ACADEMIC REGULATIONS

COURSE STRUCTURE AND DETAILED SYLLABUS

FOR

M.Tech – STRUCTURAL ENGINEERING

(APPLICABLE FOR THE BATCHES ADMITTED FROM ACADEMIC YEAR 2015-16)

REGULATION: R15

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ACADEMIC REGULATIONS
COURSE STRUCTURE AND DETAILED SYLLABUS
FOR
M.TECH
STRUCTURAL ENGINEERING
FOR M.TECH.TWO YEAR POST GRADUATE COURSE
(APPLICABLE FOR THE BATCHES ADMITED FROM 2015-2016)

REGULATION:R15

J.B.INSTITUTE OF ENGINEERING & TECHNOLOGY
UGC AUTONOMOUS
(Permanently Affiliated to JNTUH, Approved By AICTE,New Delhi and Accredited By NBA,NAAC)

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J.B.INSTITUTE OF ENGINEERING AND TECHNOLOGY
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(BHASKAR NAGAR, MOINABAD MANDAL,R.R.DIST,HYDERABAD-500075,TELANGANA,INDIA)

R 15 - ACADEMICREGULATIONS (CBCS) FORM. Tech. (REGULAR) DEGREE PROGRAMMES

Applicable for the students of M. Tech. (Regular) programme from the Academic Year ***2015-16*** and on wards

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

1. ELIGIBILITY FORADMISSIONS

Admission to the above programme shall be made subject to eligibility, qualification and specialization as prescribed by the University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

AWARD OFM. Tech. DEGREE

A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years. However, he is permitted to write the examinations for two more years after four academic years of course work, failing which he shall forfeit his seat in M. Tech. programme.

The student shall register forall88 creditsandsecureallthe88credits.

The minimum instruction days in each semester are90.

3.0 COURSESOFSTUDY

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

1. CAD / CAM
2. Computer Science and Engineering
3. Electrical Power Systems
4. Energy Systems
5. Software Engineering
6. Structural Engineering
7. VLSI System Design

3.1 Departments offering M. Tech. Programmes with specializations are noted below:

CIVIL ENGINEERING	STRUCTURAL ENGINEERING
COMPUTER SCIENCE & ENGINEERING	COMPUTER SCIENCE & ENGINEERING SOFTWARE ENGINEERING
ELECTRONICS & COMMUNICATION ENGINEERING	VLSI SYSTEM DESIGN
ELECTRICAL & ELECTRONICS ENGINEERING	ELECTRICAL POWER SYSTEMS ENERGY SYSTEMS
MECHANICAL ENGINEERING	CAD / CAM

4 Course Registration

4.1 A 'Faculty Advisor or Counselor' shall be assigned to each student, who will advise him on the Post Graduate Programme (PGP), its Course Structure and Curriculum, Choice/Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.

4.2 Academic Section of the College invites 'Registration Forms' from students with in 15 days from the commencement of classwork through 'ON-LINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ON-LINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

4.3 A Student can apply for ON-LINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from his Faculty Advisor, which should be submitted to the College Academic Section through the Head of Department (a copy of it being retained with Head of Department, Faculty Advisor and the Student).

4.4 If the Student submits ambiguous choices or multiple options or erroneous entries - during ON-LINE Registration for the Subject(s) / Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first mentioned Subject/ Course in that Category will be taken into consideration.

4.5 Subject/ Course Options exercised through ON-LINE Registration are final and CANNOT be changed, nor can they be inter-changed; further, alternate choices will also not be considered. However, if the Subject/ Course that has already been listed for Registration (by the Head of Department) in a Semester could not be offered due to any unforeseen or unexpected reasons, then the Student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements will be made by the Head of Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

1. ATTENDANCE

The programmes are offered on a unit basis with each subject being considered a unit.

- Attendance in all classes (Lectures/Laboratories etc.) is compulsory. The minimum required attendance in each theory / Laboratory etc. is 75% including the days of attendance in sports, games, NCC and NSS activities for appearing for the End Semester examination. A student shall not be permitted to appear for the Semester End Examinations (SEE) if his attendance is less than 75%.

- Condonation of shortage of attendance in each subject up to 10% (65% and above

and below75%) in each semester shall be granted by the College Academic Committee.

- Shortage of Attendance below65% in each subject shall not be condoned.
- Students whose shortage of attendance is not condoned in any subject are not eligible to write their end semester examination of that subject and their registration shall stand cancelled.
- A prescribed fee shall be payable towards condonation of shortage of attendance.
- A Candidate shall put in a minimum required attendance at least three (3) theory subjects in I Year I semester for promoting to I Year II Semester. In order to qualify for the award of the M.Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.
- A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present Semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission in to the same class.

6 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

6.1 For the theory subjects 75 marks shall be awarded for the performance in the Semester End Examination and 25 marks shall be awarded for Continuous Internal Evaluation (CIE). The Continuous Internal Evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted, one in the middle of the Semester and the other, immediately after the completion of Semester instructions. Each mid-term examination shall be conducted for a total duration of 120 minutes with Part A as compulsory question (10 marks) consisting of 5 sub-questions carrying 2 marks each, and Part B with 3 questions to be answered out of 5 questions, each question carrying 5 marks. The details of the Question Paper pattern for End Examination (Theory) are given below:

- The Semester End Examination will be conducted for 75 marks. It consists of two parts. i).Part-A for 25 marks, ii). Part-B for 50 marks.
- Part-A is a compulsory question consisting of 5 questions, one from each unit and carries 5 marks each.

- Part-B to be answered 5 questions carrying 10 marks each. There will be two questions from each unit and only one should be answered.

6.2 For practical subjects, 75 marks shall be awarded for performance in the Semester End Examinations and 25 marks shall be awarded for day-to-day performance as Internal Marks.

6.3 For conducting laboratory end examinations of all PG Programmes, one internal examiner and one external examiner are to be appointed by the Principal of the College and the same to be informed to the Director of Evaluation in two weeks before for commencement of the lab end examinations. The external examiner should be selected from outside the College concerned but within the cluster. No external examiner should be appointed from any other College in the same cluster/any other cluster which is run by the same Management.

6.4 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50marks. A candidate has to secure a minimum of 50%ofmarks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.

6.5 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M. Tech. course of study. The Head of the Department shall be associated with the conduct of the Comprehensive Viva-Voce through a Committee. The Committee consisting of Head of the Department, one senior faculty member and an external examiner. The external examiner shall be appointed by the Director of Evaluation. For this, the Principal of the College shall submit a panel of 3 examiners. There are no internal marks for the Comprehensive Viva-Voce and evaluates for maximum of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.

6.6 A 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 Semester End Examination and a minimum aggregate of 50% of the total marks in the Semester End Examination and Continuous Internal Evaluation taken together.

6.7 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6.6) he has to reappear for the Semester End Examination in that subject.

6.8 A candidate shall be given one chance to re-register for the subjects if the internal marks secured by a candidate is less than 50% and failed in that subject for maximum of two subjects and should register within four weeks of commencement of the class work. In such a case, the candidate must re-register for the subjects and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the Semester End Examination in those subjects. In the event of the student taking another chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stands cancelled.

6.9 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the Semester End Examination in that subject. He shall re-register for the subject when next offered.

1. Examinations and Assessment - The Grading System

Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item6above, and a corresponding Letter Grade shall be given.

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Points*
80% and above (>80% , ≤ 100%)	O (Outstanding)	10
Below 80% but not less than 70% (>70% , < 80%)	A^+ (Excellent)	9
Below 70% but not less than 60% (>60% , < 70%)	A (Very Good)	8
Below 60% but not less than 55% (>55% , < 60%)	B^+ (Good)	7
Below 55% but not less than 50% (>50% , < 55%)	B (above Average)	6
Below 50% (< 50%)	F (FAIL)	0
Absent	**Ab**	**0**

7.3 A student obtaining F Grade in any Subject shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE

Marks) in those Subjects will remain the same as those he obtained earlier.

7.4 A student not appeared for examination then 'Ab' Grade will be allocated in any Subject shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered.

7.5 A Letter Grade does not imply any specific Marks percentage and it will be the range of marks percentage.

7.6 In general, a student shall not be permitted to repeat any Subject/ Course (s) only for the sakeof 'Grade Improvement' or 'SGPA/ CGPA Improvement'.

7.7 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course. The corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

7.8 The Student passes the Subject/ Course only when he **gets GP □ 6(B Grade or above).**

7.9 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit
Points (□ CP) secured from ALL Subjects/ Courses registered in a Semester, by the Total
is the no. of Subjects 'REGISTERED' for the Semester . SGPA is rounded off to **TWO** decimal places. SGPA is thus computed as

$$\textbf{SGPA} = \frac{\left\{\sum_{i=1}^{N} C_i G_i\right\}}{\left\{\sum_{i=1}^{N} C_i\right\}} \quad \textbf{……. For each semester.}$$

Where **'i'** is the subject indicator index (takes into account aii subjects in a semester), 'N' is the number of subjects **'registered'** for the semester (as specially required and listed under the course structure of the department). $\mathbf{G_i}$ is the number of credits allotted to the $\mathbf{i^{th}}$ subject, and $\mathbf{G_i}$ represents the grade points (GP) corresponding to the letter grade awarded for that $\mathbf{i^{th}}$ subject.

7.10 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to tow decimal places. CGPA is thus computed from the I year II semester onwards at the end of each

semester as per the formula.

$$\textbf{CGPA} = \frac{\left\{\sum_{j=1}^{M} C_j G_j\right\}}{\left\{\sum_{j=1}^{N} C_j\right\}} \textbf{ …….. For all S semester registered}$$

(i.e., up to and inclusive of S semester, S ≥ 2)

Where **'M'** is the total number of subjects (as specially required and listed under the course structure of the parent department) the student has **'registered'** i.e. from the first semester onwards upto and exclusive of the forth semester, "j" is the subject indicator index (takes in to account all subjects for one to four semester), C_j is the number of credits allotted to the j^{th} subject, G_i represents the grade points(GP) corresponding to the letter grade awarded for the j^{th} subject. After registration and completion of first year first semester, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

7.11 For Calculations listed in Item 7.6 – 7.10, performance in failed Subjects/ Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/ Courses will also be included in the multiplications and summations.

8. EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

8.1 A Project Review Committee (PRC) shall be constituted with Head of the Department as Chairperson, Project Supervisor and one senior faculty member of the Departments offering the M. Tech. programme.

8.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

8.3 After satisfying 8.2, a candidate has to submit, in consultation with his Project Supervisor, the title, objective and plan of action of his project work to the PRC for approval. Only after obtaining the approval of the PRC the student can initiate the Project work.

8.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

8.5 A candidate shall submit his project status report in two stages at least with a gap of 3 months between them.

8.6 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of all theory and practical courses with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the PRC.

8.7 After approval from the PRC, the soft copy of the thesis should be submitted to the University for ANTI-PLAGIARISM for the quality check and the plagiarism report should be included in the final thesis. If the copied information is less than 24%, then only thesis will be accepted for submission.

8.8 Three copies of the project should be submitted to the college which is certified by the superior

8.9 For Project work Review I in II Year I Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review I. If he fails to fulfill minimum marks, he has to reappear during the supplementary examination.

8.10 For Project work Review II in II Year II Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 marks. The PRC will examine the overall progress of the Project Work and decide the Project is eligible for final submission or not. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review II. If he fails to fulfill minimum marks, he has to reappear during the supplementary examination.

8.11 For Project Evaluation (Viva Voce) in II Year II Sem. there is an external marks of 150 and the same evaluated by the External examiner appointed by the University. The candidate has to secure minimum of 50% marks in Project Evaluation (Viva-Voce) examination.

8.12 If he fails to fulfill as specified in 8.11, he will reappear for the Viva-Voce examination only after three months. In the reappeared examination also, fails to fulfill, he will not be eligible for the award of the degree.

8.13 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 3 examiners, eminent in that field, with the help of the guide concerned and Head of the Department.

8.14 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected.

8.15 If the report of the examiner is favorable, Project Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis.

8.16 The Head of the Department shall coordinate and make arrangements for the conduct of Project Viva- Voce examination.

9. AWARD OFDEGREEAND CLASS

9.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course The entire PG Programme (PGP), and secures the required number of **88** Credits (with CGPA 6.0), shall be declared to have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with specialization as he admitted.

9.2 **Award of Class**

After a student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes based on the CGPA:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	6.75≤CGPA < 7.75
Second Class	6.00≤CGPA < 6.75

9.3 A student with final CGPA (at the end of the PGP) < 6.00 will not be eligible for the Award of Degree.

10. WITHHOLDING OFRESULTS

If the student has not paid the dues, if any, to the University or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be with held in such cases.

11. TRANSITORY REGULATIONS

11.1 If any candidate is detained due to shortage of attendance in one or more subjects, they are eligible for re-registration to maximum of two earlier or equivalent subjects at a time as and when offered.

11.2 The candidate who fails in any subject will be given two chances to pass the same subject; otherwise, he has to identify an equivalent subject as per R15 Academic Regulations.

12 GENERAL

12.1 **Credit**: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.

12.2 **Credit Point:** It is the product of grade point and number of credits for a course.

12.3 Wherever the words "he", "him", "his", occur in the regulations, they include "she", "her".

12.4 The academic regulation should be read as a whole for the purpose of any interpretation.

12.5 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

12.6 The College 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 College.

DISCIPLINARY ACTIO N FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractice/Improper conduct	**Punishment**
	If the student:	
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which student is appearing but has not made use of (material shall include any marks on the body of the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phones with any student or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in the subject only of all the students involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
		Expulsion from the examination hall

2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing.	and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The hall ticket of the student is to be cancelled and sent to the university.
3.	Impersonates any other student in connection with the examination.	The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and UG major project) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of sea. If the imposter is and outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the answer book or additional sheet or takes our or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in the subject and all the other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the chief superintendent/assistant – superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizers a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or writer or by signs or by spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work

		and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeiture of seat.
9.	If student of the college, who is not a student for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all the other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeiture of seat. Person(s) who do not belong to the college will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of performance in that subject and all other subjects the student has appeared including practical examinations and UG major project of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the university for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
   (i) A show cause notice shall be issued to the college.
   (ii) Imposes suitable fine on the college.
   (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

J.B.INSTITUTE OF ENGINEERING & TECHNOLOGY

(UGC AUTONOMOUS)

Bhaskar Nagar, Moinabad(M), RR Dist , Telangana-500075

STRUCTURAL ENGINEERING

COURSE STRUCTURE – R15

I YEAR I SEM

S.NO	CODE	Course Title	L	P	C
1	DM41A	Theory of Elasticity and plasticity	4	0	4
2	DM41B	Theory of Plates	4	0	4
3	DM41C	Advanced Structural Analysis	4	0	4
4	**ELECTIVE - I:**		4	0	4
	DM41D	Advanced Concrete Technology			
	DM41E	Tall Buildings			
	DM41F	Advanced Foundation Engineering			
5	**ELECTIVE - II:**		4	0	4
	DM41G	Advanced R.C. Design			
	DM41H	Bridge Engineering			
	DM41I	Plastic Analysis & Design			
6	**OPEN ELECTIVE I:**		4	0	4
	DM41J	Computer Oriented Numerical Methods			
	DM41K	Reliability Engineering			
	DM41L	Experimental Stress Analysis			
7	DM41M	Advanced Concrete Lab	0	4	2
8	DM41N	Seminar	0	4	2
		Total Credits	**24**	**8**	**28**

I YEAR II SEM

S.NO	CODE	Course Title	L	P	C
1	DM42A	Finite Element Method	4	0	4
2	DM42B	Structural Dynamics	4	0	4
3	DM42C	Pre-stressed Concrete	4	0	4
4	**ELECTIVE - III:**		4	0	4
	DM42D	Advanced Steel Design			
	DM42E	Soil Dynamic & Foundation Engineering			
	DM42F	Stability of Structures			
5	**ELECTIVE - IV:**		4	0	4
	DM42G	Design of shells & folded plates			
	DM42H	Earthquake Resistant Design of Buildings			
	DM42I	Fracture Mechanics			
6	**OPEN ELECTIVE II:**		4	0	4
	DM42J	Repair & Rehabilitation of Buildings			
	DM42K	Composite Materials			
	DM42L	Optimisation Techniques			
7	DM42M	CAD Lab	0	4	2
8	DM42N	Seminar	0	4	2
		Total Credits	**24**	**8**	**28**

II YEAR I SEM

S.NO	CODE	Course Title	L	P	C
1	DM43A	Comprehensive Viva-Voce	0	0	4
2	DM43B	Project work Review I	0	24	12
		Total Credits	**0**	**24**	**16**

II YEAR II SEM

S.NO	CODE	Course Title	L	P	C
1	DM44A	Project work Review II	0	8	4
2	DM44B	Project Evaluation (Viva-Voce)	0	16	12
		Total Credits	**0**	**24**	**16**

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B.Tech. SE	**L**	**P**	**C**
I Year - I Semester	**4**	**0**	**4**

THEORY OF ELASTICITY AND PLASTICITY

Objectives:
To impart knowledge on the basic concepts of theory of elasticity, and solve the Structural Engineering problems.

Outcomes:
The learner will be able to solve problems of elasticity and plasticity and be able to apply numerical methods to solve continuum problems.

UNIT - I:
Introduction: Elasticity - notation for forces and stresses - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - plane stress - plane strain - differential equations of equilibrium - boundary conditions - compatibility equations - stress function - boundary condition.

UNIT II:
Two dimensional problems in rectangular coordinates - solution by polynomials - Saint-Venant's principle - determination of displacements - bending of simple beams - application of corier series for two dimensional problems - gravity loading. Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions - simple symmetric and asymmetric problems - general solution of two- dimensional problem in polar coordinates - application of general solution in polar coordinates.

UNIT - III:
Analysis of stress and strain in three dimensions - principal stresses - stress ellipsoid - director surface - determination of principal stresses - max shear stresses – homogeneous deformation - principal axes of strain rotation. General Theorems: Differential equations of equilibrium - conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solution - the reciprocal theorem.

UNIT - IV:
Torsion of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections - other elementary solution - membrane analogy - torsion of rectangular bars - solution of torsion problems by energy method - use of soap films in solving torsion problems - hydro dynamical analogies - torsion of shafts, tubes , bars etc. Bending of Prismatic Bars: Stress function - bending of cantilever - circular cross section - elliptical cross section - rectangular cross section - bending problems by soap film method - displacements.

UNIT - V:
Theory of Plasticity: Introduction - concepts and assumptions - yield criterions.

Text Books:

2. Theory of Elasticity by Timeshanko, McGrawhill Publications.
3. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.

Reference Books:

1. Theory of Elasticity by Y.C.Fung.
2. Theory of Elasticity by Gurucharan Singh.

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B.Tech. SE	**L**	**P**	**C**
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THEORY OF PLATES

Objectives:
To impart knowledge on the behavior of plates and to analyze the problems pertaining to beams on elastic foundation.

Outcomes:
The learner will be able to understand the behavior of plates for loadings and boundary conditions.

UNIT - I:
Cylindrical Bending : Different kind of plates – Assumptions - Derivation of differential equation for cylindrical bending of long rectangular plates - Analysis of uniformly loaded rectangular plates with edges simply supported and fixed subjected to uniform load.
Pure Bending of Plates : Slope and curvature of slightly bent plates – Relations between moments and curvature - Particular cases of pure bending - Strain energy in pure bending – Energy methods like Ritz and Galerkin Methods to rectangular plates subjected to simple loadings.

UNIT II:
Small Deflection Theory of Thin Rectangular Plates : Assumptions – Derivation of governing differential equations of thin plates-boundary conditions –simply supported load under sinusoidal load-navies' solution-applicant to different solutions – levy's solution for various boundary conditions subjected to different loadings such as uniform and hydro static pressure.

UNIT - III:
Circular Plates : Symmetrical loading – Relations between slope, deflection, moments and curvature– Governing differential equation – Uniformly loaded plates with clamped and simply supported edges– Central hole – bending by moments and shearing forces uniformly distributed.
Orthotropic Plates : Introduction – Bending of anisotropic plates - Derivation of governing differential equation – Determination of Rigidities in various cases like R.C. slabs, corrugated sheet – Application to the theory of grid works.

UNIT - IV:
Plates on Elastic Foundations : Governing differential equation – deflection of uniformly loaded simply supported rectangular plate – Navier and Levy type solutions - Large plate loaded at equidistant points by concentrated forces P.

UNIT - V:
Buckling of Plates: Governing equation for Bending of plate under the combined action of in-plane loading and lateral loads – Buckling of rectangular plates by compressive forces

acting in one and two directions in the middle plane of plate

Finite Difference Methods: Introduction - Application to rectangular plates subjected to simple loading.

Text Books:

1. Theory of Plates and Shells by Timoshenko, McGraw Hill Book Co., New York.
2. Theory and Analysis of Plates by P. Szilard, Prentice Hall.

Reference Books:

1. Theory of Plates by Chandrasekhar, University Press.
2. Plate Analysis by N. K. Bairagi, Khanna Publishers. New Delhi.

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ADVANCED STRUCTURAL ANALYSIS

Objectives:
To impart knowledge on the analysis of indeterminate structures like continuous beams, trusses and portal frames.

Outcomes:
The learner will be able to analyze different indeterminate structures using Matrix methods.

UNIT - I:
Introduction to matrix methods of analysis - static indeterminacy and kinematic indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations - for truss element, beam element and tensional element.
Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates.

UNIT II:
Assembly of stiffness matrix from element stiffness matrix - direct stiffness method - general procedure - band matrix - semi bandwidth - computer algorithm for assembly by direct stiffness matrix method.

UNIT - III:
Analysis of plane truss - continuous beam - plane frame and grids by flexibility methods.

UNIT - IV:
Analysis of plane truss - continuous beam - plane frame and grids by stiffness methods.

UNIT - V:
Special analysis procedures - static condensation and sub structuring - initial and thermal stresses .Shear walls- Necessity - structural behavior of large frames with and without shear walls - approximate methods of analysis of shear walls.

Text Books:

1. Matrix Analysis of Frames structures by William Weaver J.R and James M.Gere, CBS publications.
2. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers

Reference Books:

1. Basic Structural Analysis by C.S.Reddy.
2. Matrix Structural Analysis by Madhu B. Kanchi.
3. Indeterminate Structural Analysis by K.U.Muthu *et al.*,I.K.International Publishng House Pvt. Ltd.

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I Year - I Semester	**4**	**0**	**4**

ADVANCED CONCRETE TECHNOLOGY
(Elective – I)

Objectives:
To impart knowledge on concrete making materials, concrete mix design for proportioning and their testing.

Outcomes:
The learner will be able to design concrete mixes of different grades and also use the special concretes.

UNIT - I:
Concrete Making Materials: Cement- Bogue's compounds – Hydration Process– Types of cement – Aggregates – Gradation Charts – Combined aggregate-Alkali Silica Reaction - Admixtures – Chemical and Mineral admixtures.

UNIT II:
Fresh and Hardened Concrete: Fresh Concrete - workability tests on Concrete Setting times of Fresh Concrete - Segregation and bleeding. Hardened Concrete : Abram's law- Gel space ratios, Maturity Concept – Stress Behavior – Creep and Shrinkage – Durability tests on concrete - Non destructive testing of concrete.

UNIT - III:
High Strength Concrete – Micro structure – Manufacturing and Properties- Design 0s HSC Using Erintroy Shaklok Method- Ultra High Strength Concrete. High Performance Concrete- Requirements and properties of High Performance Concrete- Design Considerations.

UNIT - IV:
Special Concrete: Self Compacting concrete – Polymer concrete – Fiber reinforced concrete – Reactive Powder concrete – Requirements and Guidelines – Advantages and Applications. Light weight concrete. Concrete mix design : Quality Control - Quality assurance - Quality audit- Mix Design method - BIS method, ACI method, DOE method.

UNIT - V:
Form work – materials – structural requirements – form work systems – connections – specifications – design of form work – shores – removal for forms – reshoring – failure of form work.

Text Books:
1. Properties of Concrete by A.M.Neville, ELBS publications.
2. Concrete: Micro Structure, Properties and Materials by P.K.Mehta, Tata Mc Graw Hill Publishing House Pvt. Ltd

Reference Books:
1. Concrete Technology by A.K. Santhakumar, Oxford Press.
2. Concrete Technology by M.S.Shetty, S.Chand & Co.

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TALL BUILDINGS
(Elective – I)

Objectives:
To impart knowledge on analysis of tall buildings.

Outcomes:
The learner will be able to analyze and chose a appropriate systems for tall buildings.

UNIT - I:
Introduction : Classification of Buildings – Low-rise, medium-rise, high-rise – Evolution of tall buildings – Ordinary framed buildings & Shear-wall buildings –Behavior of buildings under lateral loads like Wind loads, Earthquake loads & Blast loads – Basic structural & functional design requirements –Strength, Stiffness & Stability.

UNIT II:
Lateral load resisting elements : Frames, Shear walls & Tubes – Shear, Bending & combined modes of deformation – Structural behavior of Rigid frames – Simplified methods of analysis – Substitute frame method, Portal method, Cantilever method, Equivalent frame method –Structural behavior of Shear walls – Approaches of analysis – Elastic continuum approach & Discrete approach -- Structural behavior of Tubes –Actions.

UNIT - III:
Choice of System for a Building : Frame building, Shear wall building, Shear walls acting with frames, Single framed tubes – Other structural forms – Staggered Wall-beam system, Tube-in-tube system, Base isolation technique for earthquake resistance. Load distribution in a tall building – Load resisted by different shear walls & frames – Determinate & Indeterminate problems – Equivalent Stiffness method.

UNIT - IV:
Methods of Analysis : Shear walls without Openings – Estimation of Stiffness by simple Cantilever theory & Deep beam theory – Shear walls with Openings – Equivalent frame for large openings –
Muto's method for small openings –Elastic Continuum approach – Coull & Chowdhry's method –
Design Charts – Limitations of Continuum approach. Shear wall- Frame Interaction : Sharing of loads between wall & frame - Different methods – comparison -- Khan & Sbrounis' method – Design charts - - Mac Leod's method - Advantages & limitations -- Cooperation of Floor slabs – Equivalent width.

UNIT - V:
Modern Methods : Analysis of Tall buildings by Stiffness method – Available Softwares for analysis of tall buildings.

Text Books:
1. Concrete & Composite Design of Tall Buildings by Taranath B., Mc Graw Hill.
2. Reinforced Concrete Design of Tall Buildings by Bungales. Taranath, CRC Press

Reference Books:

1. Analysis of Shear Walled Buildings by S. M. A. Kazimi & R. Chandra, Tor-steel Research Foundation, Calcutta, India.
2. Analysis of Framed Structures by Gere & Weaver
3. Design of Building Structures by Wolfgang Schuller, Prentice Hall

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I Year - I Semester	**4**	**0**	**4**

ADVANCED FOUNDATION ENGINEERING
(Elective – I)

Objectives:
To determine the bearing capacity of shallow and deep foundations and to estimate settlements of structures subjected to external loads, leading to design of foundations resting on soils.

Outcomes:
Students should be in a position to design foundations for varieties of structures resting on soil deposits, and appreciate the importance of reliability based design in geotechnical engineering.

UNIT - I:
Soil Exploration: Exploration Methods; Planning the Exploration Program; Boring and Sampling; In Situ Tests: Standard & Cone Penetration Tests, Field Vane, Dilatometer, Pressure meter; Rock Sampling, Core Recovery, RQD; Geophysical Exploration; Preparation of Soil Report, Case Studies.

UNIT II:
Shallow Foundations: **Bearing Capacity:-** Shear Failure; Effect of Water Table; Footings with Eccentric or Inclined Loads, Footings on Layered Soils, Slopes on finite layer with a Rigid Base at Shallow Depth, effect of compressibility of soil, on soils with strength increasing with depth, Plate Load tests, Presumptive bearing capacity.

UNIT - III:
Settlement: Components – Immediate, Primary and Secondary Settlements, Consolidation, Stresses and Displacements in Homogeneous, Layered and Anisotropic Soils; Bearing Pressure using SPT, CPT, Dilatometer and Pressure meter; Settlement of foundations on Sands-Schmertmann and Burland & Burbridge methods; Structure Tolerance to Settlement and Differential Settlements, Rotation, Codal Provisions.

UNIT - IV:
Deep Foundations: **Single Pile:** Vertically loaded piles, Static capacity- α, β and λ Methods, Dynamic formulae; Wave Equation Analyses; Point Bearing Resistance with SPT and CPT Results; Bearing Resistance of Piles on Rock; Settlement; Pile Load Test; Uplift Resistance; Laterally Loaded Piles -Ultimate Lateral Resistance; Negative Skin Friction; Batter Piles; Under Reamed Piles; Ultimate Capacity of Pile Groups in Compression, Pullout & Lateral Load; Efficiency; Settlements of Pile Groups; Interaction of Axially & Laterally Loaded Pile Groups, Codal Provisions.

UNIT - V:
Special Topics of Foundation Engineering
Foundations on Collapsible Soils: Origin and occurrence, Identification, Sampling and Testing,Preventive and Remedial measures.
Foundations on Expansive Soils: The nature, origin and occurrence, Identifying, testing and evaluating expansive soils, typical structural distress patterns and Preventive design &

construction measures.

***Introduction to Reliability-Based Design**: Brief introduction of probability and statistics, LRFD for structural strength requirements, LRFD for geotechnical strength requirements, Serviceability requirements

Text Books:

1. Das, B. M. - Principles of Foundation Engineering 5th Edition Nelson Engineering (2004)
2. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012. Phi Learning (2008)

Reference Books:

1. Bowles, J. E. - Foundation Analysis & Design 5th Edition McGraw-Hill Companies, Inc. (1996)
2. Poulos, H. G. & Davis, E. H. - Pile Foundation Analysis and Design john wiley & sons inc (1980-08)

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ADVANCED REINFORCED CONCRETE DESIGN
(Elective – II)

Objectives:
To impart knowledge on the behavior and design on various reinforced concrete structural elements.

Outcomes:
The learner will be able to design the reinforced concrete elements like beams, slabs and compression members.

UNIT - I:
Basic Design Concepts: Behaviour in flexure, Design of singly reinforced rectangular sections, Design of doubly reinforced rectangular sections, Design of flanged beams, Design of shear, Design for Torsion, Limit state of Serviceability: Deflections of Reinforced concrete beams and slabs, short term deflection and long term deflection, estimation of crack width in RCC members, calculation of crack widths.

UNIT II:
Limit Analysis of R.C.Structures: Rotation of a plastic hinge, Redistribution of moments, moment rotation characteristics of RC member, I.S. code provisions, applications for fixed and continuous beam. Yield line analysis for slabs: Upper bound and lower bound theorems – yield line criterion – Virtual work and equilibrium methods of analysis for square and circular slabs with simple and continuous end conditions.

UNIT - III:
Design of Ribbed slabs, Flat slabs: Analysis of the Slabs for Moment and Shears, Ultimate Moment of Resistance, Design for shear, Deflection, Arrangement of Reinforcements.
Flat slabs: Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears - Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip.

UNIT - IV:
Design of Reinforced Concrete Deep Beams & Corbels: Steps of Designing Deep Beams, Design by IS 456, Checking for Local Failures, Detailing of Deep Beams, Analysis of Forces in a Corbels , Design of Procedure of Corbels, Design of Nibs.

UNIT - V:
Design of Compression members: Estimation of effective length of a column-Code requirements on Slenderness Limits, Design of Short Columns under Axial Compression, Design of Short Columns with Uniaxial Bending, Design of Short Columns under Biaxial Bending, Design of Slender Columns.
Design of Combined Footings- Distribution of soil Pressure – Geometry of Two Column Combined Footing – Design Considerations in Combined Footing for Two – Columns.

Text Books:

1. Reinforced concrete design by S. Unnikrishna Pillai & Menon, Tata Mc. Graw Hill, 2nd Edition, 2004
2. Advanced Reinforced Concrete Design – P.C. Varghese, Prentice Hall of India, 2008

Reference Books:

2. Reinforced concrete design by Kennath Leet, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
3. Reinforced concrete structural elements – Behaviour, Analysis and design by P.Purushotham, Tata Mc.Graw-Hill, 1994.

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BRIDGE ENGINEERING
(Elective – II)

Objectives:
To impart knowledge on the behavior and design aspects of various types of bridges.

Outcomes:
The learner will be able to analyze and design of different types of bridges.

UNIT - I:
Concrete Bridges: Introduction-Types of Bridges-Economic span length-Types of loading-Dead load-live load-Impact Effect-Centrifugal force-wind loads-Lateral loads-Longitudinal forces-Seismic loads-Frictional resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Width of roadway and footway-General Design Requirements.

UNIT II:
Solid slab Bridges: Introduction-Method of Analysis and Design.

UNIT - III:
Girder Bridges: Introduction-Method of Analysis and Design-Courbon's Theory, Grillage analogy

UNIT - IV:
Pre-Stressed Concrete Bridges: Basic principles-General Design requirements-Mild steel reinforcement in prestressed concrete member-Concrete cover and spacing of pre-stressing steel-Slender beams-Composite Section-Propped-Design of Propped Composite Section-Unproped composite section-Two-stage Prestressing-Shrinking stresses-General Design requirements for Road Bridges.

UNIT - V:
Analysis of Bridge Decks: Harmonic analysis and folded plate theory-Grillage analogy-Finite strip method and FEM. Sub-structure of bridges: Substructure- Beds block-Piers- Pier Dimensions- Design loads for piers- Abutments- Design loads for Abutments.

Text Books:
1. Design of Concrete Bridges by M.G.Aswani, V.N.Vazirani and M.M.Ratwani.
2. Essentials of Bridge Engineering by Johnson Victor, Oxford & IBH.

Reference Books:
1. Bridge Deck Behaviour by E.C.Hambly.
2. Design of Bridges by N.Krishna Raju, Oxford & IBH.
3. Design of Bridges by V.V.Sastry, Dhanpat Rai & Co

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PLASTIC ANALYSIS AND DESIGN
(Elective – II)

Objectives:
To impart knowledge on the analysis of steel structures like continuous beams, steel frames and connection, using Plastic Analysis.

Outcomes:
The learner will be able to design continuous beams and steel frames.

UNIT - I:
Analysis of Structures for Ultimate Load: Fundamental Principles – statical method of Analysis – Mechanism method of analysis – Method of analysis, Moment check – Carry over factor – Moment Balancing Method.

UNIT II:
Design of Continuous Beams: Continuous Beams of uniform section throughout – Continuous Beams with different cross-sections.

UNIT - III:
Secondary Design Problems: Introduction – Influence of Axial force on the plastic moment – influence of shear force – local buckling of flanges and webs – lateral buckling – column stability.

UNIT - IV:
Design of Connections: Introduction – requirement for connections – straight corner connections – Haunched connection – Interior Beam-Column connections.

UNIT - V:
Design of Steel Frames: Introduction – Single bay, single storey frames – simplified procedures for Sinole span frames – Design of Gable frames with Hunched Connection. Ultimate Deflections:
Introduction – Deflection at ultimate load – Deflection at working load – Deflections of Beams and Sinole span frames.

Text Books:
1. Plastic Design of Steel Frames, L.S.Beedle.
2. Plastic Analysis, B.G.Neal.

Reference Books:
1. Plastic Analysis, Horve.

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I Year - I Semester	**4**	**0**	**4**

COMPUTER ORIENTED NUMERICAL METHODS
(Open Elective – I)

Objectives:
To impart knowledge about various methods of analysing linear equations and understand the different mathematical techniques.

Outcomes:
The learner will be able to apply various mathematical techniques to Structural engineering problems.

UNIT - I:
Solutions of linear equations: Direct method – Cramer's rule, Guass – Elimination method- Gauss – Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Siedel iteration, Successive over –relaxation method.
Eigen values and eigen vectors: Jacobi method for symmetric matrices- Given's method for symmetric matrices-Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method.

UNIT II:
Interpolation: Linear Interpolation - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.

UNIT - III:
Finite Difference and their Applications: Introduction- Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulae using Taylor series- Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly spaced pivotal points- Integration formulae by interpolating parabolas- Numerical solution to spatial differential equations

UNIT - IV: Numerical Differentiation: Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation. Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method.

UNIT - V:
Ordinary Differential Equation: Euler's method – Backward Euler method – Mid point method – single step method, Taylor's series method- Boundary value problems.

Text Books:

1. Numerical methods for scientific and engineering computations. M.K.Jain- S.R.K.Iyengar – R.K.Jain Willey Eastern Limited.
2. Numerical methods by S.S.Shastry.

Reference Books:

1. Applied numerical analysis by – Curtis I.Gerala- Addission Wasley – published campus.
2. Numerical methods for Engineers Stevan C.Chopra, Raymond P.Canal Mc. Graw Hill book company.
3. C Language and Numerical methods by C.Xavier – New age international publisher.

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RELIABILITY ENGINEERING
(Open Elective – I)

Objectives:
To impart knowledge on concepts of reliability, discrete distributions and hierarchical systems.

Outcomes:
The learner will be able to design a reliable systems and develop and analyse reliability and cost models for hierarchical systems.

UNIT - I:
Basic Concepts of Reliability : Introduction, Reliability and Quality, Failures and Failure Modes, Cuses of Failures and Unreliability, Maintainability and Availability, History of Reliability, Reliability Literature.

UNIT II:
Design for Reliability : Constraints and Considerations : Reliability Analysis, Mathematical Models and Numerical Evaluation, Designing for Higher Reliability, Redundancy Techniques, Equipment Hierarchy, Reliability and Cost.

UNIT - III:
Discrete Distributions : Density and distributions, Continuous Distributions, Numerical Characteristics of Random Variables, Laplace Transform.

UNIT - IV:
Maintainability and Availability Concepts : Introduction, Maintainability Function, Availability Function, Frequency of Failure, Two-unit parallel system with Repair, K-out-of M systems, Preventive Maintenance**.**

UNIT - V:
Hierarchical Systems : Introduction, Logic Diagram Approach, Conditional Probability Approach, System Cost, Illustrations and Discussions, Reliability Approximations.

Text Books:

2. Reliability Engineering by E. Balagurusamy, McGraw Hill Education(India) Pvt. Ltd.
3. Reliability Evaluation of Engineering Systems by Roy Billinton & Ronald N. Allan, Springer.

Reference Books:

1. Reliability of Structures, Second Edition by Andrzej S. Nowak, Kevin R. Collins December 20, 2012 by CRC Press

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I Year - I Semester	**4**	**0**	**4**

EXPERIMENTAL STRESS ANALYSIS
(Open Elective – I)

Objectives:
To impart knowledge on the strain measurement, brittle coating and photo elasticity.

Outcomes:
The learner will be able to understand the properties of strain-gauge systems and the computation techniques.

UNIT - I:
Basic equations and Plane Elasticity Theory: Introduction, Strain equations of Transformation, Compatibility, Stress-Strain Relations-Two dimensional State of Stress. The Plane-Elastic problem, The Plane-Strain Approach, Plane Stress, Airy's Stress function-Cartesian Co-ordinates-Two dimensional problems in Polar Co-ordinates, Polar Components of Stress in terms of Airy's Stress function, Forms.
Principles of Experimental Approach: Merit of Experimental Analysis introduction, uses of experimental stress analysis-Advantages of experimental stress analysis, Different methods, Simplification of problems.

UNIT II:
Strain Measurement using Strain Gauges: Definition of strain and its relation to Experimental Determinations, properties of strain-gauge systems, Types of strain gauges, Mechanical and Optical strain gauges. Electrical Strain Gauges - Introduction, LVDT - resistance strain gauge - various types - gauge factor, Materials for adhesion base, etc.
Strain Rosettes: Introduction, The three element rectangular Rosette - The delta rosette - Corrections for Transverse strain effects

UNIT - III:
Brittle Coating Method: Introduction, Coating stresses - Failure theories - Brittle coating Crack pattern - Crack detection - Types of Brittle coating - Test procedures for brittle coating analysis - Calibration procedures - Analysis of brittle coating data.

UNIT - IV:
Theory of Photo Elasticity: Introduction, Temporary double refraction - The stress optic law - Effects of stressed model in a Polaris cope for various arrangements - Fringe sharpening, Brewster stress optic law.

UNIT - V:
Two Dimensional Photo Elasticity: Introduction, Isochromatic Fringe patterns - Isoclinic fringe patterns, passage of light through plane Polaris cope and circular Polaris cope, Isoclinic fringe pattern - Computation techniques - calibration methods, separation methods, scaling Model to Proto type stress- Materials for photo - elasticity, properties of photo elastic materials.

Text Books:

1. Experimental Stress Analysis by J.W.Dally and W.F.Riley
2. Experimental Stress Analysis by Dr. Sadhu Singh

Reference Books:

1. Experimental Stress Analysis by Dove and Adams

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I Year - I Semester	**0**	**4**	**2**

ADVANCED CONCRETE LABORATORY

Objectives:
To impart knowledge on the test on cement and aggregates.

Outcomes:
The learner will be able to understand the properties of the materials and the behavior of the concrete.

EXPERIMENT1.Tests on cement - Consistency, Setting times, Soundness, Compressive Strength.
EXPERIMENT 2.Gradation Charts of Aggregates
EXPERIMENT 3.Bulking of fine Aggregate
EXPERIMENT 4.Aggregate Crushing and Impact value
EXPERIMENT 5.Workability Tests on Fresh self compacting concrete
EXPERIMENT 6.Air Entrainment Test on fresh concrete.
EXPERIMENT 7.Marsh cone test.
EXPERIMENT 8.Permeability of Concrete.
EXPERIMENT 9.Non Destructive Testing of Concrete.
EXPERIMENT 10.Accelerated Curing of Concrete.
EXPERIMENT 11.Influence of W/C ratio on strength and Aggregate / Cement ratio on workability and Strength
EXPERIMENT 12.Influence of Different Chemical Admixtures on concrete.

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I Year - II Semester	**4**	**0**	**4**

FINITE ELEMENT METHODS

Objectives:
To impart knowledge about various finite element techniques and development of finite element code.

Outcomes:
The learner will be able to solve continuum problems using finite element analysis.

UNIT - I:
Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles – Discretization - Raleigh - Ritz method of functional approximation.
Principles of Elasticity: Stress equations - strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

UNIT II:
One dimensional FEM: Stiffness matrix for beam and bar elements - shape functions for 1-D elements.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

UNIT - III:
Isoparametric formulation: Concept - different isoparametric elements for 2D analysis - formulation of 4-noded and 8-noded isoparametric quadrilateral elements - Lagrange elements - serendipity elements.Axi Symmetric Analysis: bodies of revolution - axi symmetric modeling - strain displacement relationship - formulation of axi symmetric elements.Three dimensional FEM: Different 3-D elements-strain-displacement relationship – formulation of hexahedral and isoparametric solid element.

UNIT - IV:
Introduction to Finite Element Analysis of Plates: Basic theory of plate bending - thin plate theory - stress resultants - Mindlin's approximations - formulation of 4-noded isoperimetric quadrilateral plate element – Shell Element.

UNIT - V:
Introduction to non – linear finite analysis – basic methods – application to Special structures.

Text Books:

1. Concepts and Applications of Finite Element Analysis by Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons.
2. Finite element Methods by OC Zienkiewicz

Reference Books:

1. Finite element analysis, theory and progarmming by GS Krishna Murthy.
2. Introduction to Finite element Method by Tirupathi Chandra Patla and Belugunudu.
3. Introduction to Finite element Method by JN Reddy.

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STRUCTURAL DYNAMICS

Objectives:

To impart knowledge on the fundamental of structural dynamics and their applications.

Outcomes:

The learner will be able to understand the equation of motion, dynamics response of single and multi degree-of freedom systems.

UNIT - I:

Theory of vibrations: Introduction - Elements of vibratory system - Degrees of Freedom - Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. - Free vibrations of single degree of freedom system - undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation -Dynamic magnification factor – Phase angle – Bandwidth

UNIT II:

Introduction to Structural Dynamics : Fundamental objectives of dynamic analysis -Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.

Single Degree of Freedom Systems : Formulation and solution of the equation of motion - Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

UNIT - III:

Multi Degree of Freedom Systems : Selection of the degrees of Freedom - Evaluation of structural property matrices - Formulation of the MDOF equations of motion -Undamped free vibrations - Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response – Normal co-ordinates - Uncoupled equations of motion - Orthogonal properties of normal modes - Mode superposition procedure.

UNIT - IV:

Practical Vibration Analysis: Introduction - Stodola method - Fundamental mode analysis - Analysis of second and higher modes - Holzer method - Basic procedure.

Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions - Principles of application to continuous beams.

UNIT - V:

Introduction to Earthquake Analysis: Introduction - Excitation by rigid base translation - Lumped mass approach - SDOF and MDOF systems - I. S. Code methods of analysis for obtaining response of multi storeyed buildings.

Text Books:

1. Dynamics of Structures by Clough & Penzien, McGraw Hill, New york
2. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.

Reference Books:

3. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
4. I.S: 1893 (Part 1) - 2002, "Code of practice for Earthquake resistant design of Structures"

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PRE-STRESSED CONCRETE

Objectives:
To impart knowledge on basics of prestressing and designing of different structural elements using Prestressing techniques.

Outcomes:
The learner will be able to understand the prestressing techniques, design the various structural elements using Prestressing techniques.

UNIT - I:
pretensioning and post tensioning , prestressing by straight , concentric, eccentric, bent parabolic tendons-different methods and systems of prestressing like hoyer system, fress Freyssinet system, Magnel Blaton system
Losses of prestressed : losses in pretensioning and prestressed 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 – Analysis of sections for flexure.

UNIT II:
Design of Section for Flexure : Allowable stresses – Elastic design of simple beams having rectangular and I-section for flexure – kern lines – cable profile and cable layout.
Design of Sections for Shear : Shear and Principal stresses – Improving shear resistance by different prestressing techniques – horizontal, sloping and v prestressing – Analysis rectangular and I–beam – Design of she reinforcement – Indian code provisions.

UNIT - III:
Deflections of Prestressed Concrete Beams : Short term deflections of uncracked members– Prediction of long-time deflections – load – deflection curve for a PSC beam – IS code requirements for max. deflections.

UNIT - IV:
Transfer of Prestress in Pretensioned Members : Transmission of prestressing force by bond –
Transmission length – Flexural bond stresses – IS code Anchorage zone stresses provisions – in
Post tensioned members –stress distribution in the end block - analysis by approximate guyon and magnel methods- anchorage zone reinforcement.

UNIT - V:
Statically Indeterminate Structures : Advantages & disadvantages of continuou PSC beams – Primary and secondary moments – P and C lines – Linear transformation concordant and non-concordant cable profiles – Analysis of continuous beams and simple portal frames (single bay and single story)

Text Books:

1. Prestressed concrete by Krishna Raju, Tata Mc Graw Hill Book – Co ., New Delhi.
2. Design of prestress concrete structures by T.Y. Lin and Burn, John Wiley, New York.

Reference Books:

1. Prestressed concrete by S. Ramamrutham Dhanpat Rai & Sons, Delhi.
2. IS 1343 -2012 Prestressed Concrete – Code of Practice, Bureau of Indian Standards.

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ADVANCED STEEL DESIGN
(Elective – III)

Objectives:
To impart knowledge on behavior and design of various connections, industrial and steel girders.

Outcomes:
The learner will be able to design different steel structures.

UNIT - I:
Simple connections – Bolted, Pinned and Welded Connections: Bolted Connections- Load Transfer Mechanism – Failure of Bolted Joints – Specifications for Bolted Joints – Bearing – Type Connections – Tensile Strength of Plate – Strength and Efficiency of the Joint – Combined Shear and Tension – Slip – Critical Connections – Praying Action – Combined Shear and Tension for Slip-Critical Connections. Design of Groove welds- Design of Fillet Welds- Design of Intermittent fillet welds- Failure of Welds.

UNIT II:
Eccentric and Moment Connections: Introduction – Beams – Column Connections- Connections Subjected to Eccentric Shear – Bolted Framed Connections- Bolted Seat Connections – Bolted Bracket Connections. Bolted Moment Connections – Welded Framed Connections – Welded Bracket Connections - Moment Resistant Connections.

UNIT - III:
Analysis and Design of Industrial Buildings : Dead loads, live loads and wind loads on roofs. Design wind speed and pressure, wind pressure on roofs; wind effect on cladding and louvers; Design of angular roof truss, tubular truss, truss for a railway platform. Design of purlins for roofs, design of built up purlins, design of knee braced trusses and stanchions. Design of bracings

UNIT - IV:
Design of Steel Truss Girder Bridges : Types of truss bridges, component parts of a truss bridge, economic proportions of trusses, self weight of truss girders, design of bridge compression members, tension members; wind load on truss girder bridges; wind effect on top lateral bracing; bottom lateral bracing; portal Bracing; sway bracing.

UNIT - V:
Design of Steel Bunkers and Silos : Introduction – Janseen's Theory – Airy's Theory – Design of Parameters – Design Criteria – Analysis of Bins – Hopper Bottom –Design of Bins.

Text Books:

1. Limit State Design of Steel Structures S.K. Duggal Mc Graw Hill Education Private Ltd. New Delhi.
2. Design of Steel Structures. P. Dayaratnam, Publisher : S. Chand, Edition 2011 – 12.

Reference Books:

1. Design Steel Structures Volume – II, Dr. Ramachandra & Vivendra Gehlot Scientitic Publishes Journals Department.

2. Design of Steel Structures Galyord & Gaylord, Publisher ; Tata Mc Graw Hill, Education. Edition 2012.
3. Indian Standard Code – IS – 800-2007 General Construction in Steel- Code of Practice.

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SOIL DYNAMICS AND FOUNDATIONS ENGINEERING
(Elective-III)

Objectives:

To understand the wave propagation in soils, determine dynamic properties of soil for analyzing and designing foundations subjected to vibratory loading.

Outcomes:

Able to understand the fundamentals of wave propagation in soil media, evaluate the dynamic properties of soil, and design foundations for centrifugal and reciprocating machines.

UNIT - I:

Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh's method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.

UNIT II:

Wave Propagation and Dynamic Soil Properties: Propagation of seismic waves in soil deposits - Attenuation of stress waves, Stress-strain behaviour of soils under cyclic loads, Strength of cyclically loaded soils, Dynamic soil properties - Laboratory and field testing techniques, Elastic constants of soils, Correlations for shear modulus and damping ratio in sand, gravels, clays and lightly cemented sand. Liquefaction of soils and its evaluation using simple methods.

UNIT - III:

Vibration Analyses: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elasto-dynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation.

UNIT - IV:

Design of Machine Foundations: Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS code of practice design procedure for foundations of reciprocating and impact type machines. Vibration isolation and absorption techniques.

UNIT - V:

Machine Foundations on Piles: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation.

Text Books:

1. Swami Saran - Soil Dynamics and Machine Foundation, Galgotia Publications Pvt.Ltd. (2010)
2. Prakash, S. - Soil Dynamics, McGraw Hill Book Company (1981)

Reference Books:

1. Prakash, S. and Puri, V. K. - Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.
2. Kameswara Rao, N. S. V. - Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.

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STABILITY OF STRUCTURES
(Elective – III)

Objectives:
To impart knowledge on the elastic, inelastic buckling and torsional buckling of structures.

Outcomes:
The learner will be able to understand buckling of bars and frames**.**

UNIT - I:
Beam Columns: Differential equations for beam columns- beam columns with concentrated loads – continuous lateral loads-couples- beam columns with built in ends – continuous beams with axial load– application of trigonometrically series – Effects of initial curvature on deflections – Determination of allowable stresses.

UNIT II:
Elastic Buckling of bars and frames: Elastic Buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns- Buckling of frames-large deflections of buckled bars-Energy methods- Buckling of bars on elastic foundations- Buckle line of bar with intermediate compressive forces - Buckling of bars with change in cross-section – Effect of shear force on critical load- built up columns.

UNIT - III:
In Elastic Buckling: Buckle line of straight bar- Double modulus theory – Tangent modulus theory, Inelastic lateral Buckling. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae for design – various end conditions

UNIT - IV:
Torsion Buckling: Pure torsion of thin walled bars of open cross section – Non-uniform torsion of thin walled bars of open cross section- Torsional buckling – Buckling by torsion and flexure.

UNIT - V:
Lateral buckling of simply supported Beams: Beams of Rectangular cross-section subjected to pure bending. Buckling of simply supported Rectangular plates: Derivation of equation of plate subjected to constant compression in one and two directions.

Text Books:
1. Theory of elastic Stability by Timshenko & Gere-Mc Graw Hill
2. Stability of metallic structures by Blunch- Mc Graw Hill

Reference Books:
1. Theory of Beam- Columns Vol I by Chem. & Atste Mc. Graw Hill

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DESIGN OF SHELLS AND FOLDED PLATES
(Elective – IV)

Objectives:
To impart knowledge on the behavior and design of shells and Folded plates.

Outcomes:
The learner will be able to analyse and design the shells and folded plates

UNIT - I:
Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation.
Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugges simulations equations.

UNIT II:
Derivation of the governing DKJ equation for bending theory, - Schorer's theory - Application to the analysis and design of short and long shells.
Beam theory of cylindrical shells: Beam and arch action, Analysis using beam theory.

UNIT - III:
Introduction to the shells of Double curvatures: Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type.

UNIT - IV:
Axi- Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application to spherical shells and hyperboloid of revolution cooling towers.

UNIT - V:
Folded plates – Introduction – Types of folded plates – structural behaviour of folded plates – advantages – Assumptions Whitney method of analysis – Edge shear equation - Analysis of folded plates of Whitney's method.
Simpsons method of Analysis of folded plates – moment and stress distribution – no rotation and rotation solutions – continuous folded plates – pre stressed continuous folded plates.

Text Books:
1.analysis and design of concrete shell groups-g.s ramaswamy
2.design of concrete roof shells – chaterjee.

Reference Books:
1. design of concrete roof shells- By Billington

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EARTHQUAKE RESISTANT DESIGN OF BUILDINGS
(Core Elective – IV)

Objectives:
To impart knowledge on the seismology and behavior of buildings during earthquakes.

Outcomes:
The learner will be able to analyse and design buildings to resist seismic forces.

UNIT - I:
Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonics-Seismic waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales-Energy released-Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph-Characteristics of strong ground motions- Seismic zones of India.

UNIT II:
Conceptual design: Introduction-Functional planning-Continuous load path-Overall form-simplicity and symmetry-elongated shapes-stiffness and strength-Horizontal and Vertical members-Twisting of buildings-Ductility-definition-ductility relationships-flexible buildings-framing systems-choice of construction materials-unconfined concrete-confined concrete-masonry-reinforcing steel. Introduction to earthquake resistant design: Seismic design requirements-regular and irregular configurations-basic assumptions-design earthquake loads-basic load combinations-permissible stresses-seismic methods of analysis-factors in seismic analysis-equivalent lateral force method-dynamic analysis-response spectrum method-Time history method

UNIT - III:
Reinforced Concrete Buildings: Principles of earthquake resistant deign of RC members-Structural models for frame buildings- Seismic methods of analysis- Seismic deign methods-IS code based methods for seismic design- Seismic evaluation and retrofitting- Vertical irregularities- Plan configuration problems- Lateral load resisting systems- Determination of design lateral forces-Equivalent lateral force procedure- Lateral distribution of base shear. Masonry Buildings: Introduction-Elastic properties of masonry assemblage- Categories of masonry buildings- Behaviour of unreinforced and reinforced masonry walls- Behaviour of walls- Box action and bands- Behaviour of infill walls- Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses- Seismic design requirements- Lateral load analysis of masonry buildings

UNIT - IV:
Structural Walls and Non-Structural Elements: Strategies in the location of structural walls-sectional shapes- variations in elevation- cantilever walls without openings – Failure mechanism of non-structures- Effects of non-structural elements on structural system-Analysis of non-structural elements- Prevention of non-structural damage- Isolation of non-structures.

UNIT - V:

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920. Behaviour of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquakes.
Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns-Case studies.

Text Books:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons
2. Masory and Timber structures including earthquake Resistant Design –Anand S.Arya, Nem chand & Bros
3. Earthquake –Resistant Design of Masonry Building –Miha Tomazevic, Imperial college Press.

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FRACTURE MECHANICS
(Elective – IV)

Objectives:
To impart knowledge on the mechanisms of failure and non linear fracture mechanics.

Outcomes:
The learner will be able to understand the behavior of concrete with tension and compression failure surfaces and concepts of CTOD and CMD.

UNIT - I:
Fundamentals of Fracture Mechanics, Mechanisms of fracture and crack growth

UNIT II:
Cleavage fracture, ductile fracture, fatigue cracking, Environment assisted cracking, Quasi brittle materials.

UNIT - III:
Service failure analysis, linear elastic fracture mechanics, Griffith's criteria, stress intensity factors, crack tip plastic zone, Erwin's plastic zone correction, R curves, compliance, J Integral, nonlinear analysis ,Review of concrete behaviour in tension and compression, Basic frameworks for modeling of quasibrittle materials.

UNIT - IV:
Nonlinear Fracture Mechanics – Discrete crack concept/Smeared crack concept, Size effect, Plasticity models for concrete – Associated and non-associated flow, Failure surfaces for quasibrittle materials.

UNIT - V:
Concept of CTOD and CMD, Material models, crack models, band models, models based on continuum damage mechanics

Text Books:

1. Elementary engineering fracture mechanics – David Broek – Sijthoff & Noordhoff - Alphen aan den Rijn – Netherlands
2. Fracture mechanics of concrete structures–Theory and applications – Rilem Report- Edited by L. Elfgreen – Chapman and Hall – 1989.

Reference Books:

1. Fracture mechanics–applications to concrete–Edited by Victor, C. Li, & Z.P. Bazant–ACI SP 118.
2. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, N D. New Delhi.
3. Venkataraman and Patel "Structural Mechanics with introduction to Elasticity and Plasticity" – Mcgraw Hill, 1990.

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REPAIR & REHABILITATION OF BUILDINGS
(Open Elective – II)

Objectives: To impart knowledge on the distress in structures.

Outcomes: :
The learner will be able to understand the reasons for distress in structures and will be able to suggest suitable solutions.

UNIT - I:
Introduction – Deterioration of Structures – Distress in Structures – Causes and Prevention. Mechanism of Damage – Types of Damage.

UNIT II:
Corrosion of Steel Reinforcement – Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation.

UNIT - III:
Inspection and Testing – Symptoms and Diagnosis of Distress - Damage assessment – NDT.

UNIT - IV:
Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shot Create – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

UNIT - V:
Health Monitoring of Structures – Use of Sensors – Building Instrumentation.

Text Books:
1. **Concrete Technology by A.R. Santakumar, Oxford University press**
2. **Defects and Deterioration in Buildingts, E F & N Spon, London**

Reference Books:
1. **Non-Destructive Evaluation of Concrete Structures by Bungey -** Surrey University Press
2. **Maitenance , Repair & Rehabilitation and Minor Works of Buildings by P.C.Varghese, PHI.**
3. **Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.**

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COMPOSITE MATERIALS
(Open Elective – II)

Objectives:
To impart knowledge on the properties of composite materials, their uses and advantages.

Outcomes:
The learner will be able to understand use of different composite materials and design GRP Box beams.

UNIT - I:
Introduction: Requirements of structural materials, influence of nature of materials in structural form, Nature of structural materials- Homogeneous materials, composite materials.

UNIT II:
Macro mechanical Properties of composite Lamina: Introduction, Assumptions and Idealizations, Stress Strain relationships for composite Laminate- Isotropic, Orthotropic lamina, Strength Characteristics- Basic concepts, Strength hypothesis for isotropic and for orthotropic lamina, macro mechanical analysis of composite lamina, introduction assumptions and limitations of stiffness characteristics of glass reinforced lamina- stress strain relation ships in continues and discontinues lamina – strength reinforcement of continues of glass reinforced lamina – strength in continuous and discontinues fiber lamina.

UNIT - III:
Behavior of Glass Fiber-Reinforced laminates: Introduction, Stiffness characteristics of Laminated composites-Behavior of Laminated beams and plates, Strength characteristics of Laminated composites- Strength analysis and failure criteria, Effect of inter laminar structures. Glass Reinforced Composites: Introduction, Continuously reinforced laminates-uni-directionally and multi directionally continuously reinforced laminates, Discontinuously reinforced laminates – Stiffness and Strength properties.

UNIT - IV:
GRP properties relevant to structural Design: Introduction, Short-term strength and stiffness-Tensile, compressive flexural and shearing,longterm strength and stiffness properties, temperature effects, effect on fire , structural joints , adhesive , mechanical , compositional joints , transformed sections.

UNIT - V:
Design of GRP Box Beams: Introduction, loading, span and cross-sectional shape, Selection of material, Beam manufacture, Beam stresses, Experimental Behaviour, Effect on Beam performance-Modulus of Elasticity, Compressive Strength, I value, prevention of compression buckling failure, Behaviour under long term loading.
Design of Stressed skinned roof structure: Introduction, loading and material properties, preliminary design, and computer analysis.

Text Books:

1. GRP in Structural Engineering M.Holmes and D.J.Just.

2. Mechanics of Composite materials and Structures by Manjunath Mukhopadhyay; Universities Press

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OPTIMIZATION TECHNIQUES
(Open Elective -II)

Objectives: To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems

Outcomes:
The student will be able to understand the basic principles of optimization, and in a position to formulate optimization models for a wide range of civil engineering problems and able to solve them.

UNIT - I:
Linear Programming: Introduction and need for optimization in engineering design, formulating linear programs, graphical solution of linear programs, special cases of linear programming.

UNIT II:
The Simplex Method: Converting a problem to standard form, the theory of the simplex method, the simplex algorithm, special situations in the simplex algorithm, obtaining initial feasible solution.

UNIT - III:
Duality and Sensitivity Analysis: Sensitivity analysis, shadow prices, dual of a normal linear program, duality theorems, dual simplex method. Integer Programming: Formulating integer programming problems, the branch-and-bound algorithm for pure integer programs, the branch-and-bound algorithm for mixed integer programs.

UNIT - IV:
Non-linear Programming: Introduction to non-linear programming (NLP), Convex and concave functions, NLP with one variable, Line search algorithms, Multivariable unconstrained problems, constrained problems, Lagrange Multiplier, The Karush-Kuhn-Tucker (KKT) conditions, the method of steepest ascent, convex combination method, penalty function, Quadratic programming,

UNIT - V:
Dynamic programming: Evolutionary algorithms: Genetic Algorithm, concepts of multiobjective optimization, Markov Process, Queuing Models.

Text Books:

1. S.S. Rao, Engineering Optimization: Theory and Practice, Wiley & Sons, New Jersey, 2009.
2. F.H. Hiller and G.J.Liberman, Introduction to Operations Research, Tata-McGraw-Hill, 2010.

Reference Books:

1. Introduction to Optimum Design by J.S.Arora,
2. W.L.Winston, Operations Research: Applications and Algorithm, 4th Edition, Cengage Learning, 1994.
3. K.Deb, Optimization for Engineering Design, Prentice Hall, 2013.

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CAD LAB

Objectives:
impart knowledge on the use of various softwares

Outcomes:
The learner will be able to understand and design the structures us

EXPERIMENT 1: Program using arrays and functions for matrix manipulation.
EXPERIMENT 2: Programs to draw bending moment and shear force diagrams. Using graphic in C
EXPERIMENT 3: Program for design of slabs. Using Excel
EXPERIMENT 4: Program for design of beams. Using Excel
EXPERIMENT 5: Program for design of column and footing using excel
EXPERIMENT 6: Analysis of truss using STAAD Pro.
EXPERIMENT 7: Analysis of multi storeyed space frame, using STAAD Pro.
EXPERIMENT 8: Analysis of Bridge deck slab