulative Grade Point Average (CGPA) will be computed for every student at the end of each semester. The CGPA would give the cumulative performance of The student from the first semester up to the end of the semester to which it refers and is calculated as follows

$$CGPA = \frac{\sum_1^m GPA_j \times TC_i}{\sum_1^m TC_j}$$

Where 'm' is the number of semester under consideration. TC_j the total number of credits for a j^{th} semester and GPA_j is the Grade Point Average of the j^{th} semester. Both GPA and CGPA will be rounded off to the second digit after decimal and recorded as such.

While computing the GPA / CGPA the subjects in which the student is awarded zero grade points will also be included.

13.0 Grade Sheet:

A grade sheet (Memorandum) will be issued to each student indicating his performance in all subjects of that semester in the form of grades and also indicating the GPA and CGPA.

14.0 Transcripts:

After successful completion of prerequisite credits for the award of degree a Transcript containing performance of all academic years will be issued as a final record. Duplicate transcripts will also be issued if required after the payment of requisite fee and also as per norms in vogue.

15.0 Minimum Instruction Days:

The minimum instruction days for each semester shall be 95 clear instruction days excluding the days allotted for tests/examinations and preparation holidays declared if any.

16.0 Amendment of Regulations:

The college may, from time to time, revise, amend or change the regulations, scheme of examinations and syllabi. However the academic regulations of any student will be same throughout the course of study in which the student has been admitted.

17.0 Transfers

There shall be no branch transfers after the completion of admission process.

18.0 Withholding of results:

If the candidate has not paid any dues to the institute or if any case of in-discipline is pending against him, the result of the candidate will be withheld and he will not be allowed for the next semester. The issue of the degree is liable to be withheld in such cases.

19.0 Transitory Regulations:

Candidates who have discontinued or have been detained for want of attendance are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 2.0 and 5.0.

20.0 Rules of Discipline:

20.1 Any attempt by any student to influence the teachers, Examiners, faculty and staff of Examination section for undue favours in the exams, and bribing them either for marks or attendance will be treated as malpractice cases and the student can be debarred from the college.

20.2 When the student absents himself, he is treated as to have appeared and obtained zero marks in that subject (s) and grading is done accordingly.

20.3 When the performance of the student in any subject (s) is cancelled as a punishment for indiscipline, he is awarded zero marks in that subject (s).

20.4 When the student's answer book is confiscated for any kind of attempted or suspected malpractice, the decision of the Chief Superintendent is final.

21.0 General:

21.1 The Academic Regulations should be read as a whole for the purpose of any interpretation.

21.2 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the College Academic Council is final.

21.3 The Institute may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Institute.

21.4 *Where the w*ords "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

I M.Tech, I-Sem (SE) T C
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STRUCTURAL DYNAMICS

Course Objectives: The main objective of this subject consists of an analysis of SDOF and MDOF; calculation of the linear response of SDOF and MDOF structures.

Pre-requisites: Design of Concrete Structures and Steel Structures.

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

CO1	Model and Formulate dynamic equilibrium equations for SDOF and MDOF systems.
CO2	Analyse SDOF and MDOF systems using classical and numerical methods.
CO3	Draw response of SDOF, MDOF systems and conduct modal analysis of MDOF systems.
CO4	Detail reinforcement for earthquake resistant RC buildings as per IS Code.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	2	-	-	-	-	-	-	-
CO3	-	1	2	-	-	-	-	-	-	-	-	-
CO4	1	-	2	-	-	2	-	-	-	-	-	-

UNIT I

Introduction to Structural Dynamics: Fundamental objective of Dynamic analysis – Types of prescribed loadings – methods of Discretization – Formulation of the Equations of Motion.

UNIT II

Theory of Vibrations: Introduction – Elements of a Vibratory system – Degrees of Freedom of continuous systems - Oscillatory motion – Simple Harmonic Motion – Free Vibrations of Single Degree of Freedom (SDOF) systems – Undamped and Damped – Critical damping – Logarithmic decrement – Forced vibrations of SDOF systems – Harmonic excitation – Dynamic magnification factor – Band width.

UNIT III

Single Degree of Freedom System: Formulation and Solution of the equation of Motion – Free vibration response – Response to Harmonic, Periodic, Impulsive and general dynamic loadings – Duhamel integral – Numerical evaluation of dynamic response, Central Difference Method, Newmark's Method – Concept of Response Spectrum – Construction of elastic design spectrum.

UNIT IV

Multi Degree of Freedom System: Formulation of the MDOF equations of motion - Undamped free vibrations - Evaluation of Structural Property Matrices - Solution of Eigen value problem for natural frequencies and mode shapes – Numerical evaluation of dynamic response for MDOF structures – Approximate methods for finding natural frequencies of MDOF structures

UNIT V

Continuous Systems: Introduction – Flexural vibrations of beams – Elementary case – Equation of motion – Analysis of undamped free vibration of beams in flexure – Natural frequencies and mode shapes of simple beams with different end conditions.

UNIT VI

Earthquake Dynamics of Base Isolated Buildings: Isolation systems – Base isolated one storey building – Effectiveness of base isolation – Base isolation for multi storied buildings – Applications of base isolation.

TEXT BOOKS

1) Anil K Chopra (2001), Structural Dynamics and Introduction to Earthquake Engineering, Pearson Publishers

REFERENCES

1) Clough and Penzien (2000), Dynamics of Structures, Computers and Structures Inc.
2) Pankaj Aggarwal and Manish Shrinkhande (2011), Earthquake Resistant Design of Structures, PHI Publishers

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THEORY OF ELASTICITY

Course Objectives: The main objective of this subject consists of the calculation of stresses and strains for 2D and 3D in cartesian and polar coordinates.

Pre-requisites: Strength of Materials

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

CO1	Understanding on calculation on stresses and strains
CO2	Calculation of stresses and strains for 2D and 3D using Cartesian and Polar coordinates
CO3	Understanding concepts of tensional behavior of prismatic bars

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	-	1	3	-	-	-	-	-	-	-	-	-
CO3	-	1	-	2	-	-	-	-	-	-	-	-

UNIT I

Introduction: Elasticity – Notation for forces and stresses – Components of stress – Components of strain – Hooke's law.

Plane Stress and Plane Strain Analysis: Differential equations of equilibrium - Plane stress-Plane strain – Equations of stress and strain relationships, strain and displacement relationships - Boundary conditions – Compatibility equations – Airy's Stress function

General Theorems: Conditions of compatibility – Principle of superposition – Reciprocal theorem

UNIT II

Two Dimensional Problems in Rectangular Coordinates: Solution by polynomials-Saint Venant's principle – Bending of simple beams with point load and uniform loads – Application of Fourier series for two dimensional problems – Gravity loading.

UNIT III

Two Dimensional Problems in Polar Coordinates : General Equation in polar co-ordinates – Stress distribution symmetrical about an axis – Pure bending of curved bars – Strain components in polar coordinates – Displacements for symmetrical stress distributions – Rotating disks – Bending of a curved bar

UNIT IV

Analysis of Stress and Strain in Three Dimensions: Introduction – Principal stresses – Stress ellipsoid and stress-director surface – Determination of the principal stresses – Determination of the maximum shearing stress – Homogeneous deformation – Strain at a point - Principal axes of a strain - Rotation

UNIT V

Strain Energy Methods: Total strain energy- complementary energy- principle of virtual work and total potential energy-Castigliano Theorems – Principle of least work and its applications to rectangular plates - Theorem of minimum potential energy and complementary energy, Shear lag

UNIT VI

Torsion of Prismatic Bars: Torsion of prismatic bars – Bars with elliptical cross section – Membrane Analogy- Torsion of rectangular bars – Torsion of hollow shafts – Torsion of thin tubes.

Bending of a prismatical bars: Bending of a cantilever – circular, elliptical, rectangular, nonsymmetric cross sections – shear center

TEXT BOOKS

1) Timoshenko and Goodier (1961), Theory of Elasticity, Tata McGrawHill Publishers

REFERENCES

1) Sadhu Singh (1978), Theory of Elasticity, Khanna Publishers
2) Arthur P Boresi, and Richard Schmidt (2011), Advanced Mechanics of Materials, John Wiley and Sons Publishers

I M.Tech, I-Sem (SE) T 3 C 3

ADVANCED METAL STRUCTURES
(Program Specific Elective-I)

Course objectives: The main objective of this subject consists of analysis and design of various metal structures like steel, cold-formed steel under axial, bending, and shear.

Pre-requisites: Strength of materials, Theory of elasticity, Composite materials etc.

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

CO1	Analyse the behaviour Cold Formed Steel Members under axial, bending and shear forces
CO2	Design of Tension members, Compression members and Beams.
CO3	Design the Steel Tubular Member
CO4	Analyse loads on Offshore Structures:

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	-	-	-	-	-	-	-	-	-
CO2	-	1	-	-	-	3	-	-	-	-	-	-
CO3	-	1	-	-	-	3	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	-

Unit I

Introduction: Methods of Analysis- Elastic analysis (first order, second order), buckling analysis (linear, inelastic). Sources of non-linearity. First order plastic analysis, second order inelastic analysis. Plastic method of analysis. static, kinematic and uniqueness theorems – Concepts of (Load and Resistance Factor Design) LRFD.

Unit II

Cold Formed Steel Members: Local and post buckling of thin elements - Behaviour under axial, bending and shear forces

Unit III

Aluminium Structures: Introduction – Stress-strain relationship – Permissible stresses – Design of Tension members, Compression members and Beams.

Unit IV

Composite Structures: Steel – Concrete Composite structures – shear connectors – types of shear connectors– degrees of shear connections – partial and full shear connections – composite sections under positive and negative bending.

Unit V

Loads on Offshore Structures: Wind Loads; Wave and Current Loads; Calculation based on Maximum base Shear and Overturning Moments; Design Wave heights and Spectral Definition; Hydrodynamic Coefficients and Marine growth

Unit VI

Steel Tubular Member Design: Principles of WSD and LRFD; Allowable stresses and Partial Safety Factors; Tubular Members, Slenderness effects; Column Buckling, Design for Hydrostatic pressure; Design for combined axial and bending stresses (API RP 2A guidelines).

Text Books

1. Gaylord, Design of Steel Structures, McGraw Hill, New York.
2. Wie-Wen Yu, Cold-Formed Steel Structures, McGraw Hill Book Company
3. N. Subramanian, Design of Steel Structures, Oxford University Press.
4. R.P. Johnson, Composite Structures in Steel & Concrete, Blackwell Scientific Publications, UK
5. Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005

I M.Tech, I-Sem (SE)

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3 3

ENGINEERING MATHEMATICS
(Program Specific Elective-I)

Course objectives: The main objective of this subject consists of understanding engineering mathematics and applications in various fields of civil engineering.

Pre-requisites: Mathematics,

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

CO1	Students are able to understand and apply partial differential equations in solving hydrodynamics and fluid mechanics problems..
CO2	Students shall apply numerical solutions in engineering, science and also in many branches of applied mathematics, e.g in fluid dynamics; boundary layer theory and heat transfer quantum mechanics
CO3	Students are able to understand and apply Fourier Transforms in many fields of learning such as mathematics, physical sciences and engineering.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	-	1	-	-	-	-	-	-	-	-	-	-
CO3	-	1	-	-	-	-	-	-	-	-	-	-

UNIT I

Matrices and Linear System of Equations: Solutions of linear systems - Direct methods - Gauss Jordan elimination method - Triangularisation method - Choleskey method - Jacobi iteration method - Gauss Siedel iteration method

UNIT II

Eigen values and Eigen vectors - Problems on Eigen values of symmetric tri -diagonal matrix- Jacobi's method.

UNIT III

Applied partial Differential Equations: One-dimensional Heat equation and two-dimensional Laplace Equation in Cartesian, cylindrical and spherical coordinates (problems having axi-symmetry – Analytical solution by separation of variables technique.

UNIT IV

Applied Statistics: Regression and correlation analysis – Curvilinear Regression – Non-linear curves – correlation coefficient – correlation of grouped bivariate data – coefficient of determination Multiple Regression – partial Regression coefficients. Analysis - Tests of significance – Analysis of variance for regression – Multiple correlation coefficients – Multiple linear regression with two independent variables

UNIT V

Complex Variables: Complex variables - Cauchy-Riemann equations - Laplace equation - Conformal transformations including Joukowski's and Schwarz and Christoffel transformations.

UNIT VI

Numerical Methods: Numerical solutions of partial differential equations - Laplace and Poisson equations by iteration method, heat equation by Schmidt method. Fast Fourier Transforms: Theory and Applications

READINGS :

1) Dr.B.S. Grewal, "*Higher Engineering Mathematics",* Khanna Publishers, New Delhi.
2) N.P. Bali and M. Goyal, *"Engineering Mathematics",* Laxmi Publishers, New Delhi
3) *"Basic Statistics*" – Agarval, B.L., Wiley 1991, 2nd edition
4) "*Numerical Algorithms*" – Krishnamurthy & Sen, Affiliated East-West Press, 1991, 2nd edition

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3 3

LOW COST HOUSING TECHNIQUES
(Program Specific Elective-I)

Course objectives: The main objective of this subject consists of understanding alternative building materials with low-cost techniques in rural areas.

Pre-requisites: Concrete Technology, Building materials, casting & construction techniques.

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

CO1	Understand the housing scenario, finance & planning.
CO2	Asses the performance of precast elements, masonries etc.,
CO3	Understand the alternative Building Materials for Low Cost Housing, Low Cost Infrastructure Services, Rural Housing & prone areas

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	-	-	-	-	-
CO2	-	-	-	-	-	1	-	-	-	-	-	-
CO3	-	1	-	-	-	-	2	-	-	-	-	-

UNIT I

1. **A) Housing Scenario**
   Introduction - Status of Urban Housing - Status of Rural Housing
   B) Housing Finance:
   Introducing - Existing Finance System in India - Government Role As Facilitator - Status At Rural Housing Finance - Impedimently In Housing Finance And Related Issues
2. **A) Land Use and Physical Planning For Housing**
   Introduction - Planning Of Urban Land - Urban Land Ceiling And Regulation Act - Efficiency Of Building Bye Lass - Residential Densities
   B) Housing the Urban Poor
   Introduction - Living Conditions In Slums - Approaches and Strategies For Housing Urban Poor

UNIT II

Development And Adoption Of Low Cost Housing Technology

Introduction - Adoption Of Innovative Cost Effective Construction Techniques - Adoption Of Precast Elements In Partial Prefatroices - Adopting Of Total Prefactcation Of Mass Housing In India- General Remarks On Pre Cast Rooting/Flooring Systems -Economical Wall System - Single Brick Thick Loading Bearing Wall - 19cm Thick Load Bearing Masonery Walls - Half Brick Thick Load Bearing Wall - Flyash Grypsym Thick For Masonry - Stone Block Masonery - Adoption Of Precast R.C. Plank And Join System For Roof/Floor In The Building

UNIT III

Alternative Building Materials For Low Cost Housing

Introduction - Substitute For Scarce Materials – Ferrocement - Gypsum Boards - Timber Substitutions - Industrial Wastes - Agricultural Wastes - Fitire Starateru; For ,P,Topm Of Alternative Building Maintenance

UNIT IV

Low Cost Infrastructure Services:

Introduce - Present Status - Technological Options - Low Cost Sanitation - Domestic Wall - Water Supply, Energy

UNIT V

Rural Housing:

Introduction Traditional Practice Of Rural Housing Continuous - Mud Housing Technology Mud Roofs - Characteristics Of Mud - Fire Treatment For Thatch Roof – Soil Stabilization - Rural Housing Programs

UNIT VI

Housing In Disaster Prone Areas:

Introduction – Earthquake - Damages To Houses - Traditional Prone Areas – Type Of Damages And Railways Of Non-Engineered Buildings - Repair And Restore Action Of Earthquake Damaged Non-Engineered Buildings Recommendations For Future Constructions. Requirement's Of Structural Safety Of Thin Precast Roofing Units Against Earthquake Forces, Status of R&D In Earthquake Strengthening Measures - Floods, Cyclone, Future Safety

TEXT BOOKS

1) Building Materials For Low –Income Houses – International Council For Building Research Studies And Documentation.
2) Hand Book Of Low Cost Housing By A.K.Lal – Newage International Publishers.
3) Properties Of Concrete – Neville A.M. Pitman Publishing Limited, London.
4) Light Weight Concrete, Academic Kiado, Rudhai.G – Publishing Home Of Hungarian Academy Of Sciences 1963.
5) Low Cost Housing – G.C. Mathur.
6) Modern Trends In Housing In Developing Countries – A.G. Madhava Rao, D.S.Ramachandra Murthy & G.Annamalai.

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3 3

ANALYSIS OF SHELLS AND FOLDED PLATES
(Program Specific Elective-II)

Course objectives: The main objective of this subject consists of the analysis of shells and folded plates, its behavior under various loads through various theories.

Pre-requisites: Mechanics of Solids and Theory of Elasticity.

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

CO1	Derivation of Governing DKJ Equation For Bending Theory, Details of Schorer's Theory,
CO2	Analysis Of Elliptic Paraboloid, Rotational Paraboloid And Hyperbolic Paraboloid Shapes By Membrane Theory
CO3	Derivation Of Equilibrium Equations By Membrane Theory, Applications To Spherical Shell And Rotational Hyperboloid

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-

UNIT I

Equations of Equilibrium : Introduction, Classification, Derivation of Stress Resultants, Principles of Membrane Theory And Bending Theory.

UNIT II

Cylindrical Shells: Derivation of Governing DKJ Equation For Bending Theory, Details of Schorer's Theory,

UNIT III

Applications To The Analysis And Design of Short Shells And Long Shells. Introduction of ASCE Manual Co-efficient For Design.

UNIT IV

Introduction To Shells of Double Curvature: (**Other Than Shells of Revolution**) Geometry And Analysis Of Elliptic Paraboloid, Rotational Paraboloid And Hyperbolic Paraboloid Shapes By Membrane Theory.

UNIT V

Folded Plates: Folded Plate Theory, Plate And Slab Action, Whitney's Theory, Simpson's Theory For The Analysis Of Different Types Of Folded Plates (Design Is Not Included)

UNIT VI

Shells Of Double Curvature (**Surfaces Of Revolution)** .Derivation Of Equilibrium Equations by Membrane Theory, Applications To Spherical Shell And Rotational Hyperboloid

TEXT / REFERENCE BOOKS:

1) Design And Construction Of Concrete Shell Roofs By G.S. Rama Swamy – CBS Publishers and Distributors, 485, Jain Bhawan Bhola Nath Nagar, Shahotra, Delhi.
2) Fundamentals Of The Analysis And Design Of Shell Structures By Vasant S.Kelkar Robert T.Swell – Prentice Hall, Inc., Englewood Cliffs, New Jersy -02632.
3) N.K.Bairagi, Shell Analysis, Khanna Publishers, Delhi, 1990.
4) Billington, Ithin Shell Concrete Structures, Mc Graw Hill Book Company, New York, St. Louis, Sand Francisco, Toronto, London.
5) ASCE Manual Of Engineering Practice No.31, Design Of Cylindrical Concrete Shell Roofs ASC, New york.

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STABILITY OF STRUCTURES

(Program Specific Elective-II)

Course objectives: The main objective of this subject consists of understanding the stability of structural members.

Pre-requisites: Mechanics of Solids and Theory of Elasticity.

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

CO1	Determine critical loads for straight columns for different loading and end conditions.
CO2	Determine the critical loads for discrete and continuous systems.
CO3	Assess the buckling of thin walled bars and lateral buckling of beams.
CO4	Assess the buckling of rectangular plates.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	-	2	-	-	-	-	-	-
CO2	-	-	1	-	-	2	-	-	-	-	-	-
CO3	-	3	-	-	-	2	-	-	-	-	-	-
CO4	-	3	-	-	-	2	-	-	-	-	-	-

UNIT I

Formulations Related To Beam Columns: Concept Of Stability, Differential Equation For Beam Columns –Beam Column With Concentrated Loads – Continuous Lateral Load – Couples -Beam Column With Built In Ends – Continuous Beams With Axial Load – Application Of Trignometric Series – Determination Of Allowable Stresses.

UNIT II

Elastic Buckling Of Bars: Elastic Buckling Of Straight Columns –Effect Of Shear Stress On Buckling-Eccentrically And Laterally Loaded Columns –Energy Methods –

UNIT III

Buckling Of A Bar On Elastic Foundation, Buckling Of A Bar With Intermediate Compressive Forces And Distributed Axial Loads –Buckling Of Bars With Change In Cross Section –Effect Of Shear Force On Critical Load –Built Up Columns

UNIT IV

Inelastic Buckling And Torsional Buckling : Buckling Of Straight Bars-Double Modulus Theory –Tangent Modulus Theory. Pure Torsion Of Thin Walled Bar Of Open Cross Section-Non –Uniform Torsion Of Thin Walled Bars Of Open Cross Section-Torsional Buckling – Buckling Under Torsion And Flexure.

UNIT V

Mathematical Treatment Of Stability Problems: Buckling Problem Orthogonality Relation –Ritz Method-Timoshenko Method, Galerkin Method

UNIT VI

Lateral Buckling Of Simply Supported Beams And Rectangular Plates :
Beams Of Rectangular Cross Section Subjected For Pure Bending. Derivation Of Equation Of Rectangular Plate Subjected To Constant Compression In Two Directions And One Direction.

REFERNCE BOOKS:

1) Stability Of Metalic Structure By Bleich –Mc Graw Hill
2) Theory Of Beam Columns Vol I By Chen & Atsuta Mc.Graw Hill
3) Smitses,Elastic Stability Of Structures, Prentice Hall,1973.
4) Timoshenko, S., And Gere., Theory Of Elastic Stability, Mc Graw Hill Book Company, 1973.
5) Brush And Almorth., Buckling Of Bars Plates And Shells, Mc Graw Hill Book Company ,1975.
6) Chajes, A., Principles Of Structural Stability Theory, Prentice Hall,1974

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3 3

BRIDGE ENGINEERING
(Program Specific Elective-II)

Course Objectives: The main objective of this subject consists of analysis and design of culverts, T beam bridge, and various components of bridge structure.

Pre-requisites: Design of steel structures and Design of concrete structures

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

CO1	Design the slab Culvert, Box culvert.
CO2	Design of T-beam bridge and substructures.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	-	-	-	2	-	-	-	-	-
CO2	-	-	1	-	-	-	2	-	-	-	-	-

UNIT 1

Hydraulic Design: Importance of hydraulic factors in Bridge Design – Methods for computation of peak flood flow – empirical methods – envelope curves – flood flows and catchment scale. Small, midsize and large catchments – their characteristics – types of catchment responses – their analysis. River Channels – Peak discharge determination – effect of bridge on river regime – linear waterways – economic span – efflux- scouring.

UNIT II

Design load for Bridges: Types of loads on bridges. Dead – vehicle live load according to IRC – Impact effect – wind loading – longitudinal – centrifugal – Buoyant forces – water current forces – determination of forces and stresses on bridges according IS code – Seismic forces.

UNIT III

Box culverts: Introduction; Design of box culverts by vector's method – Design problems.

UNIT IV

Beam and slab bridges: Introduction – Design of Interior panel of slabs- Piegaud's Method. Design of longitudinal girders – Guyon –Massonet Method – Calculation of longitudinal moment – Henry jaegar Method – Courbon's Theory – Design problems.

UNIT V

Composite bridges: Introduction: Composite action – shear connectors – designs requirements of shear connectors – Transformed sections - Design problems.

UNIT VI

Prestressed concrete Bridge Decks: Introduction – Principles of prestressing – pretensioning and post tensioning – strands, tendons and bars – anchorages and end blocks – steps for design of post tensioned prestressed desk slabs and design example – Steps for design of post tensioned concrete T beam bridge desk and Design problems.

READING:

1. Design of Bridge structure s by T R Jagadeesh & M A Jayaram, PHI Learning Private limited, New Delhi.
2. Design of concrete bridges- Aswini, Vazirani, Ratwani
3. Essentials of bridge engineering- Jhonson Victor D
4. Design of bridges- Krishna Raju

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RESEARCH METHODOLOGY & IPR

Course Objectives:

- The student would be able to understand the research methodology basics and its application
- To develop orientation towards research related activities and ethical research recognizing the ensuing knowledge as property.
- To create consciousness for Intellectual Property Rights and its constituents.
- To understand the procedures of attaining patents in domestic and international scenario.
- To update on the contemporary issues in Intellectual Property rights

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

CO1	The students will be able to demonstrate their ability in understanding and formulation of research problem.
CO2	To understand plagiarism and follow research ethics
CO3	To analyze research related information, able to interpret and write research report.
CO4	To understand the role of internet in IPR and its impact on ideas, concept, and creativity.
CO5	Understand current and emerging issues related to IP protection and its impact on research and development which ultimately leads to economic growth and social benefits.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	2	-	-	-	-
CO3	-	-	-	-	-	-	-	2	-	-	-	-
CO4	-	-	-	-	-	-	-	2	-	-	-	-
CO5	-	-	-	-	-	-	-	2	-	-	-	-

UNIT I

Introduction to Research methodology, Research problem, Scope and objectives of research problem, Research process, Research Design Types of research , Research Approaches.

UNIT II

Effective literature review approaches, Data collection, analysis, interpretation, Tools and techniques of research analysis,Plagiarism analysis, Research ethics

UNIT III

Effective technical writing, Report writing, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee..

UNIT IV

Nature of Intellectual Property: Patents, Designs, Trademark and Copyright, Process of Patenting and Development, Technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents.

UNIT V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications, Patenting under Patent Cooperation Treaty(PCT)

UNIT VI

Contemporary issues in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge of IPR, Role of Institutions in IPR,The Impact of Internet on IPR,India`s New National IP Policy – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – IPR in current scenario with case studies.

REFERENCE BOOKS:

1) Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2) Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction” Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
3) Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
4) Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
5) Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007. 5. Mayall , “Industrial Design”, McGraw Hill, 1992..

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3 0

ENGLISH FOR RESEARCH PAPER WRITING AND DOCUMENTATION
(Audit Course)
(Common to All Branches)

Course Objectives:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title

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

CO1	Understand that how to improve your writing skills and level of readability
CO2	Learn about what to write in each section
CO3	Understand the skills needed when writing a Title

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	-	-	-	-	-	-	-	1	-	-	-	-
CO3	-	-	-	-	-	-	-	2	-	-	-	-

UNIT- I

Planning and preparation, Word order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT- II

Clarifying Who Did What, Highlighting your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a paper, Abstracts.

UNIT- III

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT – IV

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT – V

Skills are needed when writing the methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the conclusions.

UNIT- VI

Useful phrases, Vocabulary- Research Paper Template- Samples.

REFERENCE BOOKS:

1. Goldbort R (2006) Writing for Science , Yale University Press (available on Google Books)
2. Day R(2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Barbara Gastel and Robert A.Day How to write and publish a scientific paper ,Green Wood Press, 7th Edition,2011.
4. William Zinsser, On Writing Well The Classic Guide to Writing Non fiction, Harper Perennial Press.
5. Highman N (1998) , Handbook of Writing for the Mathematical Sciences, SIAM, Highman's book.
6. Adrian Wallwork, English for Writing Research Papers, Springer New York Doredrecht Heidelberg London, 2011.

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3 1.5

STRUCTURAL DESIGN LAB – I

Pre-requisites: Mathematics, Strength of Materials Design of Structures.

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

CO1	Mat Lab Programming to Civil Engineering problems
CO2	Solving Algebraic equations Using Different techniques

1) Bending Moment and Shear Force for Simply supported beam with given loading
2) Bending Moment and Shear Force for Cantilever beam with given loading
3) Design of one way and two way slab
4) Design of RCC beam, and steel beam
5) Design of RCC column and steel column
6) Bending stress distribution of a beam with given loading
7) Shear stress distribution with given loading
8) Finding out roots of an algebraic equations
9) Finding out deflection of a beam through energy methods
10) Formulation of a global stiffness matrix of a beam
11) Draw column interaction curve
12) Mix Design

Tools to be used:

1) MATLAB
2) EXCEL

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3 1.5

STRUCTURAL ENGINEERING LAB-I

Pre-requisites: Concrete technology

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

CO1	Know how the water cement ratio influence the workability and strength of the concrete
CO2	Know how the fine aggregate/Coarse aggregate ratio influence the strength of the concrete
CO3	Know the idea on Mix Design

1) Study of effect of water/cement ratio on workability and strength of concrete.
2) Study of effect of aggregate/cement ratio on strength of concrete.
3) Study of effect of fine aggregate/coarse aggregate ratio on strength and permeability of concrete.
4) Mix Design methods: (a) I.S. Code method (b) ACI Code method.
5) Study of stress-strain curve of concrete for different mixes and different rates of loadings.
6) Study of Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
7) Study of behavior of under reinforced and over-reinforced beam in flexure.
8) Study of behavior of steel beam under flexure.

READING:

1) Structural Engineering Journals.
2) Research Articles / Reports available on Internet.
3) A.M. Neville," Properties of Concrete" 5th Edition, Prentice
4) M.S. Shetty, "Concrete Technology", S. Chand and Co.,

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CONTINUOUS COMPREHENSIVE EVALUATION

Detailed Syllabus:
Entire course of study (All the required courses studied) up to I Semester of I Year **Reading:**

1. Reading Material of all the courses

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3 3

FINITE ELEMENT METHOD IN STRUCTURAL ENGINEERING

Course Objectives: The main objective of this subject consists of analyzing the structural member under various loads for finding out displacement, stresses in the finite element method.

Pre-requisites: Mathematics and Theory of structures – II.

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

CO1	Generate Stiffness matrix for bar element and beam element
CO2	Develop the shape functions for different elements.
CO3	Formulation of 4-node iso-parametric axi-symmetric element

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	2	-	-	-	-	-	-	-
CO2	-	1	1	2	-	-	-	-	-	-	-	-
CO3	-	1	3	2	2	-	-	-	-	-	-	-

UNIT-I

Introduction- Concepts Of FEM –Steps Involved –Merits &Demerits –Energy Principles – Discretization –Rayleigh –Ritz Method Of Functional Approximation.

UNIT-II

Elastic Formulations: Stress Equations-Strain Displacement Relationships In Matrix Form-Plane Stress, Plane Strain And Axi-Symmetric Bodies Of Revolution With Axi Symmetric Loading.

UNIT-III

One Dimensional FEM-Stiffness Matrix For Beam And Bar Elements Shape Functions For ID Elements –Static Condensation Of Global Stiffness Matrix- Solution –Initial Strain And Temperature Effects.

UNIT-IV

Two Dimensional FEM-Different Types Of Elements For Plane Stress And Plane Strain Analysis –Displacement Models –Generalized Coordinates-Shape Functions-Convergent And Compatibility Requirements –Geometric Invariance –Natural Coordinate System-Area And Volume Coordinates-Generation Of Element Stiffness And Nodal Load Matrices –Static Condensation.

UNIT-V

Isoparametric Formulation-Concept, Different Isoparametric Elements For 2D Analysis-Formulation Of 4-Noded And 8-Noded Isoparametric Quadrilateral Elements –Lagrangian Elements-Serendipity Elements.

Axi Symmetric Analysis –Bodies Of Revolution-Axi Symmetric Modelling –Strain Displacement Relationship-Formulation Of Axi Symmetric Elements.

UNIT-VI

Non-linear FE analysis – Introduction- Non-linearity – Material Non-linearity – Geometric Non- linearity – various methods of modeling**.**

TEXT/REFERENCE BOOKS:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
2. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
3. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
4. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
5. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
6. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., Prentice Hall India, 1991.

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3 3

ADVANCED CONCRETE TECHNOLOGY

Course Objectives: The main objective of this subject consists of Asses the performance of special concretes and also repairs and strengthening techniques of the elements of the structures.

Pre-requisites: Concrete Technology.

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

CO1	Understand the influence of constituents on the properties of concrete.
CO2	Asses the performance of special concretes and also repairs and strengthening techniques of the elements of the structures.
CO3	Assess the properties of concrete using Rebound Hammer and Ultrasonic Pulse Velocity instruments.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	-	2	-	-	-	-	-	-
CO2	-	-	2	-	-	2	-	-	-	-	-	-
CO3	-	-	2	-	-	2	-	-	-	-	-	-

UNIT I
Cement – Chemical Composition – Bogue's compounds - Hydration, Setting and Fineness of cement – Structure of Hydrated Cement – Mechanism of cement gel - Water held in hydrated cement paste – Heat of Hydration of cement – Influence of the compound composition on properties of cement –Tests on physical properties of cement - I.S. Specifications-Different Types of cements.

UNIT II
Aggregates - Classification of aggregates - Particle shape and texture – Bond, strength and other mechanical properties of aggregates– Soundness of aggregate - Alkali aggregate reaction-Thermal properties - Grading of fine and coarse aggregates - Gap graded aggregates.

UNIT III
Admixtures –Types of admixtures-Accelerating, retarding and water reducing admixtures – Super plasticizers-Special admixtures.

UNIT IV
Fresh and Hardened Concrete: Fresh Concrete - workability tests on Concrete Setting times of Fresh Concrete - Segregation and bleeding.
Hardened Concrete: Water/Cement ratio - Effective water in the mix -Abram's law- Gel space ratios, Maturity Concept – Influence of properties of coarse aggregate on strength- Influence of aggregate/cement ratio on strength- Relation between compressive and tensile strengths- Curing of concrete– Factors affecting strength– Non destructive tests.

UNIT V
Elasticity, Shrinkage and Creep : Modulus of Elasticity - Dynamic modulus of elasticity - Poisson's ratio-Early volume changes – Swelling - Drying Shrinkage - Mechanism of Shrinkage - Factors affecting Shrinkage - Differential Shrinkage - Moisture movement - Carbonation shrinkage - Creep of concrete - Factors influencing creep - Relation between creep and time - Effect of creep.

Durability of Concrete : Water permeability - Air and vapour permeability – Carbonation - Acid attack on concrete - Sulphate attack on concrete – Efflorescence - Effect of sea water on concrete – Disruption by alkali-silica reaction – Types of cracking.

UNIT VI

Special Concrete: Self Compacting concrete - Light weight aggregate concrete – No-Fines concrete – High density concrete – Fiber reinforced concrete – Reactive Powder concrete – Applications-Polymer concrete – Types of polymer concrete-Properties of polymer concrete – Applications.

Concrete mix design: Quality Control - Quality assurance - Quality audit- Mix Design method – IS method.

READING:

1. A.M.Neville, "*Properties of Concrete*" Pearson Education
2. Concrete technology-M S Shetty. S. Chand and Company Limited
3. ML Gambhir, "*Concrete Technology*", Tata Mc Graw Hill Publishing Company

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MAINTENANCE AND REHABILITATION OF STRUCTURES

(Program Specific Elective-III)

Course Objectives: The main objective of this subject consists of formulating guidelines for repair management

Pre-requisites: Concrete Technology and Neo Construction Materials

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

CO1	Estimate the causes for distress and deterioration of structures.
CO2	Understand NDT for condition assessment of structures, identify damages in RC structures
CO3	Select repair material and retrofitting strategy suitable for distress.
CO4	Formulate guidelines for repair management of deteriorated structures.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	1	-	-	-	-	-	-

UNIT I

Introduction to Maintenance and Repairs: Introduction, Definitions, Objective of maintenance**,** Factors influencing the maintenance, Necessity of maintenance, Classification of maintenances, Mechanism of deterioration, Factors responsible for the initiation of the process of deterioration or decay, Effects of deterioration on constructional materials.

UNIT II

Investigation of Defects in Buildings: Introduction-Systematic approach of Investigation-Scope and Objectives of investigations-Preliminary considerations-Detailed Steps for Diagnosis of Defects-Physical Measurements-Material Tests-Non-Destructive Tests-Study of available Document- Diagnosis of problem- Loads and Environmental effects-original design and construction practices-Retrospective Analysis-Confirmation of Diagnosis.

UNIT III

Materials for Repair, Maintenance and Protection: Introduction-Durability-Compatibility-Types of repair Materials- Characteristics and properties-Selection of materials for repairs- Commercially available repair materials.

UNIT IV

Protection, Repair and Maintenance of RCC Elements: Introduction-Prevention of corrosion in reinforcement-Preparation of RCC for repair-Repair of corroded RCC Elements-Concrete Placement Techniques-Repair of surface defects.

UNIT V

Common Techniques of Building Repair: Introduction-Surface preparation-Common repair techniques-Common methods of crack repair.

UNIT VI

Common Strengthening Techniques: Introduction-Additional interior Reinforcement-Exterior reinforcing–Exterior post tensioning- Guniting, jacketing, Brackets and collars-Supplementary Members-Underpinning.

READING

1) Building repair and maintenance management: P.S.Gahlot ,Sanjay Sharma,CBS Publishers & Distributors Pvt.Ltd.
2) Maintenance &Repair of Civil Strucures: B.L.Gupta ,Amit Gupta, Standard Publishers Distributors.
3) Raikar R.N., Diagnosis and treatment of Structures in Distress

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BUILDING CONSTRUCTION AND MANAGEMENT
(Program Specific Elective-III)

Course Objectives: The main objective of this subject consists of applying theoretical and practical aspects of project management techniques to achieve project goals.
Pre-requisites: Concrete Technology, Construction Materials & Project management

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

CO1	To apply theoretical and practical aspects of project management techniques to achieve project goals..
CO2	To apply knowledge and skills of modern construction practices and techniques.
CO3	To apply knowledge and skills of modern construction practices and techniques.
CO4	Have necessary knowledge and skills in accounting, financing, risk analysis and contracting.
CO5	Be capable of using relevant software packages for planning, scheduling, executing and controlling of construction projects

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	2	2	-
CO2	-	-	-	-	-	-	-	-	1	1	3	-
CO3	-	-	-	-	-	-	-	-	1	2	2	-
CO4	-	-	-	-	-	-	-	-	1	2	2	-
CO5	-	-	-	-	1	-	-	-	1	2	2	-

UNIT I
Introduction – Types Constructions Public And Private Contract Management – Scrutinizing Tenders And Acceptance Of Tenders, Contracted, Changes And Terminating Of Contract – Subcontracts Construction Organizations – Organizational Chart-Decentralization Payrolls And Records – Organization Chart Of A Construction Company.

UNIT II
Construction Practices – Times Management – Bar Chart, CPM, PERT – Progress Report

UNIT III
Resources Management And Inventor- Basic Concepts Equipment Management, Material Management Inventory Control.

UNIT IV
Accounts Management – Basic Concepts, Accounting System And Book Keeping, Depreciation, Balance Sheet, Profit And Loss Account, Internal Auditing. Quality Control By Statistical Methods, Sampling Plan And Control Charts, Safety Requirements.

UNIT V
Cost And Financial Management – Cost Volume Relationship, Cost Control System, Budget Concept Of Valuation, Cost Of Equity Capital Management Cash.

UNIT VI
Labor And Industrial; Laws – Payment Of Wages Act. Contract Labor, Workmen's Compensation, Insurance, Industrial Disputes Act.

REFERENCE:

1) Construction Project Management By Jha ,Pearson Pubilications,New Delhi.
2) Construction Technology By Subir K.Sarkar And Subhajit Saraswati – Oxford Higher Education- Univ.Press, Delhi.
3) Project Planning And Control With PERT And CPM By Dr.B.C.Punmia, K.K.Khandelwal, Lakshmi Publications New Delhi.
4) Optimal Design of Water Distribution Networks P.R.Bhave, Narosa Publishing House 2003.
5) Total Project Management, The Indian Context- By : P.K.JOY- Mac Millan Publishers India Limited.

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EARTHQUAKE AND WIND ANALYSIS OF STRUCTURES
(Program Specific Elective-III)

Course Objectives: The main objective of this subject consists of detailing the reinforcement of earthquake-resistant buildings as per IS 1893:2016, and IS 13920:2016 codes.

Pre-requisites: Design of Concrete Structures and Steel Structures.

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

CO1	Calculation of equivalent lateral load analysis
CO2	Detail reinforcement for earthquake resistant RC buildings as per IS Code.
CO3	Calculation of response spectrum method
CO4	Criteria for earthquake resistant design guidelines

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	3	-	-	-	-	-	-

UNIT I
Engineering seismology – rebound theory – plate tectonics – seismic waves – Earthquake size and various scales – local site effects – Indian seismicity – seismic zones of India.

UNIT II
Seismic design concepts – EQ load on simple building – load path – floor and roof diaphragms – seismic resistant building architecture – plan configuration – vertical configuration – pounding effects – mass and stiffness irregularities – torsion in structural system- Provision of seismic code (IS 1893 & ; 13920) – Building system – frames – shear wall – braced frames – layout design of Moment Resisting Frames (MRF) – ductility of MRF – Infill wall – Non- structural elements.

UNIT III
Calculation of equivalent lateral force- Design Base Shear- Storey Shear, Estimation of Natural period of Structure, Computation of Response acceleration Coefficient- Zone factor- Seismic weight- Response reduction factors- Seismic Coefficient Method.

UNIT IV
Design and ductile detailing of Beams and columns of frames -Concept of strong column weak beams, Ductility criteria for earthquake resistant design, Ductile detailing of flexural members as per IS 13920- Longitudinal reinforcement, Shear reinforcement, Anchorage of reinforcement Development length, Lap Splices.

UNIT V
Seismic Analysis and design of simple 2-storied RC Building frame – Equivalent static lateral force method and response spectrum method.

UNIT VI
Seismic Evaluation of RC buildings – Condition assessment Field Evaluation Identification and assessment of concrete - Seismic retrofitting R.C.C and masonry building – Ductile detailing for earthquake resistant construction. I.S. Codal Provisions

READING

1) 'Earthquake Resistant Design of Structures' -Pankaj Agarwal and Manish ShriKhande, Prentice– Hall of India, 2007, New Delhi.
2) 'Earthquake Resistant Design of Building Structures' by Vinod Hosur, Wiley India Ltd.
3) 'Reinforced Concrete Design'by A. K. Jain.

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OPTIMIZATION TECHNIQUES
(Program Specific Elective/MOOCS-I)

Course Objectives: The main objective of this subject consists of learning effective and efficient computational procedures to solve optimization problems.

Pre-requisites: Mathematical preliminaries, Linear programming etc.,

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

CO1	Learn efficient computational procedures to solve optimization problems
CO2	Cast engineering minima/maxima problems into optimization framework

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	2	-	-	-	-	-
CO2	-	-	-	-	-	1	2	-	-	-	-	-

UNIT I
Introduction and Basic Concepts – Historical Development and Model Building – Engineering Applications of optimization – Optimization Problem and Model Formulation

UNIT II
Classification of Optimization Problems – Based on Existence of Constraints, Nature of design variables – physical structure of the problem – Nature of the equations involved – Permissible values of the decision variables – Deterministic nature of the variables – Separability of the Functions – Number of Objective Functions

UNIT III
Linear programming: Standard form of linear programming problem, geometry of linear programming problem. Solution of system of linear simultaneous equations.

UNIT IV
Simplex method. –Revised simplex method, duality of linear programming sensitivity or post optimality analysis.

UNIT V
Dynamic Programming – Applications – Design of Continuous Beam – Optimum Geometric Layout of Truss

UNIT VI
Optimization Techniques applied to fully stressed design with deflection constraints, optimality criterion methods.

REFERENCE BOOKS:

1) Spunt, Optimum Structural Design, Civil Engineering and Engineering mechanics Services, Prentice Hall New Jersey, 1971.
2) S.S.Rao, Optimization theory and applications, Wiley Eastern Limited, New Delhi,1977.
3) Uri Krisch, Optimum Structural Design Mc Graw hill Book co., 1981.
4) Richard Bronson, Operations Research, Schaums, outline series, Mc Graw Hill book company, Singapore 1983.
5) J.S.Arora, introduction to optimum Design, Mc Graw Hill Book company, new York,1989.
6) 6.A.J. Morris (Editor) Foundations of Structural Optimization –a unified Approach, John Wiley and Sons, Chichester, 1982

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FRACTURE MECHANICS
(Program Specific Elective/MOOCS-I)

Course Objectives: The main objective of this subject consists of identifying and classifying cracks in concrete structures from fracture mechanics principles.
Pre-requisites: Mathematics and Theory of Elasticity.

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

CO1	Identify and classify cracking in concrete structures based on fracture mechanics principles.
CO2	Understand stress intensity factor and implement to notched members.
CO3	Apply fracture mechanics models to high strength concrete and FRC structures.
CO4	Understand the concepts of LEFM and compute J-Integral for various sections.

_Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	3	-	-	-	-	-	-	-	-
CO2	-	1	2	3	-	-	-	-	-	-	-	-
CO3	-	1	2	3	-	-	-	-	-	-	-	-
CO4	-	1	2	3	-	-	-	-	-	-	-	-

UNIT I
Introduction: Fundamentals of elastic and plastic behaviour of materials- stresses in a plate with a hole – Stress Concentration factor- modes of failure- Brittle fracture and ductile fracture- history of fracture mechanics-Griffiths criteria of cracks- mode I, mode II and mode III failure.

UNIT II
Principles of Linear Elastic Fracture Mechanics: SOM vs Fracture Mechanics -stressed based Criteria for fracture- Stress Intensity Factors- K_I K_{II} and K_{III} – Critical stress Intensity Factors, K_{Ic} K_{IIc} and K_{IIc} – crack tip plastic zone – Erwin's plastic zone correction - Critical crack length-Load carrying capacity of a cracked component- Design of components based on fracture mechanics.

UNIT III
Griffith's criteria- Criteria for crack propagation -Energy release rate , G_I G_{II} and G_{III} - Critical energy release rate G_{Ic} , G_{IIc} and G_{IIIc} – surface energy - R curves – compliance- J-Integrals: Material characterisation by Crack Tip Opening Displacements (CTOD)- Crack Mouth Opening Displacement (CMOD)- Critical crack tip opening displacement ($CTOD_c$) – critical Crack Mouth Opening Displacement ($CMOD_c$)-Determination of fracture parameters.

UNIT IV
Experimental determination of fracture parameters- K_{Ic} , G_{Ic}, $CTOD_c$ and critical J-Integral.- for brittle and quasi brittle materials like concrete and rock- Specimen geometry .

UNIT V

The crack tip plastic zone: The Irwin plastic zone correction- The Dugdale approach- The shape of the plastic zone- Plane stress versus plane strain- Plastic constraint factor- The thickness effect. Nonlinear Fracture Mechanics for mode I quasi- brittle fracture(Concrete): General quasi-brittle fracture-Ficticious crack approach - Hillerborg's Fictitious crack model-Bazanth's crack band model- Effective elastic crack approach-Two Parameter model-Bazanth' Size effect model-effective crack model-softening-

UNIT VI

Applications of Fracture Mechanics to Concrete structures: Size effect on nominal strength-Tension, Bending, Shear and torsion of RRC members-Concrete dams- Interfacial fracture mechanics

READING

1. Engineering Fracture Mechanics- S.A. Meguid, Elsevier Applied Science Publications.
2. Elementary engineering fracture mechanics – David Broek – Sijthoff & Noordhoff – Alphenaan den Rijn – Netherlands.
3. Elements of Fracture Mechanics – Prasanth Kumar, wiley Eastern Publications
4. Fracture Mechanics: Fundamentals and applications – T. L. Andrason, PhD, CRC publications

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ADVANCED DESIGN OF FOUNDATIONS

(Program Specific Elective/MOOCS-I)

Course Objectives: The main objective of this subject consists of the analysis and design of various types of foundations.

Pre-requisites: Soil Mechanics & Foundation Engineering

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

CO1	Understand the different types foundations and its designs
CO2	Understand the different types dams, analysis and its designs
CO3	Planning of soil exploration for Different Projects & methods of Subsurface Exploration ,borings etc

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	-	-	-

UNIT I

Planning of Soil Exploration: Planning of soil exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.

UNIT II

Shallow Foundations: Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.

UNIT III

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

UNIT IV

Well Foundation: IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods.

UNIT V

Tunnels: Tunnels and Arching in Soils, Pressure Computations around Tunnels.

Open Cuts: Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.

UNIT VI

Coffer Dams: Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction

REFERENCE BOOKS:

1) Design of foundation system, N.P. Kurian, Narosa Publishing House
2) Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York
3) Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

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RELIABILITY OF STRUCTURES
(Program Specific Elective/MOOCS-I)

Course Objectives: The course objective of this subject consist of Design of retaining wall, cantilever, and counter fort, RCC water, circular, rectangle tank, and chimney.

Prerequisites: Strength of materials, Structural Analysis-I & Structural Analysis-II

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

CO1	An ability to analyze beams & frames to determine the reactions, moments and drawing the shear force &bending moment diagram, for different methods
CO2	An ability to analyze two & three hinged archs to determine the reactions, moments and drawing the shear force &bending moment diagram by influence line diagram and knowledge of plastic analysis

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-

UNIT I
Analysis of Two hinged and three hinged arches using influence lines.

UNIT II
Moment Distribution method: Application to the analysis of portal frames with inclined legs, gable frames

UNIT III
Strain energy method: Application to the analysis of continuous beams and simple portal frames.

UNIT IV
Plastic Analysis: Introduction – Idealized stress – Strain diagram – shape factors for various sections – Moment curvature relationship – ultimate moment – Plastic hinge – lower and upper bound theorems – ultimate strength of fixed and continuous beams.

UNIT V
Flexibility Method: Introduction to the structural analysis by flexibility concept using Matrix approach and application to portal frames.

UNIT VI
Influence lines: Influence line diagrams for Reaction, Shearing force and bending moment in case of determinate beams and application of influence line diagrams.

TEXT BOOKS:

1. Analysis of structures Vol. I & II by Vazrani and Ratwani. Khanna publications.
2. Wang C.K. - Intermediate Structural Analaysis – Tata Mc Graw Hill Publishers, 2010
3. Structural Analysis Vol. I & II by Bhavi Katti Vikas Publications.
4. Matrix methods of Structural Analysis by Pandit and Gupta – Tata Mc.Graw Hill

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PROFESSIONAL ETHICS

(Audit Course)

Course Objectives: The main objective of this subject consists of to learn the rights and responsibilities as an employee, team member and a Global citizen.

Course Outcomes: Students will be able to:

CO1	Imbibe the values and Ethical Behavior in the personal and professional lives
CO2	The students will learn the rights and responsibilities as an employee, team member and a Global citizen

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	2	1	-	-	-

UNIT I

Definition, Nature, Scope- Moral Dilemmas- Moral Autonomy- Kohlberg's theory- Gilligan's theory- Moral Reasoning and Ethical theories- Theories of Right Action- Utilitarianism interest- Use of ethical Theories- Case study.

UNIT II

Life skills, Emotional Intelligence, Professionalism, Professional Associations, Risks , Professional Accountabilities,Professional success, Feminist Consequentialism.

UNIT III

Professional etiquettes- Mobile Etiquettes- Email Etiquettes- Kinesics- Proxemics- Chronemics- Chromatics- Olfacts- Haptics- Case study.

UNIT IV

Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Relevant Information – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Accountability – Role of Codes – Codes and Experimental Nature of Engineering

UNIT V

Multinational Corporations- Corporate Governance- Corporate Social Responsibility Environmental Ethics- Case study.

UNIT VI

Meaning and Types of Intellectual Property- Recent developments of the copy right act- Trademark Protection- Patent Law- Plagiarism.

TEXT BOOKS:

Professional Ethics: R. Subramanian, Oxford University Press,2015.
Ethics in Engineering Practice & Research, Caroline whitbeck, 2nd edition, Cambridge University Press, 2015.
R.R. Gaur, R Sangal, GP Bagaria, " A foundation course in Human Values and Professional Ethics", Cambridge University Press, 2009.
Charles D. Fleddermann, " Engineering Ethics", Prentice Hall, New Mexico,1999.
Mike Martin & Roland Schingzinger, " Ethics in Engineering", Mc Graw Hill, New York,1996.

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STRUCTURAL DESIGN LAB – II

Pre-requisites: Building Planning and Construction.

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

CO1	Use of important software's used in the field of structural engineering for analysis, design and drafting
CO2	Design of RC Structures and Steel Structures using software tools like STAAD, E-TAB.

DETAILED SYLLABUS:

1) Analysis of a solid slab in a typical floor for a residential building
2) Analysis of beams in a typical intermediate floor of a multi-storey building
3) Analysis of circular ring beam supporting an overhead water tank
4) Analysis of a shear wall-frame interaction
5) Application of strut-and-tie method to design and detail various RC elements and junctions
6) Analysis of a steel industrial building
7) Analysis of a communication tower
8) Time history analysis of a building
9) Response spectrum analysis of a building
10) Pushover analysis of a building
11) Analysis of a prestressed concrete beam
12) Analysis of beam on elastic foundation
13) Analysis of barrel vaulted structure

READINGS:

1) IS 456: 2000, Indian Standard for Plain and Reinforced Concrete- Code of Practice, BIS, New Delhi
2) IS 13920: 2016, Indian Standard for Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice, BIS, New Delhi
3) Dayaratnam, P., Design of steel structures, Wheeler Pub.
4) Structural Analysis and Program (SAP) SAP2000 Software
5) ANSYS Software

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STRUCTURAL ENGINEERING LAB-II

Pre-requisites: Concrete Technology.

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

CO1	Conduct and monitor various types of non-destructive test.
CO2	TO Understand the Mix design of fly-ash concrete.
CO3	To design the Self Compacting Concrete and workability tests

DETAILED SYLLABUS:

1) Self Compacting Concrete Design and workability tests
   a) Slump flow test & J-Ring Test
   b) V-Funnel Test
   c) L-Box Test
2) Non Destructive Testing on Concrete
   a) Rebound Hammer
   b) Ultra Sonic Pulse Velocity.
3) Accelerating Curing Test on Concrete Cubes
4) Tensile Test on Mild Steel
5) Deflection Test on I joist
6) Mix Design of Fly Ash Concrete Including Casting and Testing Of Specimens.
7) Demo on Ferro-cement

READING:

1) A.M. Neville, "Properties of Concrete", 5th Edition, PHI, 2012.
2) Kumar Mehta. P and Paulo J M Monteiro, "Concrete Microstructure, Properties and Materials", McGraw Hill, 2006.

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MINI PROJECT

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

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CONTINUOUS COMPREHENSIVE EVALUATION

Entire course of study (All the required courses studied) up to II Semester of I Year **Reading:**

1. Reading Material of all the courses

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PRE-STRESSED CONCRETE
(Program Specific Elective-IV)

Course Objectives: The main objective of this subject consists of designing pre and post-tensioned members.
Pre-requisites: Reinforced Concrete Design
Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the methods & systems of Pre & post tensioned members, Different systems of pre stressing, losses of pres stressing members
CO2	Analysis and design of section of flexure, Shear and Deflection
CO3	Design and testing of pre-stressing and Post tensioning members

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	2	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-

UNIT I
Introduction – General Principles of Prestressed Concrete- Advantages and limitations of Pre-stressing concrete, Pre-tensioning and Post –tensioning, Prestressing by straight, concentric, eccentric, bent and parabolic tendons, Different methods and systems of prestressing like Hoyer system, Freyssinet system, Magnel-Blaton system and Lee-Mc call system.

UNIT II
Analysis of Pre-stress and Bending Stresses: Basic Assumptions-Analysis of Pre-stress-Resultant Stresses at a Section-Pressure line or Thrust line and internal resisting couple-Couple of load Balancing-Stresses in tendons-Cracking Moment.

UNIT III
Losses of Pre-stress : Loss of pre-stress in pre-tensioned and post-tensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of steel, slip in anchorage, bending of member and frictional loss.

UNIT IV
Deflections of pre-stressed concrete Members: Importance of control of deflections-factors influencing deflections- short term deflections of uncracked member – prediction of long term deflections-Deflection curve for PSC beam - Deflections of cracked members-IS code requirements for maximum deflection.

UNIT V
Flexural Strength of Pre-stressed concrete sections: Types of flexural failure- Strain Compatibility method-Indian code provision-Elastic design of simple beams having rectangular and I sections for flexure – Kern lines – Cable profile and cable outlet.

UNIT VI

Transfer of Prestress in Pre-tensioned Members: Transmission of pre-stressing force by bond, Transmission length, Flexural bond stresses- Transverse tensile stresses-End-Zone reinforcement. IS code provisions.

Anchorage zone stresses in post-tensioned members: Introduction- stress distribution in End block-Investigation on anchorage zone reinforcement. - Analysis by approximate, Guyon and Magnel methods, Anchorage zone reinforcement.

READING:

1. Pre-stressed Concrete by Krishna Raju, Tata Mc.Graw Hill Publications,4th Edition,2006
2. Pre-stressed Concrete by Ramamrutham, Dhanpat Rai & Sons Publications, 2nd Edition,2005
3. Pre-stressed Concrete by N.Rajagopalan, Narosa publications, 2nd Edition,2014

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PLASTIC ANALYSIS AND DESIGN
(Program Specific Elective-IV)

Course Objectives: The main objective of this subject consists of concepts of stress-strain relation of moment-curvature relation, and limit design principles**.**

Pre-requisites: Theory of plasticity
Course Outcomes: At the end of the course, the student will be able to

CO1	Understanding the Concepts of stress and strain relation of steel Moment curvature relation- basic difference between elastic and plastic analysis & Limit design Principles etc.
CO2	Design of Continuous Beams by using Plastic analysis
CO3	Perform Minimum weight design of steel structures.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	1	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	-	-	-

UNIT I
Introduction and basic hypothesis: Concepts of stress and strain – relation of steel Moment curvature relation- basic difference between elastic and plastic analysis with examples- Yield condition, idealizations, collapse criteria- Virtual work in the elastic-plastic state- Evaluation of fully plastic moment and shape factors for the various practical sections.

UNIT II
Analysis of structures for Ultimate Load: Fundamental Principles – Statically method of analysis – Mechanism method of analysis – Method of analysis, Moment check – Carry over factor –Moment Balancing Method.

UNIT III
Method of Limit Analysis: Introduction to limit analysis of simply supported fixed beams and continuous beams, Effect of partially fixity and end, invariance of collapse loads.

UNIT IV
Basic theorems of limit analysis, rectangular portal frames, gable frames, grids, superposition of mechanisms, drawing statistical bending moment diagrams for checks. Limit design Principles: Basic principles, limit design theorems, application of limit design theorems, trial and error method, method of combining mechanisms, plastic moment distribution method, load replacement method, continuous beams and simple frames designs using above principles.

UNIT V
Deflection in Plastic beams and frames: Load deflection relations for simply supported beams, deflection of simple pin based and fixed based portal frames, method of computing deflections.

UNIT VI
Minimum weight Design: Introduction to minimum Weight and linear Weight functions- Foulkes theorems and its geometrical analogue and absolute minimum weight design. Design of Continuous Beams: Continuous Beams of uniform section throughout – Continuous Beams with different cross-sections.

READING:

1. Plastic Methods of Structural analysis- B G Neal, Chapman and Rall publications
2. Plastic analysis and Design – C E Messennet, M A Seve

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THEORY AND APPLICATIONS OF CEMENT COMPOSITES

(Program Specific Elective-IV)

Course Objectives: The main objective of this subject consists of mechanical behavior of composite materials and its applications.

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

CO1	Mechanical behavior of composite material
CO2	Applications of cement composite materials
CO3	Understand analysis and design of composite structural elements

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	-	2	-	-	-	-	-	-
CO2	-	-	2	-	-	2	-	-	-	-	-	-
CO3	-	-	1	-	-	1	-	-	-	-	-	-

UNIT I

Introduction-Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.

UNIT II

Mechanical Behaviour-Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.

UNIT III

Cement Composites: Types of Cement Composites, Terminology, Constituent Materials And their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

UNIT IV

Mechanical Properties of Cement Composites: Behavior of Ferro-cement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

UNIT V

Application of Cement Composites: FRC and Ferro-cement- Housing, Water Storage, Boats and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.

UNIT VI

Analysis and Design of Cement Composite Structural Elements – Ferro-cement, SIFCON and Fiber Reinforced Concrete.

REFERENCE BOOKS:

1) Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998.
2) Ferro-cement – Theory and Applications, Pama R. P., IFIC, 1980.
3) New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman &Hall, 1983.

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DISASTER MANAGEMENT
(Open Elective/MOOCS-II)

Course Objectives: The main objective of this subject consists of understanding disaster management and risk reduction in the country.

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

CO1	Understand the risk reduction of an area due to any disaster
CO2	Understand disaster management in the country
CO3	Understand disaster mitigation

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	-	-	-	-	-

UNIT I

INTRODUCTION TO DISASTERS DEFINITION: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters –Earthquake, Landslide, Flood, Drought, Fire etc – Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability – Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II

APPROACHES TO DISASTER RISK REDUCTION: Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural-nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders-Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III

INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV

DISASTER RISK MANAGEMENT IN INDIA Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment

UNIT V

DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal

Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

UNIT VI

DISASTER MITIGATION Importance of Disaster Mitigation, Cost – benefit analysis, relationship between vulnerability and development. Sample Surveys, Epidemiological Surveillance, Nutrition Centered Health Assessment, Remote sensing and Aerial photography, nature and damage to houses and infrastructure due to different disasters.

TEXT/REFERENCE BOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010.
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

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COMPOSITE MATERIALS
(Open Elective/MOOCS-II)

Course Objectives: The main objective of this subject consists of fabrication techniquies and structural applications of different composites.

Pre-requisites: Concrete technology

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

CO1	Classify the Composite Materials, MicroMechanics and thermo elastic Properties
CO2	Have a knowledge of Composite materials
CO3	Fabrication techniquies and structural applications of different composites

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	1	-	-	1	-	-	-	-	-	-
CO2	-	-	1	-	-	1	-	-	-	-	-	-
CO3	-	-	2	-	-	1	-	-	-	-	-	-

UNIT I

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications

UNIT IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT V

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure.

UNIT VI

Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

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STRUCTURAL HEALTH MONITORING
(Open Elective/MOOCS-II)

Course Objectives: The main objective of this subject consists of formulating guidelines for repair management of deteriorated structures.
Pre-requisites: Concrete Technology
Course Outcomes: At the end of the course, the student will be able to

CO1	Understand NDT for condition assessment of structures, identify damages in RC structures
CO2	Formulate guidelines for repair management of deteriorated structures.
CO3	Understand Simulation and loading methods.

Mapping with COs& POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	2	-	1	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-

UNIT I

Introduction to Structural Health Monitoring (SHM) : Definition & motivation for SHM, SHM - a way for smart materials and structures, SHM and bio mimetic - analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and Active SHM, NDE, SHM and NDECS, basic components of SHM, materials for sensor design.

UNIT II

Application of SHM in Civil Engineering: Introduction to capacitive methods, capacitive probe for cover concrete, SHM of a bridge, applications for external post tensioned cables, monitoring historical buildings.

UNIT III

Non Destructive Testing of Concrete Structures: Introduction to NDT - Situations and contexts, where NDT is needed, classification ofNDT procedures, visual Inspection, half-Cell electrical potential methods, Schmidt Rebound Hammer Test, resistivity measurement, electromagnetic methods, radiographic Testing, ultrasonic testing, Infra Red thermography, ground penetrating radar, radio isotope gauges, other methods.

UNIT IV

Condition Survey & NDE of Concrete Structure: Definition and objective of Condition survey, stages of condition survey (Preliminary, Planning, Inspection and Testing stages), possible defects in concrete structures, quality control of concrete structures - Definition and need,Quality control applications in concrete structures, NDT as an option for Non-Destructive Evaluation (NDE) of Concrete structures, case studies of a few NDT procedures on concrete structures

UNIT-V

Static Field Testing: Types of static tests - Simulation and loading methods - Static response measurement.

Dynamic Field Testing: Stress history data, types of dynamic field test - Dynamic response methods; Periodic and Continuous Monitoring.

UNIT-VI

Remote SHM: Importance and advantages – methodology – IOT applications in SHM – Applications to machine learning techniques in SHM

READING:

1. Daniel Balageas, Claus - Peter FritzenamI Alfredo Guemes, *Structural Health Monitoring,* Published by ISTE Ltd., U.K. 2006.
2. *Guide Book on Non-destructive Testing of Concrete Structures,Training course series No. 17,* International Atomic Energy Agency, Vienna, 2002.
3. *Hand book on "Repair and Rehabilitation of RCC Buildings*", Published by Director General, CPWD, Govt. of India, 2002.
4. *Hand Book on Seismic Retrofitting of Buildings,* Published by CPWD & Indian Building Congress in Association with IIT, Madras, Narosa Publishing House, 2008
5. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007.
6. J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and Intelligent Infrastructure, Vol-1, Taylor and Francis Group, London, U.K, 2006

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CONTINUOUS COMPREHENSIVE EVALUATION

Detailed Syllabus:

Entire course of study (All the required courses studied) up to III Semester of II Year

Reading:

1. Reading Material of all the courses

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MAIN PROJECT (PHASE-I)

Syllabus Contents:

Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution. Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.

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TECHNICAL SEMINAR

DETAILED SYLLABUS:

There is no specific syllabus for this course. However, student can choose any topic, of his choice, pertaining to Engineering Structures. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals in the area of Structural Engineering for choosing their seminar topics. Student should review minimum of 5 to 6 research Papers relevant to the topic chosen, in addition to standard textbooks, codebooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates. It is mandatory for all the students to attend the presentations of their classmates.

READING:

1. Structural Engineering Journals.
2. Research Articles / Reports available on Internet

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MAIN PROJECT (PHASE-II)

SYLLABUS CONTENTS:

Dissertation – II will be extension of the to work on the topic identified in Dissertation – I. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.