

**ACADEMIC REGULATIONS  
COURSE STRUCTURE  
AND  
DETAILED SYLLABUS**

**For  
CIVIL ENGINEERING**

**M.Tech. - STRUCTURAL ENGINEERING**



**JAWAHARLAL NEHRU TECHNOLOGY UNIVERSITY KAKINADA  
KAKINADA - 533 003, Andhra Pradesh, India**



**ACADEMIC REGULATIONS R13 FOR M. Tech (REGULAR)**  
**DEGREE COURSE**

Applicable for the students of M. Tech (Regular) Course from the Academic Year 2013-14 onwards

The M. Tech Degree of Jawaharlal Nehru Technological University Kakinada shall be conferred on candidates who are admitted to the program and who 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 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.

**2.0 AWARD OF M. Tech DEGREE**

- 2.1 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.
- 2.2 The student shall register for all 80 credits and secure all the 80 credits.
- 2.3 The minimum instruction days in each semester are 90.

**3.0 A. COURSES OF STUDY**

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

1. M.Tech- Structural Engineering
2. M.Tech- Transportation Engineering
3. M.Tech- Infrastructure Engineering & Management
4. ME- Soil Mechanics and Foundation Engineering
5. M.Tech- Environmental Engineering
6. M.Tech-Geo-Informatics
7. M.Tech-Spatial Information Technology

8. M.Tech- Civil Engineering
9. M.Tech -Geo-Technical Engineering
10. M.Tech- Remote Sensing
11. M.Tech- Power Electronics
12. M.Tech- Power & Industrial Drives
13. M.Tech- Power Electronics & Electrical Drives
14. M.Tech- Power System Control & Automation
15. M.Tech- Power Electronics & Drives
16. M.Tech- Power Systems
17. M.Tech- Power Systems Engineering
18. M.Tech- High Voltage Engineering
19. M.Tech- Power Electronics and Power Systems
20. M.Tech- Power System and Control
21. M.Tech- Power Electronics & Systems
22. M.Tech- Electrical Machines and Drives
23. M.Tech- Advanced Power Systems
24. M.Tech- Power Systems with Emphasis on High Voltage Engineering
25. M.Tech- Control Engineering
26. M.Tech- Control Systems
27. M.Tech- Electrical Power Engineering
28. M.Tech- Power Engineering & Energy System
29. M.Tech- Thermal Engineering
30. M.Tech- CAD/CAM
31. M.Tech- Machine Design
32. M.Tech- Computer Aided Design and Manufacture
33. M.Tech- Advanced Manufacturing Systems
34. M.Tech-Computer Aided Analysis & Design
35. M.Tech- Mechanical Engineering Design
36. M.Tech- Systems and Signal Processing
37. M.Tech- Digital Electronics and Communication Systems
38. M.Tech- Electronics & Communications Engineering
39. M.Tech- Communication Systems
40. M.Tech- Communication Engineering & Signal Processing
41. M.Tech- Microwave and Communication Engineering
42. M.Tech- Telematics

43. M.Tech- Digital Systems & Computer Electronics
44. M.Tech- Embedded System
45. M.Tech- VLSI
46. M.Tech- VLSI Design
47. M.Tech- VLSI System Design
48. M.Tech- Embedded System & VLSI Design
49. M.Tech- VLSI & Embedded System
50. M.Tech- VLSI Design & Embedded Systems
51. M.Tech- Image Processing
52. M.Tech- Digital Image Processing
53. M.Tech- Computers & Communication
54. M.Tech- Computers & Communication Engineering
55. M.Tech- Instrumentation & Control Systems
56. M.Tech – VLSI & Micro Electronics
57. M.Tech – Digital Electronics & Communication Engineering
58. M.Tech- Embedded System & VLSI
59. M.Tech- Computer Science & Engineering
60. M.Tech- Computer Science
61. M.Tech- Computer Science & Technology
62. M.Tech- Computer Networks
63. M.Tech- Computer Networks & Information Security
64. M.Tech- Information Technology
65. M.Tech- Software Engineering
66. M.Tech- Neural Networks
67. M.Tech- Chemical Engineering
68. M.Tech- Biotechnology
69. M.Tech- Nano Technology
70. M.Tech- Food Processing
71. M.Tech- Avionics

and any other course as approved by AICTE/ University from time to time.

**3.0 B. Departments offering M. Tech Programmes with specializations are noted below:**

<b>Civil Engg.</b>	<ol style="list-style-type: none"> <li>1. M.Tech- Structural Engineering</li> <li>2. M.Tech- Transportation Engineering</li> <li>3. M.Tech- Infrastructure Engineering &amp; Management</li> <li>4. ME- Soil Mechanics and Foundation Engineering</li> <li>5. M.Tech- Environmental Engineering</li> <li>6. M.Tech-Geo-Informatics</li> <li>7. M.Tech-Spatial Information Technology</li> <li>8. M.Tech- Civil Engineering</li> <li>9. M.Tech -Geo-Technical Engineering</li> <li>10. M.Tech- Remote Sensing</li> </ol>
<b>EEE</b>	<ol style="list-style-type: none"> <li>1. M.Tech- Power Electronics</li> <li>2. M.Tech- Power &amp; Industrial Drives</li> <li>3. M.Tech- Power Electronics &amp; Electrical Drives</li> <li>4. M.Tech- Power System Control &amp; Automation</li> <li>5. M.Tech- Power Electronics &amp; Drives</li> <li>6. M.Tech- Power Systems</li> <li>7. M.Tech- Power Systems Engineering</li> <li>8. M.Tech- High Voltage Engineering</li> <li>9. M.Tech- Power Electronics and Power Systems</li> <li>10. M.Tech- Power System and Control</li> <li>11. M.Tech- Power Electronics &amp; Systems</li> <li>12. M.Tech- Electrical Machines and Drives</li> <li>13. M.Tech- Advanced Power Systems</li> <li>14. M.Tech- Power Systems with Emphasis on High Voltage Engineering</li> <li>15. M.Tech- Control Engineering</li> <li>16. M.Tech- Control Systems</li> <li>17. M.Tech- Electrical Power Engineering</li> <li>18. M.Tech- Power Engineering &amp; Energy System</li> </ol>
<b>ME</b>	<ol style="list-style-type: none"> <li>1. M.Tech- Thermal Engineering</li> <li>2. M.Tech- CAD/CAM</li> <li>3. M.Tech- Machine Design</li> <li>4. M.Tech- Computer Aided Design and Manufacture</li> <li>5. M.Tech- Advanced Manufacturing Systems</li> <li>6. M.Tech-Computer Aided Analysis &amp; Design</li> <li>7. M.Tech- Mechanical Engineering Design</li> </ol>

<b>ECE</b>	<ol style="list-style-type: none"><li>1. M.Tech- Systems and Signal Processing</li><li>2. M.Tech- Digital Electronics and Communication Systems</li><li>3. M.Tech- Electronics &amp; Communications Engineering</li><li>4. M.Tech- Communication Systems</li><li>5. M.Tech- Communication Engineering &amp; Signal Processing</li><li>6. M.Tech- Microwave and Communication Engineering</li><li>7. M.Tech- Telematics</li><li>8. M.Tech- Digital Systems &amp; Computer Electronics</li><li>9. M.Tech- Embedded System</li><li>10. M.Tech- VLSI</li><li>11. M.Tech- VLSI Design</li><li>12. M.Tech- VLSI System Design</li><li>13. M.Tech- Embedded System &amp; VLSI Design</li><li>14. M.Tech- VLSI &amp; Embedded System</li><li>15. M.Tech- VLSI Design &amp; Embedded Systems</li><li>16. M.Tech- Image Processing</li><li>17. M.Tech- Digital Image Processing</li><li>18. M.Tech- Computers &amp; Communication</li><li>19. M.Tech- Computers &amp; Communication Engineering</li><li>20. M.Tech- Instrumentation &amp; Control Systems</li><li>21. M.Tech – VLSI &amp; Micro Electronics</li><li>22. M.Tech – Digital Electronics &amp; Communication Engineering</li><li>23. M.Tech- Embedded System &amp; VLSI</li></ol>
<b>CSE</b>	<ol style="list-style-type: none"><li>1. M.Tech- Computer Science &amp; Engineering</li><li>2. M.Tech- Computer Science</li><li>3. M.Tech- Computer Science &amp; Technology</li><li>4. M.Tech- Computer Networks</li><li>5. M.Tech- Computer Networks &amp; Information Security</li><li>6. M.Tech- Information Technology</li><li>7. M.Tech- Software Engineering</li><li>8. M.Tech- Neural Networks</li></ol>
<b>Others</b>	<ol style="list-style-type: none"><li>1. M.Tech- Chemical Engineering</li><li>2. M.Tech- Biotechnology</li><li>3. M.Tech- Nano Technology</li><li>4. M.Tech- Food Processing</li><li>5. M.Tech- Avionics</li></ol>

#### 4.0 ATTENDANCE

- 4.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.
- 4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.
- 4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.
- 4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.
- 4.5 A prescribed fee shall be payable towards condonation of shortage of attendance.
- 4.6 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 into the same class.

#### 5.0 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.

- 5.1 For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The 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 instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks. End semester examination is conducted for 60 marks for 5 questions to be answered out of 8 questions.



- 5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day-to-day performance as Internal Marks.
- 5.3 There shall be two seminar presentations during III semester and IV 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 Project Review 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 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.
- 5.4 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 End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.
- 5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the End semester Examination in that subject. A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination. In such a case, the candidate must re-register for the subject(s) 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 end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled. For re-registration the candidates have to apply to the University through the college by paying the requisite fees and get approval from the University before the start of the semester in which re-registration is required.

- 5.6 In case the candidate secures less than the required attendance in any re registered subject (s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered.
- 5.7 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher of the respective college and the second examiner shall be appointed by the university from the panel of examiners submitted by the respective college.

## **6.0 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.

- 6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members.
- 6.2 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.
- 6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).
- 6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the Project Review Committee (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.
- 6.5 A candidate shall submit his status report in two stages at least with a gap of 3 months between them.
- 6.6 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 theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. The candidate has to pass all the theory and practical subjects before submission of the Thesis.

- 6.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.
- 6.8 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.
- 6.9 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the University.
- 6.10 If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work as one of the following:
  - A. Excellent
  - B. Good
  - C. Satisfactory
  - D. Unsatisfactory

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

- 6.11 If the report of the Viva-Voce is unsatisfactory, the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the University.

## **7.0 AWARD OF DEGREE AND CLASS**

After a 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 four classes:

<b>Class Awarded</b>	<b>% of marks to be secured</b>
First Class with Distinction	70% and above (Without any Supplementary Appearance )
First Class	Below 70% but not less than 60% 70% and above (With any Supplementary Appearance )
Second Class	Below 60% but not less than 50%

The marks in internal evaluation and end examination shall be shown separately in the memorandum of marks.

## **8.0 WITHHOLDING OF RESULTS**

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. His degree will be withheld in such cases.

## **9 .0 TRANSITORY REGULATIONS (for R09)**

- 9.1 Discontinued or detained candidates are eligible for re-admission into same or equivalent subjects at a time as and when offered.
- 9.2 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 R13 academic regulations.

## **10. GENERAL**

- 10.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.
- 10.2 The academic regulation should be read as a whole for the purpose of any interpretation.
- 10.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- 10.4 The University 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 University.

**MALPRACTICES RULES****DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS**

	<b>Nature of Malpractices/ Improper conduct</b>	<b>Punishment</b>
	<i>If the candidate:</i>	
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 he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in 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 candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
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	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project

	(theory or practical) in which the candidate is appearing.	work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an 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 out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and

	the examination.	shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate 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 organizes 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 written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or	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 candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates 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.

	<p>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.</p>	
7.	<p>Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.</p>	<p>Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.</p>
8.	<p>Possess any lethal weapon or firearm in the examination hall.</p>	<p>Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining</p>



		examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate 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 other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the 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 the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work 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 the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work 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.	

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**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) Impose a 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.



# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA



KAKINADA-533003, Andhra Pradesh (India)






For Constituent Colleges and Affiliated Colleges of JNTUK

# Ragging

## Prohibition of ragging in educational institutions Act 26 of 1997

### Salient Features

- ⇒ Ragging within or outside any educational institution is prohibited.
- ⇒ Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing and Humiliation	 6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	 1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	 2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	 5 Years	+	Rs.10,000/-
Causing death or abetting suicide	 10 Months	+	Rs. 50,000/-

In Case of Emergency CALL TOLL FREE NO. : 1800 - 425 - 1288

LET US MAKE JNTUK RAGGING FREE UNIVERSITY



# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA



KAKINADA-533003, Andhra Pradesh (India)  
For Constituent Colleges and Affiliated Colleges of JNTUK

# Ragging

## ABSOLUTELY NO TO RAGGING

1. Ragging is prohibited as per Act 26 of A.P. Legislative Assembly, 1997.
2. Ragging entails heavy fines and/or imprisonment.
3. Ragging invokes suspension and dismissal from the College.
4. Outsiders are prohibited from entering the College and Hostel without permission.
5. Girl students must be in their hostel rooms by 7.00 p.m.
6. All the students must carry their Identity Card and show them when demanded
7. The Principal and the Wardens may visit the Hostels and inspect the rooms any time.



**Jawaharlal Nehru Technological University Kakinada**  
**For Constituent Colleges and Affiliated Colleges of JNTUK**

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**LET US MAKE JNTUK A RAGGING FREE UNIVERSITY**

**DEPARTMENT OF CIVIL ENGINEERING**

Revised course structure for

**M.Tech (Structural Engineering) (DT)****I Year – I SEMESTER Programme**

S.No	Name of the Subject	L	P	C
1	Advanced Mathematics	4		3
2	Theory of Elasticity	4	—	3
3	Matrix Analysis of Structures	4	—	3
4	Structural Dynamics	4	—	3
5	<b>Elective – I</b>	4	—	3
	a) Experimental Stress Analysis b) Sub-Structure Design c) Structural Optimization			
6	<b>Elective – II</b>	4	---	3
	a) Repair and Rehabilitation of Structures b) Analysis and Design of Tall Buildings c) Plastic Analysis and Design			
7	Advanced Structural Engineering Laboratory	—	3	2
	<b>Total</b>			<b>20</b>

**II SEMESTER**

1	Finite Element Method	4		3
2	Earthquake Resistant Design	4	—	3
3	Stability of Structures		—	3
4	Theory of Plates & Shells	4	—	3
5	<b>Elective - III</b>	4	—	3
	a) Pre-stressed Concrete b) Mechanics of Composite Materials c) Fracture Mechanics		—	
6	<b>Elective – IV</b>	4	---	3
	a) Industrial Structures b) Bridge Engineering c) Earth Retaining Structures			
7	CAD Laboratory	—	3	2
	<b>Total</b>			<b>20</b>

**III SEMESTER**

1	Seminar	—	—	2
2	Dissertation / Thesis	—	—	18
	<b>Total</b>			<b>20</b>

**IV SEMESTER**

1	Seminar	—	—	2
2	Dissertation / Thesis	—	—	18
	<b>Total</b>			<b>20</b>

**SYLLABUS**

I – I	L	P	Credits
	4	-	3
<b>ADVANCED MATHEMATICS</b>			

**Common for M.Tech.**

**(Structural Engineering, Soil Mechanics & Foundation Engineering, Geotechnical Engineering, and Transportation Engineering)**

**UNIT-I**

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

**UNIT-II**

Numerical solutions to Heat and Laplace Equations in Cartesian coordinates using finite – differences. Implicit methods, Crank NicholSEN Method, Jacobi Method, Gauss Seidal method.

**UNIT-III**

Applied Statistics: Regression and correlation analysis – Method of Least squares – Curve fitting – Curvilinear Regression – Non-linear curves – correlation coefficient – Correlation of grouped bi-variate data – coefficient of determination Multiple Regression – partial Regression coefficients.

**UNIT-IV**

Tests of significance – Analysis of variance for regression – Multiple correlation coefficients – Multiple linear regression with two independent variables.

**UNIT-V**

Linear Programming Problem Formation, Graphical Method, Simplex method, artificial variable method-Big-M method-Two Phase Method.

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Non Linear Programming Problem Gradient method, Steepest Ascent  
Descent Methods.

**TEXT BOOKS**

1. Solutions of Partial Differential Equations” – Duffy, D.G. CBS Publishers, 1988
2. Introductory Methods of Numerical Analysis – Sastry, S.S. Prentice-Hall, 2<sup>nd</sup> Edition, 1992
3. Basic Statistics – Agarwal, B.L., Wiley 1991, 2<sup>nd</sup> edition.
4. Operations Research – Hamdy A, Taha. Optimization Techniques.- S.S.Rao:.



I - I	L	P	Credits
	4	-	3
<b>THEORY OF ELASTICITY</b>			

**UNIT-I**

Elasticity – Notation for forces and stresses – components of stresses and strains – Hooke’s Law - Plane Stress – Plane strain – Differential Equations of equilibrium – Boundary conditions – Compatibility equations - Stress function – Boundary Conditions.

**UNIT-II**

Two dimensional problems in rectangular co-ordinates – Solution by polynomials – Saint Venant’s principle – Determination of displacements – Bending of simple beams – Application of Fourier series for two dimensional problems for gravity loading

**UNIT-III**

Two dimensional problems in polar co-ordinates - General equations in polar co-ordinates – Stress distribution for problems having symmetrical about an axis - Strain components in polar co-ordinates – Displacements for symmetrical stress distributions - Stresses for plates with circular holes subjected to far field tension – stress concentration factor.

**UNIT-IV**

Analysis of stress and strain in three dimension - Principal stresses – Stress ellipsoid and stress director surface – Determination of principal stresses - Maximum shear stress – Homogeneous Deformation – General Theorems - Differential equations of equilibrium – Conditions of compatibility – Equations of equilibrium in terms of displacements – Principle of superposition – Uniqueness of solution –Reciprocal theorem.

**UNIT-V**

Torsion of prismatical bars – Bars with elliptical cross section – Other elementary solution – Membrane analogy – Torsion of rectangular bars – Solution of torsional problems by energy method.

**REFERENCES**

1. Theory of Elasticity- Timoshenko & Goodier
2. Elasticity: Theory, Applications and Numeric- Martin H. Sadd

I - I	L	P	Credits
	4	-	3
<b>MATRIX ANALYSIS OF STRUCTURES</b>			

**UNIT-I**

Introduction of matrix methods of analysis – Static indeterminacy and kinematic indeterminacy – Degree of freedom – Structure idealization- stiffness and flexibility methods – Suitability: Element stiffness matrix for truss element, beam element and Torsional element- Element force - displacement equations

**UNIT-II**

Stiffness method – Element and global stiffness equation – coordinate transformation and global assembly – structure stiffness matrix equation – analysis of simple pin jointed trusses – continuous beams – rigid jointed plane frames

**UNIT-III**

Stiffness method for Grid elements – development of stiffness matrix – coordinate transformation. Examples of grid problems – tapered and curved beams

**UNIT-IV**

Additional topics in stiffness methods – discussion of band width – semi band width – static condensation – sub structuring –Loads between joints-Support displacements- inertial and thermal stresses- Beams on elastic foundation by stiffness method.

**UNIT-V**

Space trusses and frames - Member stiffness for space truss and space frame– Transformation matrix from Local to Global – Analysis of simple trusses, beams and frames

**REFERENCES:**

1. Matrix analysis of structures- Robert E Sennet- Prentice Hall- Englewood cliffs-New Jercy
2. Advanced structural analysis-Dr. P. Dayaratnam- Tata McGraw hill publishing company limited.
3. Indeterminate Structural analysis- C K Wang
4. Analysis of tall buildings by force – displacement – Method M. Smolira – Mc. Graw Hill.
5. Foundation Analysis and design – J.E. Bowls.

I - I	L	P	Credits
	4	-	3
<b>STRUCTURAL DYNAMICS</b>			

**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.

**UNIT-IV**

**Multi Degree of Freedom System:** Selection of the Degrees of Freedom – Evaluation of Structural Property Matrices – Formulation of the MDOF equations of motion - Undamped free vibrations – Solution of Eigen value problem for natural frequencies and mode shapes – Analysis of dynamic response - Normal coordinates.

**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.

**REFERENCES:**

1. Dynamics of Structures by Clough & Penzien.
2. Structural Dynamics A K Chopra

I - I	L	P	Credits
	4	-	3
<b>(ELECTIVE I)</b> <b>EXPERIMENTAL STRESS ANALYSIS</b>			

**UNIT-I**

Introduction and Strain measurement methods – Model & Prototype – Dimensional analysis-Factors influencing model design – Scale factors and Model material properties – Methods of model design. Definition of strain and its relation to experimental determinations - properties of strain gauge systems – Mechanical, Optical, Acoustic and Pneumatic types.

**UNIT-II**

Electrical resistance strain gages: Introduction – gauge construction – strain gauge adhesives - mounting methods – gauge sensitivities and gage factor – performance characteristics of wire and foil strain gauges – environmental effects. Analysis of strain gauge data – the three element rectangular rosette – the delta rosette – correction for transverse sensitivity.

**UNIT-III**

Non – destructive testing: Introduction – objectives of non destructive testing. Ultrasonic pulse velocity method – Rebound Hammer method (Concrete hammer) – Acoustic Emission- application to assessment of concrete quality.

**UNIT-IV**

Theory of photo elasticity: Introduction – temporary double refraction – Index ellipsoid and stress ellipsoid – the stress optic law – effects of stressed model in a polariscope for various arrangements - fringe sharpening.

**UNIT-V**

Two dimensional photo elasticity: Introduction – iso-chromatic fringe patterns – isoclinic fringe patterns – compensation techniques –

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calibration methods – separation methods – materials for photo-elasticity – properties of photo-elastic materials.

**REFERENCES:**

1. Experimental Stress Analysis- Riley and Dally
2. Experimental Stress Analysis - L.S. Srinath
3. Experimental Stress Analysis – Lee
4. Experimental Stress Analysis- Sadhu Singh

I - I	L	P	Credits
	4	-	3
<b>(ELECTIVE I)</b> <b>SUB-STRUCTURE DESIGN</b>			

**UNIT-I**

Soil Exploration – Importance, Terminology, planning - Geophysical methods. Borings, location, spacing and depth, methods of boring including drilling, stabilization of boreholes, boring records.

**UNIT-II**

Soil sampling – Methods of sampling -Types of samples and samplers-cleaning of bore holes, preservation, labeling and shipment of samples - Design considerations of open drive samplers.

**UNIT-III**

Shallow Foundations –Bearing capacity – General bearing capacity equation, Meyerhof's, Hansen's and Vesic's bearing capacity factors - Bearing capacity of stratified soils - Bearing capacity based on penetration resistance- safe bearing capacity and allowable bearing pressure. (Ref: IS -2131 & IS 6403)

**UNIT-IV**

Types and choice of type. Design considerations including location and depth, Proportioning of shallow foundations- isolated and combined footings and mats - Design procedure for mats. Floating foundation- Fundamentals of beams on Elastic foundations. .(Ref: IS -456 & N.B.C. relevant volume).

**UNIT-V**

Pile foundations-Classification of piles-factors influencing choice-Load -carrying capacity of single piles in clays and sands using static pile formulae-  $\hat{\alpha}$  -  $\hat{\beta}$  - and  $\lambda$  - methods –Dynamic pile formulae-limitations- Monotonic and cyclic pile load tests – Under reamed piles.

Pile groups -Efficiency of pile groups- Different formulae-load carrying capacity of pile groups in clays and sands – settlement of pile groups in clays and sands – Computation of load on each pile in a group.

**REFERENCES:**

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1. Principles of Foundation Engineering by Braja M. Das.
2. Soil Mechanics in Engineering Practice by Terzaghi and Peck
3. Foundation Design by Wayne C. Teng, John Wiley & Co.,
4. Foundation Analysis and Design by J.E. Bowles McGraw Hill Publishing Co.,
5. Analysis and Design of sub structures by Swami Saran
6. Design Aids in Soil Mechanics and Foundation Engineering by Shanbaga R. Kaniraj, Tata Mc. Graw Hill.
7. Foundation Design and Construction by MJ Tomlinson – Longman Scientific
8. A short course in Foundation Engineering by Simmons and Menzes – ELBS.

I - I	L	P	Credits
	4	-	3
<b>(ELECTIVE-I)</b>			
<b>STRUCTURAL OPTMIZATION</b>			

**UNIT-I**

Introduction: Need and scope for optimization – statements of optimization problems- Objective function and its surface design variables- constraints and constraint surface- Classification of optimization problems (various functions continuous, discontinuous and discrete) and function behavior (monotonic and unimodal)

**UNIT-II**

Classical optimization techniques: Differential calculus method, multi variable optimization by method of constrained variation and Lagrange multipliers (generalized problem) Khun-Tucker conditions of optimality -Fully stressed design and optimality criterion based algorithms-introduction, characteristics of fully stressed design theoretical basis-examples

**UNIT-III**

Non-Liner programming: Unconstrained minimization- Fibonacci, golden search, Quadratic and cubic interpolation methods for a one dimensional minimization and univariate method, Powel's method, Newton's method and Davidon Fletcher Powell's method for multivariable optimization- Constrained minimization- Cutting plane method- Zoutendijk's method- penalty function methods

**UNIT-IV**

Linear programming: Definitions and theorems- Simplex method-Duality in Linear programming- Plastic analysis and Minimum weight design and rigid frame

**UNIT-V**

Introduction to quadratic programming: Geometric programming- and dynamic programming- Design of beams and frames using dynamic programming technique

**REFERENCES**

1. Optimization Theory and Applications – S.S. Rao, Wiley Eastern Limited, New Delh  
Optimization Concepts and Application in Engineering- Belegundu A.D. and Chandrupatla T.R



I - I	L	P	Credits
	4	-	3
<b>(ELECTIVE-II)</b>			
<b>REPAIR AND REHABILITATION OF STRUCTURES</b>			

1. Materials for repair and rehabilitation -Admixtures- types of admixtures- purposes of using admixtures- chemical composition- Natural admixtures- Fibres- wraps- Glass and Carbon fibre wraps- Steel Plates- Non destructive evaluation: Importance- Concrete behavior under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods- Corrosion activity measurement- chloride content – Depth of carbonation- Impact echo methods- Ultrasound pulse velocity methods- Pull out tests.
2. Strengthening and stabilization- Techniques- design considerations- Beam shear capacity strengthening- Shear Transfer strengthening- stress reduction techniques- Column strengthening-flexural strengthening- Connection stabilization and strengthening, Crack stabilization.
3. Bonded installation techniques- Externally bonded FRP- Wet layup sheet, bolted plate, near surface mounted FRP, fundamental debonding mechanisms-intermediate crack debonding- CDC debonding- plate end debonding- strengthening of floor of structures.
4. Fibre reinforced concrete- Properties of constituent materials- Mix proportions, mixing and casting methods-Mechanical properties of fiber reinforced concrete- applications of fibre reinforced concretes- Light weight concrete- properties of light weight concrete- No fines concrete- design of light weight concrete- Flyash concrete- Introduction- classification of flyash- properties and reaction mechanism of flyash- Properties of flyash concrete in fresh state and hardened state- Durability of flyash concretes.
5. High performance concretes- Introduction- Development of high performance concretes- Materials of high performance concretes-

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Properties of high performance concretes- Self Consolidating concrete-  
properties- qualifications.

**REFERENCE:**

1. Concrete technology- Neville & Brooks
2. Special Structural concrete- Rafat Siddique
3. Concrete repair and maintenance illustrated- Peter H Emmons
4. Concrete technology-M S Shetty

I - I	L	P	Credits
	4	-	3
<b>(ELECTIVE-II)</b>			
<b>ANALYSIS AND DESIGN OF TALL BUILDINGS</b>			

1. Design Criteria Philosophy, Materials – Modern concepts – High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self Compacting Concrete
2. Gravity Loading – Dead load, Live load, Impact load, Construction load, Sequential loading. Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods. Earthquake Loading – Equivalent lateral Load analysis, Response Spectrum Method, Combination of Loads.
3. Behavior of Structural Systems- Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, In-filled frames, Shear walls, Coupled Shear walls, Wall-Frames, Tubular, Outrigger braced, Hybrid systems.
4. Analysis and Design- Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of structures as an integral unit, Analysis for member forces, drift and twist. Computerized 3D analysis. Design for differential movement, Creep and Shrinkage effects, Temperature Effects and Fire Resistance.
5. Stability Analysis- Overall buckling analysis of frames, wall-frames, Approximate methods, Second order effect of gravity loading, P-Delta Effects, Simultaneous first order and P-Delta analysis, Translational instability, Torsional Instability, Out of plumb effects, Effect of stiffness of members and foundation rotation in stability of structures.

#### **TEXTBOOKS:**

1. Bryan Stafford Smith and Alex Coull, "Tall Building Structures - Analysis and Design", John Wiley and Sons, Inc., 1991.
2. Taranath B.S, "Structural Analysis and Design of Tall Buildings", McGraw-Hill, 1988.

I - I	L	P	Credits
	4	-	3
<b>(ELECTIVE-II)</b> <b>PLASTIC ANALYSIS AND DESIGN</b>			

1. 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.
2. Method of Limit Analysis: Introduction to limit analysis of simply supported fixed beams and continuous beams, Effect of partial fixity and end, invariance of collapse loads, basic theorems of limit analysis, rectangular portal frames, gable frames, grids, superposition of mechanisms, drawing statistical bending moment diagrams for checks.
3. 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.
4. 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.
5. Minimum weight Design: Introduction to minimum Weight and linear Weight functions- Foulkes theorems and its geometrical analogue and absolute minimum weight design.

#### **REFERENCES:**

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

I - I	<b>L</b>	<b>P</b>	<b>Credits</b>
	-	<b>3</b>	<b>2</b>
<b>ADVANCED STRUCTURAL ENGINEERING LABORATORY</b>			

1. Strain measurement - Electrical resistance strain gauges
2. Non destructive testing- Impact Hammer test, UPV test
3. Qualifications tests on Self compaction concrete- L Box test, J Box test, U box test, Slump test
4. Tests on Buckling of columns – Southwell plot
5. Identification of Dynamic Mode shapes and frequencies
6. Repair and rehabilitation of concrete beams

**NOTE: A minimum of five experiments from the above set have to be conducted.**

I – II	L	P	Credits
	4	-	3
<b>FINITE ELEMENT METHOD</b>			

1. Introduction: Review of stiffness method- Principle of Stationary potential energy-Potential energy of an elastic body- Rayleigh-Ritz method of functional approximation - variational approaches -weighted residual methods
2. Finite Element formulation of truss element: Stiffness matrix- properties of stiffness matrix –Selection of approximate displacement functions- solution of a plane truss- transformation matrix and stiffness matrix for a 3-D truss- Inclined and skewed supports- Galerkin’s method for 1-D truss – Computation of stress in a truss element.
3. Finite element formulation of Beam elements: Beam stiffness- assemblage of beam stiffness matrix- Examples of beam analysis for concentrated and distributed loading- Galerkin’s method - 2-D Arbitrarily oriented beam element – inclined and skewed supports – rigid plane frame examples
4. Finite element formulation for plane stress, plane strain and axisymmetric problems- Derivation of CST and LST stiffness matrix and equations-treatment of body and surface forces-Finite Element solution for plane stress and axisymmetric problems- comparison of CST and LST elements –convergence of solution- interpretation of stresses
5. Iso-parametric Formulation: An isoparametric bar element- plane bilinear isoparametric element – quadratic plane element - shape functions, evaluation of stiffness matrix, consistent nodal load vector - Gauss quadrature- appropriate order of quadrature – element and mesh instabilities – spurious zero energy modes, stress computation- patch test.

#### **REFERENCES:**

1. Concepts and applications of Finite Element Analysis – Robert D. Cook, Michael E Plesha, John Wiley & sons Publications
2. A first course in the Finite Element Method – Daryl L. Logan, Thomson Publications.
3. Introduction to Finite Elements in Engineering- Tirupati R. Chandrupatla, Ashok D. Belgunda, PHI publications.

I – II	L	P	Credits
	4	-	3

**EARTHQUAKE RESISTANT DESIGN**

1. Engineering seismology – rebound theory – plate tectonics – seismic waves - earthquake size and various scales – local site effects – Indian seismicity – seismic zones of India – theory of vibrations – near ground and far ground rotation and their effects.
2. 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.
3. Calculation of EQ load – 3D modeling of building systems and analysis (theory only) Design and ductile detailing of Beams and columns of frames Concept of strong column weak beams, Design and ductile detailing of shear walls
4. Cyclic loading behavior of RC, steel and pre- stressed concrete elements - modern concepts- Base isolation – Adaptive systems – case studies.
5. Retrofitting and restoration of buildings subjected to damage due to earthquakes- effects of earthquakes – factors related to building damages due to earthquake- methods of seismic retrofitting- restoration of buildings

## REFERENCES

1. Pankaj Agarwal and Manish ShriKhande, Earthquake Resistant Design of Structures, Prentice – Hall of India, 2007, New Delhi.
2. Bullen K.E., Introduction to the Theory of Seismology, Great Britain at the University Printing houses, Cambridge University Press 1996.
3. Relevant code of practices.

I – II	L	P	Credits
	4	-	3

**STABILITY OF STRUCTURES**

1. Beam columns: Differential equation for beam columns – Beams column with concentrated loads – continuous lateral load – couples – Beam column with built in ends – continuous beams with axial load – application of Trigonometric series – Determination of allowable stresses.
2. Elastic buckling of bars : Elastic buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns – Sway & Non Sway mode - Energy methods – Buckling of a bar on elastic foundation – Buckling of 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 – Effect of Initial curvature on bars – Buckling of frames – Sway & Non Sway mode.
3. In-elastic buckling: Buckling of straight bars – Double modulus theory Tangent modulus theory. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae of design – various end conditions – Design of columns based on buckling. Mathematical Treatment of stability problems: Buckling problem orthogonality relation – Ritz method – Stiffness method and formulation of Geometric stiffness matrix- Applications to simple frames
4. Torsional 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 of Torsion and Flexure.
5. Lateral Buckling of simply supported Beams: Beams of rectangular cross section subjected for pure bending, Buckling of I Section subjected to pure bending.

#### REFERENCES:

1. Theory of Elastic stability by Timshenko & Gere-Mc Graw Hill
2. Theory of Stability of Structures by Alexander ChaJes.



I - II	L	P	Credits
	4	-	3
<b>THEORY OF PLATES AND SHELLS</b>			

1. Derivation of governing differential equation for plate– in plane bending and transverse bending effects- Rectangular plates: Plates under various loading conditions like concentrated, uniformly distributed load and hydrostatic pressure. Navier and Levy’s type of solutions for various boundary condition.
2. Circular plates: Symmetrically loaded, circular plates under various loading conditions, Annular plates.
3. Introduction to Shells- Single and double curvature- Equations of Equilibrium of Shells: Derivation of stress resultants, Principles of membrane theory and bending theory.
4. Cylindrical Shells: Derivation of the governing DKJ equation for bending theory, details of Schorer’s theory. Application to the analysis and design of short and long shells. Use of ASCE Manual coefficients for the design.
5. Beam theory of cylindrical shells: Beam and arch action. Design of diaphragms - Geometry analysis and design of elliptic Paraboloid, Conoidal and Hyperbolic Paraboloid shapes by membrane theory.

#### REFERENCES:

1. Theory of Plates and Shells – Timoshenko and Krieger, McGraw-Hill book company, INC, New york.
2. K. Chandra Sekhara
3. A Text Book of Plate Analysis – Bairagi, K, Khanna Publisher, New Delhi.
4. Design and Construction of Concrete Shell Roofs – Ramaswamy, G.S, Mc Graw – Hill, New York.

I – II	L	P	Credits
	4	-	3
<b>(ELECTIVE –III)</b> <b>PRESTRESSED CONCRETE</b>			

1. General principles of Pre-stressing- Pre-tensioning and Post tensioning  
- Pre tensioning and Post tensioning methods- Different systems of Pre-stressing- Analysis of prestress and Bending stresses– Resultant – stress at a section – pressure line – concept of load balancing – stresses in tendons.
2. Losses of Pre-stressing- Loss of Pre-stress in pre-tensioned and post tensioned members due to various causes -Elastic shortening of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel, slip in anchorage, differential shrinkage- bending of members and frictional losses- Long term losses
3. Flexural, shear; torsional resistance and design of Prestressed concrete section. Types of flexural failure – code procedures-shear and principal stresses – Prestressed concrete members in torsion – Design of sections for flexure, Axial Tension, Compression and bending, shear, Bond
4. Analysis of continuous beams –Elastic theory- Linear transformation and Concordant tendons- Deflections of pre-stressed concrete beams: Importance of control of deflections- factors influencing deflections- short term deflections of un-cracked member – prediction of long term deflections
5. Analysis of end blocks: By Guyon’s method and Magnel’s method, Anchorage zone stresses- Approximate method of design- anchorage zone reinforcement- transfer of pre stresses- pre tensioned members- Composite sections: Introduction-Analysis for stresses- differential shrinkage- general design considerations

#### **REFERENCES:**

1. Prestressed Concrete- N. Krishna Raju
2. Prestressed Concrete- S. Ramamrutham
3. Prestressed Concrete- P. Dayaratnam
4. Prestressed Concrete- T.Y.Lin

I – II	L	P	Credits
	4	-	3

**(ELECTIVE –III)**  
**MECHANICS OF COMPOSITE MATERIALS**

- 1. Introduction to Composite Materials:** Introduction ,Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and application-**Reinforcements:** Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.-**Manufacturing methods:** Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.
- 2. Macromechanical Analysis of a Lamina:** Introduction, Definitions: Stress, Strain ,Elastic Moduli, Strain Energy. Hooke’s Law for Different Types of Materials, Hooke’s Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke’s Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina,
- 3. Hooke’s Law for a Two-Dimensional Angle Lamina,** Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina Strength Failure Theories of an Angle Lamina : Maximum Stress Failure Theory Strength Ratio, Failure Envelopes, Maximum Strain Failure Theory ,Tsai–Hill Failure Theory, Tsai–Wu Failure Theory, Comparison of Experimental Results with Failure Theories. Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress–Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress–Strain Relationships for an Angle Lamina
- 4. Micromechanical Analysis of a Lamina :**Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi-Empirical Models, Elasticity Approach, Elastic Moduli of Lamina with Transversely

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Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion

5. **Macromechanical Analysis of Laminates:** Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates -**Failure, Analysis, and Design of Laminates :** Introduction , Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite

**TEXTBOOKS:**

1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.
3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw ,Publisher: CRC

I – II	L	P	Credits
	4	-	3
<b>(ELECTIVE –III)</b> <b>FRACTURE MECHANICS</b>			

1. 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 for crack propagation cracks- 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.
2. 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  $K_{IIIc}$  – 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.
3. Mixed mode crack propagation- Maximum tangential stress criterion – crack propagation angle -Material characterisation by Crack Tip Opening Displacements (CTOD)- Crack Mouth Opening Displacement (CMOD)- Critical crack tip opening displacement (CTOD<sub>c</sub>) –critical Crack Mouth Opening Displacement (CMOD<sub>c</sub>).
4. Fatigue Crack propagation- Fatigue load parameters Fatigue crack growth curve –Threshold stress intensity factor-Paris law- Retardation effects.
5. Applications of fracture Mechanics to concrete- reasons –strain softening behaviour –Bazant’s size effect law.

#### REFERENCES

1. Elementary engineering fracture mechanics – David Broek – Sijthoff & Noordhoff – Netherlands.
1. Elements of Fracture Mechanics – Prasanth Kumar, wiley Eastern Publications
2. Fracture Mechanics: Fundamentals and applications – T. L. Anderson, PhD, CRC publications
3. Fracture Mechanics of Concrete: Applications of fracture mechanics to concrete, Rock, and other quasi-brittle materials, Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang, John Wiley & Son publications.

I – II	L	P	Credits
	4	-	3
<b>(ELECTIVE –IV)</b> <b>INDUSTRIAL STRUCTURES</b>			

1. Planning and functional requirements- classification of industries and industrial structures- planning for layout- requirements regarding lighting ventilation and fire safety- protection against noise and vibrations
2. Industrial buildings- roofs for industrial buildings (Steel) - design of gantry girder- design of corbels and nibs- machine foundations
3. Design of Folded plates- Design considerations- analysis of folded plates- analysis of multibay folded plates- design of diaphragm beam
4. Power plant structures- Bunkers and silos- chimney and cooling towers- Nuclear containment structures
5. Power transmission structures- transmission line towers- tower foundations- testing towers

#### **REFERENCES:**

1. Advanced reinforced concrete design- N. Krishnam Raju
2. Handbook on machine foundations- P. Srinivasulu and C.V. Vaidyanathan
3. Tall Chimneys- Design and construction – S.N. Manohar
4. Transmission Line Structures- A.R. Santakumar and S.S. Murthy
5. SP 32: 1986, Handbook on functional requirements of Industrial buildings
6. Design of shells- K. Chandrasekhara

I – II	L	P	Credits
	4	-	3
<b>(ELECTIVE –IV)</b> <b>BRIDGE ENGINEERING</b>			

1. Masonry arch Bridge design details- Rise, radius, and thickness of arch- Arch ring- Dimensioning of sub structures- Abutments pier and end connections.(Ref: IRC- SP-13)
2. Super Structure: Slab bridge- Wheel load on slab- effective width method- slabs supported on two edges- cantilever slabs- dispersion length- Design of interior panel of slab- Pigeaud’s method- design of longitudinal girders- Guyon-Messonet method- Hendry Jaegar method- Courbon’s theory. (Ref: IRC-21), voided slabs, T-Beam bridges.
3. Plate girder bridges- Elements of plate girder and their design-web-flange- intermediate stiffener- vertical stiffeners- bearing stiffener- design problem
4. Prestressed Concrete and Composite bridges- Preliminary dimensions- flexural and torsional parameters- Courbon’s Theory – Distribution coefficients by exact analysis- design of girder section- maximum and minimum prestressing forces- eccentricity- live load and dead load shear forces- cable zone in girder- check for stresses at various sections- check for diagonal tension- diaphragms and end block design- short term and long term deflections- Composite action of composite bridges- shear connectors- composite or transformed section- design problem. (Ref: IRC: Section-VI)
5. Sub structure- Abutments- Stability analysis of abutments- piers- loads on piers – Analysis of piers- Design problem(Ref: IRC-13, IRC-21, IRC-78)- Pipe culvert- Flow pattern in pipe culvers- culvert alignment- culvert entrance structure- Hydraulic design and structural design of pipe culverts- reinforcements in pipes .(Ref: IRC: SP-13)

#### REFERENCES:

1. Design of concrete bridges- Aswini, Vazirani, Ratwani
2. Essentials of bridge engineering- Jhonson Victor D
3. Design of bridges- Krishna Raju

I – II	L	P	Credits
	4	-	3
<b>(ELECTIVE –IV)</b> <b>EARTH RETAINING STRUCTURES</b>			

1. Earth pressures – Different types and their coefficients- Classical Theories of Earth pressure – Rankine’s and Coulomb’s Theories for Active and Passive earth pressure- Computation of Lateral Earth Pressure in Homogeneous and Layered soils- Graphical solutions for Coulomb’s Theory in active and passive conditions.
2. Retaining walls – different types - Type of Failures of Retaining Walls – Stability requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.
3. Sheet Pile Structures – Types of Sheet piles – Cantilever sheet piles in sands and clays – Anchored sheet piles – Free earth and Fixed earth support methods – Row’s moment reduction method – Location of anchors, Forces in anchors.
4. Soil reinforcement – Reinforced earth - Different components – their functions – Mechanics of reinforced earth – Failure modes-Failure theories – Design of Embakments on problematic soils.
5. Braced cuts and Cofferdams: Lateral Pressure in Braced cuts – Design of Various Components of a Braced cut – Stability of Braced cuts – Bottom Heave in cuts. – types of cofferdam, suitability, merits and demerits – Design of single – wall cofferdams and their stability aspects – TVA method and Cummins’ methods.

## REFERENCES

1. Principles of Foundation Engineering by Braja M. Das.
2. Foundation analysis and design – Bowles, JE – McGraw Hill
3. Soil Mechanics in Engineering Practice – Terzaghi, K and Rolph, B. peck 2<sup>nd</sup> Edn. – John Wiley & Co.,
4. Analysis and Design of Foundations and Retaining Structures, Prakash, S – Saritha Prakashan, Mearut.



I - II	L	P	Credits
	-	3	2

**CAD LABORATORY**

**Analysis and Design using STADD, STRAP, STRUDS, ANSYS**

1. Programming for beams subject to different loading (mandatory).
2. Analysis of reinforced concrete multistoried building
3. Analysis of steel transmission line tower
4. Analysis of plane and space truss
5. Analysis of plane and space frame
6. Determination of mode shapes and frequencies of tall buildings using lumped mass (stick model) approximation
7. Wind analysis on tall structure
8. Analysis of pre stressed concrete bridge girder
9. Analysis of Cylindrical shell

**NOTE: A minimum of eight (including item 1) from the above set have to be conducted.**

**REFERENCE:**

Computer aided design laboratory (Civil Engineering) by Shesha Prakash and Suresh.s