ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

STRUCTURAL ENGINEERING

Department of Civil Engineering

M.Tech Two Year Degree Course

(Applicable for the batch admitted from 2017-18)

GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

Seshadri Rao Knowledge Village

GUDLAVALLERU - 521 356, Krishna District, Andhra Pradesh

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VISION, MISSION

OF THE

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AND

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VISION & MISSION OF THE COLLEGE

Vision

To be a leading institution of engineering education and research, preparing students for leadership in their fields in a caring and challenging learning environment.

Mission

- To produce quality engineers by providing state-of-the-art engineering education.
- To attract and retain knowledgeable, creative, motivated and highly skilled individuals whose leadership and contributions uphold the college tenets of education, creativity, research and responsible public service.
- To develop faculty and resources to impart and disseminate knowledge and information to students and also to society that will enhance educational level, which in turn, will contribute to social and economic betterment of society.
- To provide an environment that values and encourages knowledge acquisition and academic freedom, making this a preferred institution for knowledge seekers.
- To provide quality assurance.
- To partner and collaborate with industry, government, and R and D institutes to develop new knowledge and sustainable technologies and serve as an engine for facilitating the nation's economic development.
- To impart personality development skills to students that will help them to succeed and lead.
- To instil in students the attitude, values and vision that will prepare them to lead lives of personal integrity and civic responsibility.
- To promote a campus environment that welcomes and makes students of all races, cultures and civilizations feel at home.
- Putting students face to face with industrial, governmental and societal challenges.

VISION & MISSION OF THE DEPARTMENT

Vision

To provide quality education embedded with knowledge, ethics and advanced skills and preparing students globally competitive to enrich the civil engineering research and practice.

Mission:

- Aims at imparting integrated knowledge in basic and applied areas of civil engineering to cater the needs of industry, profession and the society at large.
- To develop faculty and infrastructure making the department a centre of excellence providing knowledge base with ethical values and transforming innovative and extension services to the community and nation.
- To make the department a collaborative hub with leading industries and organizations, promote research and development and combat the challenging problems in civil engineering which leads for sustenance of its excellence.

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO-I : To prepare the students with comprehensive and in depth understanding of knowledge and research directions in structural engineering discipline

PEO-II : To Prepare the students applying the established engineering method to solve complex and challenging engineering problem

PEO-III: To inculcate ethical practices in students making them creative innovative and pro-active demeanour and understand the significance of lifelong learning in global perspective.

IV. PROGRAM OUTCOMES (POs)

PO-1 : An ability to independently carry out research /investigation and development work to solve practical problems.

PO-2 : An ability to write and present a substantial technical report/document.

PO-3 : Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

V. ACADEMIC REGULATIONS

Applicable for the students of M.Tech from the Academic Year 2017-18.

1. Duration of the Program

The duration of the program is two academic years consisting of four semesters. However, a student is permitted to complete the course work of M.Tech program in the stipulated time frame of four academic years from the date of joining.

2. Minimum Instruction Days

Each semester consists of a minimum of ninety instruction days.

3. Program Credits

Each specialization of the M.Tech programs is designed to have a total of 70 credits and the student shall have to complete the two year course work and earn all the 70 credits for the award of M.Tech Degree.

4. Attendance Regulations

4.1 A student shall be eligible to appear for Semester End Examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

4.2 Condoning of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester will be considered for genuine reasons such as medical grounds and participation in co-curricular and extra-curricular activities and shall be granted only after approval by the College Academic Committee. Student should submit application for medical leave along with medical certificate from a registered medical practitioner within three days from reporting to the class work after the expiry of the medical leave. In case of participation in co-curricular and extra-curricular activities, either in the college or other colleges, students must take prior written permission from HoD concerned and should also submit the certificate of participation from the organizer of the event within three days after the completion of the event. Only such cases will be considered for condoning attendance shortage.

4.3 A student shall be eligible to claim for condonation of attendance shortage only once during the two years (four semesters) course work.

4.4 A student will not be promoted to the next semester unless he satisfies the attendance requirement of the current semester. He may seek re-admission for that semester when offered next.

4.5 Shortage of Attendance below 65% in aggregate shall in *NO* case be condoned.

4.6 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that semester and their registration shall stand cancelled.

4.7 A fee stipulated by the college shall be payable towards condoning attendance shortage.

5. Examinations and Scheme of Evaluation

5.1 Theory Courses :

Each theory course shall be evaluated for a total of 100 marks, consisting of 40 marks for internal assessment and 60 marks for semester end examination.

Internal Assessment:

i) Of 40 marks for internal assessment, 10 marks are for continuous assessment in the form of two assignments and 30 marks are based on two mid-term examinations.

ii) Each assignment carries 10 marks and the average of two assignments shall be taken as the marks for continuous assessment.

iii) Each mid-term examination is conducted for 40 marks with two hours duration. Each mid-term examination consists of four questions, each for 10 marks. All the questions need to be answered.

iv) Sum of the75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 30 marks.

v) For the project based theory course, the distribution of 40 marks for internal evaluation shall be 20 marks for theory, based on two mid- term examinations and 20 marks for project. Each mid-term examination is conducted for 40 marks with two hours duration. Each mid-term examination consists of two questions, each for 20 marks, with internal choice. All the questions need to be answered. Sum of the 75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 20 marks.

External Assessment:

i) Semester End Examination will have 8 questions, each for 12 marks, out of which 5 questions are to be answered.

ii) For the project based theory course, semester end examination will have three questions, each for 20 marks, with internal choice. All the questions need to be answered. There will be no external assessment for project component.

5.2 Laboratory Courses :

i) For practical subjects the distribution shall be 40 marks for Internal Evaluation and 60 marks for the End-Examinations. There shall be continuous evaluation by the internal subject teacher during the semester for 40 internal marks. Of the 40 marks for internal, 25 marks shall be for day-to-day performance (15 marks for day-to-day evaluation and 10 marks for Record) and 15 marks shall be evaluated by conducting an internal laboratory test towards the end of semester.

ii) Semester end examination shall be conducted by an internal examiner and an external examiner for 60 marks.

5.3 (a) Seminar:

i) For seminar, a student under the supervision of a faculty member, shall collect the literature on an advanced topic related to his specialization and critically review the literature and submit it to the department in a report form towards the end of semester and shall make an oral presentation before the Departmental Review Committee consisting of the supervisor and a senior faculty member / Head of the Department. There shall be an internal evaluation for 100 marks in the form of viva-voce examination and assessment of report and its presentation. There will be NO external evaluation.

ii) If a candidate fails to secure the minimum marks prescribed for successful completion, he has to re-register by paying the prescribed fee at the beginning of subsequent semester(s). He has to submit a fresh report towards the end of that semester and appear for evaluation by the committee.

(b) Term Paper:

i) For term paper, a student under the supervision of a faculty member, shall collect the literature on an advanced topic related to his specialization and critically review the research papers and submit it to the department in publication form towards the end of semester and shall make an oral presentation before the Departmental Review Committee consisting of the supervisor and a senior faculty member / Head of the Department. There shall be an internal evaluation for 100 marks in the form of viva-voce examination and assessment of paper and its presentation. There will be NO external evaluation.

ii) If a candidate fails to secure the minimum marks prescribed for successful completion, he has to re-register by paying the prescribed fee at the beginning of subsequent semester(s). He has to submit a fresh paper towards the end of that semester and appear for evaluation by the committee.

5.4 Project Work:

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

i) A Project Review Committee (PRC) shall be constituted for each specialization with Head of the Department / a Senior Faculty as Chairman and two other senior faculty members.

ii) Registration of Project Work: A candidate who has been promoted to 3rd semester shall be eligible to register for the project work.

iii) The eligible candidate can choose his project supervisor and submit the title, objective, abstract and plan of action of the proposed project work to the department for approval by the PRC. The candidate whose proposal is approved by the PRC shall register for the project work. The minimum duration of project work will be 36 weeks from the date of registration.

iv) If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. In case of such changes, the candidate has to register afresh.

v) There shall be three reviews on the progress of the project work by the PRC with an interval of 12 weeks. The candidate needs to submit a report on the progress of his work and present it before the PRC for assessment. The PRC may suggest for an extension of date of submission of dissertation if the progress of work is not satisfactory or absent himself for the review.

vi) A candidate who has passed all the theory, laboratory, seminar and term paper examinations and shown satisfactory progress of project work is permitted to submit the dissertation after 36 weeks from the date of registration.

vii) If a candidate fails to submit the dissertation by the end of the 4th semester, he has to take the permission for an extension by paying the semester(s) tuition fee.

viii) Three copies of the Project Thesis certified by the supervisor shall be submitted to the Department.

ix) Project evaluation and Viva-Voce examination is conducted at the end of 4th semester by a committee consisting of Project Supervisor, senior faculty of the department, HoD and an External Examiner nominated by the Chief Controller of Examinations out of a panel of three examiners suggested by the department.

The following grades are awarded for the project work:

i. Excellent
ii. Very Good
iii. Good
iv. Satisfactory
v. Unsatisfactory

The Grade "unsatisfactory" is treated as Fail. Failed Students should take supplementary examination after making required modifications, if any, in the dissertation with a minimum gap of 8 weeks by paying the required examination fee.

6. Criteria for Passing a Course and Award of Grades:

6.1 Criteria for Passing a Course:

i) A candidate shall be declared to have passed in individual theory / laboratory course, if he secures a minimum of 50% aggregate marks (internal & semester end examination marks put together), subject to securing a minimum of 40% marks in the semester end examination.

ii) The candidate shall be declared to have passed in seminar / term paper viva-voce if he secures 50% marks.

iii) The candidate shall be declared to have successfully completed the project work if he secures a minimum of 'satisfactory' grade in the project evaluation and viva-voce examination.

iv) On passing a course of a program, the student shall earn assigned credits in that course.

6.2 Method of Awarding Letter Grade and Grade Points for a Course:

A letter grade and grade points will be awarded to a student in each course based on his performance, as per the grading system given below.

Theory /Elective /Laboratory /Seminar / Term Paper /Project Dissertation (%)	Grade Points	Letter Grade
≥ 90	10	O (Outstanding
≥ 80 & < 90	9	A+ (Excellent)
≥ 70 & < 80	8	A (Very Good)
≥ 60 & < 70	7	B+ (Good)
≥ 50 & < 60	6	B (Above Average)
< 50	0	F (Fail)

6.3 Calculation of Semester Grade Point Average (SGPA)* for semester:

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as given below:

$$\textbf{SGPA} = \frac{\sum(CR \times GP)}{\sum CR} \quad \text{for each semester.}$$

where CR = Credits of a course

GP = Grade Points awarded for a course

* SGPA is calculated for a candidate who passed all the courses in that semester.

6.4 Eligibility for Award of B.Tech Degree:

A student will be declared eligible for the award of the M. Tech. Degree if he fulfills the following academic regulations.

(a) Pursued a course of study for not less than two academic years and not more than four academic years.

(b) Registered for prescribed **70** credits and secured **70** credits.

(c) Students, who fail to complete their Two years Course of study within Four years or fail to acquire the prescribed **70** Credits for the award of the degree within four academic years from the year of their admission shall forfeit their seat in M. Tech course and their admission shall stand cancelled.

6.5 Calculation of Cumulative Grade Point Average (CGPA) for Entire Program:

The CGPA is calculated as given below:

$$\textbf{CGPA} = \frac{\sum(CR \times GP)}{\sum CR} \quad \text{for entire program.}$$

where CR = Credits of a course

GP = Grade points awarded for a course

* CGPA is calculated for a candidate who passed all the prescribed courses excluding project work.

6.6 Award of Division:

After satisfying the requirements prescribed for the completion of the program, the student shall be eligible for the award of B.Tech Degree and shall be placed in one of the following grades:

CGPA	Class
≥ 7.5	First Class with Distinction
≥ 6.5 & < 7.5	First Class
≥ 6.0 & < 6.5	Second Class

7. Supplementary Examinations

i) Supplementary examinations will be conducted once in a year along with regular examinations.

ii) Semester end supplementary examinations shall be conducted till next regulation comes into force for that semester after the conduct of the last set of regular examinations under the present regulation.

iii) Thereafter supplementary examinations will be conducted in the equivalent courses as decided by the Board of Studies concerned.

8. Re-admission Criteria

A candidate, who is detained in a semester due to lack of attendance has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling the required norms stipulated by the college and by paying the required tuition fee and special fee in addition to paying an administrative fee of Rs. 1,000/-

9. Break in Study

Student, who discontinues the studies for what-so-ever reason, can get readmission into appropriate semester of M.Tech program only with the prior permission of the Principal of the College, provided such candidate shall follow the transitory regulations applicable to the batch he joins. An administrative fee of Rs.2,000/- per each year of break in study in addition to the prescribed tuition and special fees shall be paid by the candidate to condone his break in study.

10. Transitory Regulations

A candidate, who is detained or discontinued in a semester, on readmission shall be required to do all the courses in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such courses in the earlier semester(s) he was originally admitted into and he will be offered substitute subjects in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

11. Withholding of Results

If the student has not paid the dues, if any, to the College 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.

12. Malpractices

i) The Principal shall refer the cases of malpractices in internal assessment tests and semester end examinations to a malpractice enquiry committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the erring students based on the recommendations of the committee.

ii) Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder.

DISCIPLINARY ACTION FOR MALPRACTICES/IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices / Improper conduct	Punishment
If the candidate		
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 candidates 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 (theory or practical) in which the candidate is appearing.	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 to appear for the remaining examinations of the subjects of that semester / year. The hall ticket of the candidate shall be cancelled.

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 the examinations of the remaining subjects of that semester / year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor 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 takes out or arranges to send out the question paper during the examination or answer book during or after 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 work and shall not be permitted to appear 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 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 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 or around the examination hall or organises a walkout or instigates others to walkout 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 outside the examination hall of any of his relations or indulges in any other act of misconduct or mischief which results 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.	Expulsion from the examination hall 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.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside 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 to appear for the remaining examinations of the subjects of that semester. 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.
8.	Possess any lethal weapon or firearm in 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 to appear for the remaining examinations of the subjects of that semester. 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.	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 to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to the police and a police case is 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 referred to the Chief Superintendent of Examinations for future action towards suitable punishment.	

iii) The involvement of the staff, who are in charge of conducting examinations, valuing examination papers and preparing / keeping records of documents related to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and appropriate disciplinary action will be taken after thorough enquiry.

13. Other Matters

i) Deserving physically challenged candidates will be given additional examination time and a scribe based on the certificate issued by the concerned authority. Students who are suffering from contagious diseases are not allowed to appear either for internal or semester end examinations.

ii) The students who participated in coaching / tournaments held at State / National / International levels through University / Indian Olympic Association during semester end external examination period will be promoted to subsequent semesters as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated 18-08-1994.

iii) The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the Departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the Departments shall be reported to the Academic Council for ratification.

17. General

i) The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and /or syllabi.

ii) The academic regulations should be read as a whole for the purpose of any interpretation.

iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman of the Academic Council is final.

v) Wherever the word he, him or his occurs, it will also include she, her and hers.

VI. CURRICULAR COMPONENTS

Sl. No.	Course Work - Subject Areas	Total No.of Credits	% of Total Credits
1	Baisc Sciences (BS)	3	4.28
2	Humanities and Social Sciences (HSS)	3	4.28
3	Professional Core (PC)	25	35.72
4	Professional Electives (PE)	9	12.86
7	Others (Seminar, Term Paper, Dissertation, etc.)	30	42.86

COURSE STRUCTURE

&

SYLLABUS

COURSE STRUCTURE

I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	MA2901	Computational Methods in Engineering	4	-	-	3
2	CE2901	Theory of Elasticity	4	-	-	3
3	CE2902	Structural Dynamics	4	-	-	3
4	CE2903	Advanced Design of Concrete Structrures	4	-	-	3
5	CE2904	Stability of Structures	4	-	-	3
6		Professional Elective - I	4	-	-	3
7	CE2908	Advanced Concrete Technology and Structural Engineering Lab	-	-	4	2
		Total	**24**	**-**	**4**	**20**

II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	CE2909	Earthquake Resistant Design	4	-	-	3
2	CE2910	Finite Element Analysis	4	-	-	3
3	CE2911	Theory of Plates and Shells	4	-	-	3
4		Research Methodologies	4	-	-	3
5		Professional Elective - II	4	-	-	3
6		Professional Elective - III	4	-	-	3
7	CE2918	Computer Applications in Structural Engineering Lab	-	-	4	2
8		Seminar	-	-	-	2
		Total	**24**	**-**	**4**	**22**

L : Lecture **T : Tutorial** **P : Practical**

III Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1		Term Paper	-	-	4	2
2		Dissertation (Initiated in third semester)	-	-	-	-
		Total	**-**	**-**	**4**	**2**

IV Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1		Dissertation (Carried out in third & Fourth Semester	-	-	52	34
		Total	**-**	**-**	**52**	**34**

Professional Electives:

Professional Elective - I

CE2905 Advanced Concrete Technology

CE2906 Ground Improvement Techniques

CE2907 Structural Optimization

Professional Elective - II

CE2912 Advanced Design of Steel Structures

CE2913 Pre-Stressed Concrete

CE2914 Fracture Mechanics of Concrete

Professional Elective - III

CE2915 Design of Sub-Structures

CE2916 Design of Bridge Structures

CE2917 High Rise Buildings

SYLLABUS

COMPUTATIONAL METHODS IN ENGINEERING

I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- know how to solve system of equations, ordinary differential equations and partial differential equations numerically.
- understand correlation and regression.
- know optimization techniques in solving linear and fractional programming problems.

Learning Outcomes

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

- find the solutions of system of linear and non linear equations.
- solve ordinary and partial differential equations numerically.
- determine the correlation coefficient and regression.
- optimize linear and fractional programming problems.

Course Content

UNIT– I: Introduction to Numerical Methods Applied to Engineering Problems

Solving system of linear equations by Gauss Seidel and Relaxation methods. Solving system of non-linear equations by Newton-Raphson method. Fitting of non-linear curves by the method of least squares.

UNIT–II: Numerical Solutions of Ordinary Differential Equations

Conversion of initial value problem to boundary value problem using shooting method, solution through a set of equations - derivative boundary conditions - Rayleigh Ritz method.

UNIT–III: Numerical Solutions of Partial Differential Equations

Finite-difference approximations to derivatives; Laplace equation : Jacobi Method - ADI method, Parabolic Equation – Crank Nicolson method.

UNIT–IV: Applied Statistics

Bivariate Data-simple correlation- Correlation analysis - correlation coefficient – coefficient of correlation for ungrouped and grouped bi-variate data – coefficient of determination – test of significance for correlation coefficient. Regression Analysis - simple linear regression - multiple linear regression.

UNIT–V: Optimization Techniques

Linear Programming : Mathematical formulation-graphical solution of two variable – simplex method-artificial variable technique- Big M method- linear fractional programming problem.

Text Books:

1. S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India,3rd Edition.(UNITS – I,II,III)
2. Agarrval, B.L., Basic Statistics ,Wiley , 2nd edition.(UNIT - IV)
3. S.D.Sharma,Operations Research,Kedarnath Ram Nadh,1972 (Unit- V)

References:

1. Ward Cheney and David Kincaid M, Numerical Mathematics and Computing, Brooks/Cole Publishing Company1999, Fourth edition.
2. Riley K.F,. M.P.Hobson and Bence S.J, Mathematical Methods for Physics and Engineering, Cambridge University press,1999.
3. Steven C.Chapra, Raymond P.Canale Numerical Methods for Engineers Tata Mc-Graw Hill
4. Curtis F.Gerald, Partick.O.Wheatly,Applied Numerical analysis, Addison-Wesley,1989
5. Kanti swarup,Gupta P.K. and Manmohan , Operations Research , S.chand and sons, 2004.

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THEORY OF ELASTICITY

I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- impart knowledge of principal stresses and strains and analytical skills of solving problems using plane stress, plane strain and torsion.

Learning Outcomes

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

- apply the knowledge of plane stress and plane strain in a given problem.
- analyze the structure using principle of elasticity.
- explain the principles of stress-strain relations for linearly elastic solids and Torsion.

Course Content

UNIT–I: Pane Stress and Plane Strain

Definition of stress and strain , component of stress and strain , hooks law, plane stress, plane strain , stress and strain at a point, differential Equation of equilibrium and compatibility equations, stress function.

UNIT–II: Two Dimensional Problems in Rectangular Co-ordinates

Solution by polynomials – Saint-Venant's principle – Determination of displacements – Bending of cantilever loaded at the end – Bending of a beam by uniform load.

UNIT–III: Two Dimensional Problems in Polar Co-ordinates

General equations in polar co-ordinates – Stress distribution symmetrical about an axis – Pure bending of curved bars - Strain components in polar co-ordinates – Displacements for symmetrical stress distributions – Stress in a circular discs – The effect of circular holes on stress distribution in plates.

UNIT–IV: Analysis of Stress and Strain in Three Dimensions

Principal stresses – Stress ellipsoid – Stress-director surface – Determination of principal stresses –Stress invariants- Max shear stress – Homogeneous deformation – Principal axes of strain rotation. General Theorems: Differential equation of equilibrium – Boundary conditions for compatibility – Displacements – Equations of equilibrium in terms of displacements – Principle of superposition.

UNIT–V: Torsion

Torsion of Straight bars – Bars with elliptical cross section – Other elementary solution – Membrane analogy – Torsion of narrow rectangular bars – Solution of torsional problems by energy method – Use of soap films in solving torsional problems.

Text books:

1. S P Timoshenko & J N Goodier, “Theory of Elasticity”, Mc Graw Hill Publications.(Units I,II,III,IV,V)
2. Sadhu Singh ,”Theory of Elasticity”, Khanna Publications.

References:

1. C.T. Wang ,”Applied Elasticity” , McGraw-Hill Publications.
2. Martin H. Sadd, “Elasticity Theory, Applications and Numeric”, Oxford Publications.

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STRUCTURAL DYNAMICS

I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- create an understanding on degrees of freedom & dynamic loading and ability to formulate the equations of motion and apply them to simple dynamic problems.
- familiarize on obtaining the natural frequencies & mode shapes and impart the knowledge on mode super position method to undamped forced motion of multi degree freedom system.

Learning Outcomes

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

- develop differential equation of motion for an undamped single degree freedom system.
- understand different types of damping and concept of logarithmic decrement.
- formulate the equations for response against harmonic, Periodic and Impulsive loadings & Duhamel integral.
- understand how to formulate stiffness and mass matrices and carry out free vibration analysis.
- obtain response against forced motion applying mode super position method.

Course Content

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.

UNIT–II: Single Degree of Freedom Systems

Fundamental objectives of dynamic analysis -Types of prescribed loading - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Formulation and solution of the equation of motion - Free vibration response - Response to Harmonic, Impulsive and general dynamic loadings -Duhamel integral.

UNIT–III :Multi Degree of Freedom Systems –Free vibrations

Selection of the degrees of Freedom- concept of shear building - 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. Examples on two degree freedom systems.

UNIT–IV: Multi Degree of Freedom Systems-Forced vibrations

Selection of the degrees of Freedom - - Formulation of the MDOF equations of motion - Analysis of Dynamic response – Normal co-ordinates - Uncoupled equations of motion - Orthogonal properties of normal modes - Mode superposition method procedure.Examples on forced vibration of undamped two degree freedom systems.

UNIT–V: 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.

Textbooks:

1. Mario Paz and Leigh ,"Structural dynamics", CBS Publishers, 1st edition 1985.(Units- II,III,IV&V)
2. S.R.Damodarasamy & S.Kavitha,"Structural Dynamics and Aseismic Design", PHI Learning private Ltd., New Delhi. (Units-I,II,III&IV)

References:

1. Anil K. Chopra ,"Dynamics of Structures", Pearson Education (Singapore), Delhi.
2. Raymond W.Clough, Joseph Penzien, "Dynamics of Structures", M.C.GrawHill Book Company.
3. Roy R.C. Craig " Structural Dynamics – An introduction to computer methods", John Wiley & sons.

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ADVANCED DESIGN OF CONCRETE STRUCTURES

I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- impart the knowledge on designing various types of structures like bunkers & silos, grid floors and RC frames, and design a project problem

Learning Outcomes

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

- design the bunkers and silos
- to analyse grid floors using approximate methods
- gain the knowledge of estimation of crack width and deflection of beams.
- design the structures for fire resistance. ·
- gain the knowledge on concept of designing Multi-storeyed building frames.

Course Content

UNIT–I: Bunkers and Silos

Introduction, design of rectangular and circular bunkers and Silos.

UNIT–II: Approximate analysis of Grid Floors

Introduction, analysis of rectangular grid floors by Timoshenko's plate theoryand stiffness matrix method, comparison of methods of analysis, reinforcementdetailing in grid floor

UNIT–III: Crack width and Redistribution of Moments

Estimation of crack width in Reinforced Concrete Members:

Introduction,factors affecting crack width in beams, mechanisms of flexuralcracking, estimation of crack width in beams by empirical method and IS 456method, shrinkage and thermal cracking.

Redistribution of Moments in Reinforced Concrete Beams:

Introduction, redistribution of moments in fixed beam, positions of points ofcontra flexures, final shape of redistributed bending moment diagram, momentredistribution for a two-span continuous beam, advantages and disadvantagesof moment redistribution, moment-curvature (M - y), relation of reinforcedconcrete sections.

UNIT–IV: Design of Reinforced Concrete Members for Fire Resistance:

Introduction, ISO 834 standard heating conditions, grading or Classifications,effect of high temperature on steel and concrete, effect of high temperatures on different types of structural members, fire resistance by structural detailingfrom tabulated

data, analytical determination of the ultimate bending moment, moment carrying capacity of reinforced concrete beams under fire- Other considerations.

UNIT–V: Multistorey Building Frames

Introduction-analysis of Multi-storey Frames-Method of substitute Frames-Design Example-Bending Moments in Columns-Analysis of Multi-storey frames subjected to horizontal forces-Design Example.

NOTE: Student should submit a report on a project problem

Text books:

1. P.C. Varghese, “Advanced Reinforced Concrete Design”, Prentice Hallpublication(Unit II,III&IV)
2. N.Krishnam Raju ,”Advanced Reinforced concrete Design”, CBSpublication.(Unit I&V)

References:

1. Park & Paulay, “Reinforced Concrete”, John Wiley & sons Publications.
2. Pillai and Menon, “Reinforced concrete Design “.

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STABILITY OF STRUCTURES

I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- impart the knowledge on linear and nonlinear behaviour of structures.
- familiarize the student with stability of plates under combined loads.

Learning Outcomes

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

- analyze these structures with linear and nonlinear behaviour.
- gain the knowledge on Stability of Continuous systems.
- distinguish between elastic buckling and in- elastic buckling.

Course Content

UNIT–I: Criteria for Design Of Structures

Concept of stability, strength, and stiffness - Stability of discrete systems - Linear and nonlinear behavior.

Beam columns: Differential equation for beam columns – Beam column with concentrated loads – Continuous with lateral load – Couples – Beam column with built in ends – Continuous beams with axial load – Determination of allowable stresses.

UNIT–II: Elastic Buckling

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 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.

UNIT–III: In-Elastic Buckling

In-elastic buckling: Buckling of straight bars – Double modulus theory, Tangent modulus theory. Empirical formulae of design – various end conditions– Design of columns based on buckling–Rayleigh Ritz method –Stiffness method and formulation of Geometric stiffness matrix- Applications to simpleframes.

UNIT–IV: Torsional Buckling

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 on Torsion and Flexure.

UNIT–V: Lateral Buckling

Lateral Buckling of simply supported Beams: Beams of rectangular cross section subjected for pure bending, buckling of I Section subjected to pure bending.

Text books:

1. Alexander Chajes," Principles of Structural Stability Theory", PHI Publications.

   (Unit I,II,III&IV,V)

2. Timshenko & Gere,"Theory of Elastic stability" ,Mc Graw Hill Publications.

References:

1. Simitses,G.J., "An introduction to the elastic stability of structures", 2nd Edition, Prentice Hall.
2. Bazant, Z.P. and Cedolin, L., "Stability of structures", 1st Edition, OxfordUniversity Press, Oxford.
3. Brush, B.O., and Almoroth,B.O.," Buckling of Bars, Plates and Shells",3rd Edition, McGraw Hill, NY.
4. Galambos,T.V., "Guide to stability design criteria for metal Structures",2nd Edition,Wiley, NY.

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Professional Elective - I

ADVANCED CONCRETE TECHNOLOGY

I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- impart awareness on ingredients of concrete, mix design, various admixtures for specific concreting purposes and testing of fresh, hardened & special concretes.

Learning Outcomes

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

- select proper ingredients of concrete and acquire knowledge about the testing of materials for quality assurance.
- select special concretes for specific purposes.
- design a required concrete mix.

Course Content

UNIT–I: Constituents of Concrete and Properties

Properties of cement, hydration of cement, hydration product, heat of hydration, review of tests on properties of cement, fine aggregate and coarse aggregate and their influence on strength of concrete. Porosity, absorption and moisture content and their influence. Soundness of aggregate. Alkali aggregate reaction. Review of tests on properties of aggregate. Water, its influence on concrete. Additives and Admixtures in concrete.

UNIT–II: Manufacturing Methods of Concrete

Manufacturing methods of concreting, properties of fresh and hardened concrete, strength of concrete – water cement ratio. Gel space ratio. Gain of strength with age. Maturity concept of concrete. Mechanical properties of concrete. Workability- tests and procedure. Influence of various parameters on strength of concrete. Use of ready mix concrete – advantages and disadvantages. Relationship between various mechanical strengths of concrete. Shrinkage and Creep of concrete - types, mechanism and factors affects.

UNIT–III: Concrete Mix Design

Design and manufacture of normal concrete, quality Control- mix design by I.S. method, Road note method and Accelerated curing method.

UNIT–IV: Special Concretes

Introduction, properties and applications of fibre reinforced concrete, light weight concrete – cellular concrete, no fine concrete and aerated & formed concrete– polymer concrete – fly ash concrete and green Concrete.

UNIT–V: Design of High Strength and High Performance Concretes

Introduction, properties and applications of Self compacting concrete – High performance concrete – High density concrete.

Text books:

1. Shetty, M.S.,"Concrete Technology" Theory and Practice, S.Chand Publications-3rd Edition (Units I,II,III,IV,V)
2. Neville,A.M. and Brookes,J.J., "Concrete Technology" , Pearson Education,2nd Edition.

References:

1. Neville,A.M., "Properties of Concrete", Pearson Education Limited , 5th Edition.
2. Shanta Kumar,A.R., "Concrete Technology", Oxford University Press, New Delhi, 2nd Edition.
3. Krishna Raju.N., " Design of Concrete Mixes", CBS Publishers and Distributors, 2nd Edition.
4. M L Gambhir," Concrete Technology", Tata McGraw Hill Publishers, New Delhi, 2nd Edition.

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Professional Elective - I

GROUND IMPROVEMENT TECHNIQUES

I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- understand the need of ground improvement techniques in improving the soil conditions.
- familirize the applications of Reinforced Earth and Geosynthetics

Learning Outcomes

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

- select suitable ground improvement technique according to soil condition.
- explain the types and functions of geosynthetics.

Course Content

UNIT–I: Introduction and Compaction Techniques

Introduction: Need and objectives of ground improvement techniques, classification of ground improvement techniques

Compaction Techniques: Methods of compaction - Shallow compaction and Deep compaction techniques – Vibro-floatation, blasting, dynamic consolidation and compaction piles

UNIT–II: Dewatering Techniques and Drains

Dewatering Techniques: Open sumps and ditches, well-point system, electro-osmosis, vacuum dewatering wells

Drains: Types, preloading and design features of vertical drains.

UNIT–III: Stabilization with Admixtures

Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen

UNIT–IV: Reinforced Earth Techniques and Grouting

Reinforced Earth Techniques: Concept of soil reinforcement, reinforcing materials, backfill criteria, design of reinforcement for internal stability, applications of reinforced earth structures. soil nailing and its applications.

Grouting: Objectives of grouting, grouts and their applications, methods of grouting

UNIT–V: Geo-synthetics

Geotextiles – Types, functions, properties and applications; Geogrids & Geomembranes - Properties and applications

Text books:

1. Purushotham Raj," Ground Improvement Techniques", Laxmi Publications, New Delhi (Unit-I, II, III)
2. Hausmann M.R. "Engineering Principles of Ground Modification", (1990), McGraw-Hill International Edition. (Unit-IV, V)

References:

1. Swami Saran ,"Reinforced Soil and its Engineering Applications", I.K. International Publishing House pvt. Ltd.
2. G.L.Siva Kumar Babu, "An introduction to Soil Reinforcement and Geosynthetics", Universities Press.
3. Moseley M.P. ,"Ground Improvement", (1993), Blackie Academic and Professional, Boca Taton, Florida, USA.

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Professional Elective - I

STRUCTURAL OPTIMIZATION

I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- familiarize on various methods of optimisation and design of structural members.

Learning Outcomes

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

- derive optimized structure using classical and modern methods of optimisation.
- impart with the knowledge of formulation of structural optimisation problems.
- understand the concept of Classical methods of optimisation for multivariable with equality or inequality constraints.

Course Content

UNIT–I: Introduction

Introduction: General Introduction: Basic theory and elements of optimisation Terminology and definitions Basic principles and 'procedure of optimisation. Classical Methods of optimisation: Trial and error method, Monte Carlo method and Lagrangian Multiplier method illustrative examples. Linear Programming: Introduction, terminology, standard form of linear programming problem, geometrical interpretation, canonical form of equation graphical and algebraic methods of solving L.P. problems, illustrative examples.

UNIT–II: Linear Programming

Linear Programming: Simplex methods, dual formulations illustrative examples.Network analysis: Introduction to network theory, transportation and assignment models Formulation of mathematical models and solutions Applications to Civil Engineering problems.

UNIT–III: Non Linear programming

Non Linear programming: Unconstrained and constrained methods of optimisation on .Univariate search, Steepest Descent Methods, Kuhn Tucker conditions –

Penalty functions, slack variables and Lagrangian multiplier methods illustrative examples.

Geometric and Dynamic Programming : illustrative Examples.

UNIT–IV: Structural Optimisation-I

Structural optimisation: Structural design of rectangular reinforced concrete beams Optimisation applied to concrete mix proportioning Procedure of optimisation for reinforced concrete deep beams.

UNIT–V: Structural Optimisation-II

Structural optimisation: Optimum structural design of reinforced concrete T and L beams Optimisation of planner trusses Procedure of optimisation for structural grid and slab Floor Systems.

Text books :

1. S.S. Rao ,"Engineering optimisation", ,New Age Internationals (1999) (Units I, II, III).
2. Paul, J.O., "Systems Analysis for Civil Engineers", John Wiley & Sons (1988) 1. Arora, J.S.(Units IV&V).

References:

1. J.S. Arora, "Introduction to Optimum Design", 2nd Edition, McGraw-Hill Book Company, 2000.
2. MorrIs A.J., "Foundations of Structural optimisation - A UnifiedApproach", 3rd Edition, John Wiley and Sons, 2003.

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ADVANCED CONCRETE TECHNOLOGY AND STRUCTURAL ENGINEERING LAB

I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

To make the students

- familiarize the students to the advanced equipment for testing of materials.

Learning Outcomes

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

- gain the knowledge on concept of NDT.
- compare the strengths of concrete by different mix design methods.
- analyze different characteristics of a structure for dynamic loadings.

List of Experiments:

1. Strain measurement - Electrical resistance strain gauges.
2. Non destructive testing- Rebound Hammer test, UPV test.
3. Qualifications tests on Self compaction concrete- L Box test, J Box test, U box test, Slump test.
4. Mix design methods using a) I.S. Code method b) ACI Code method.
5. Measurement of cover and bar diameter by poroscope /re-bar locator.
6. Buckling of columns.
7. Determination of horizontal thrust in two hinged arche.
8. Determination of horizontal thrust in three hinged arche.
9. Identification of dynamic Mode shapes and frequencies for rigid type structure.
10. Identification of dynamic Mode shapes and frequencies for flexible structure.
11. Repair and rehabilitation of concrete beam.
12. Open ended experiment.

References:

1. process manual by Millennium Technologies.
2. N. Krishna Raju, “Design of Concrete Mixes”.
3. M. S. Shetty,” Concrete Technology (Theory And Practice)”, S. Chand Publication.

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EARTHQUAKE RESISTANT DESIGN

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course objectives

To make the students

- impart the knowledge of designing earthquake resistant structures and familiarize the codal provisions and carry out an analytical problem.

Learning Outcomes

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

- describe various terms of engineering seismology.
- gain the knowledge on seismic codal provisions and detailing.
- design earthquake-resistant structures by using different methods.
- acquire the knowledge in structural irregularities in seismic planning and shear wall concept.
- Understand the retrofitting techniques and base isolation of structure.

Course Content

UNIT–I: Engineering Seismology

Introduction, structure of earth, plate tectonics, elastic rebound theory, earthquake terminology- source, focus, epicenter, hypocenter, earthquake size, magnitude & intensity, seismic waves, seismic zones, seismic zoning map of India, seismograms and accelerograms – Causes and effects of earthquakes.

UNIT–II: Codal Provisions

Review of Indian Seismic code IS: 1893 – 2002 (Part- I) provisions- Earthquake design philosophy.

Introduction - Design forces for buildings by Equivalent static method and Response spectrum method.

UNIT–III: Structural Irregularities and Shear Walls

Structural Irregularities: Vertical discontinuity in load path, irregularities in strength and stiffness, mass irregularities, vertical geometric irregularity, proximity of adjacent buildings, plan configurations, torsion irregularities, re-entrant corners, non-parallel systems, diaphragm discontinuity.

Shear Walls: Introduction, types of shear walls, description of building, determination of lateral forces in buildings, design of shear walls as per Indian Standard Code: 13920, ddetailing of reinforcement of shear walls.

UNIT–IV: Retrofitting Techniques

Introduction, seismic evaluation methods, consideration in retrofitting of structures, classification of retrofitting techniques, retrofitting strategies of R.C.buildings - structural level and member level retrofit methods.

UNIT–V: Masonry Buildings

Introduction, determination of design lateral load, distribution of lateral forces on shear wall, determination of wall rigidities, determination of torsional forces, determination of pier loads, moments and shear, design of shear walls for shear, structural details**.**

NOTE: Student should submit a report on a project problem

Text books:

1. pankaj Agarwal & shrikhande Manish, “Earthquake Resistant Design of Structures”, Eswar Press. (Units II, III, IV & V)
2. Duggal S.K., “Earthquake Resistant Design of Structures”, Oxford University Press,2nd Edition. (Units I & V)

References:

1. Anil K. Chopra, “Dynamics of Structures, Theory and Applications to Earthquake Engineering”,4 th Edition, Prentice Hall of India.
2. JaiKrishna AR Chandrasekharan,and Brijesh Chandra, “Elements of Earthquake Engineering”, 3rd Edition, Saritha Prakasham, Meerut.
3. Relevant Indian Standard Codes: IS-875, IS-1893, IS -4326, IS- 13920

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FINITE ELEMENT ANALYSIS

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course objectives

To make the students

- apply the concepts of Finite Element Method (FEM) for solving structural Engineering problems and familiarize the usage of the software.

Learning Outcomes

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

- understand the fundamentals of Finite element method.
- derive the solution of the problems of 1D and 2D by FEM.
- apply the concept of iso-parametric formulation for solving problems.
- derive the shape functions for higher order elements.
- slove the finite element problems using software.

Course Content

UNIT–I: Fundamental Concepts of FEM

Introduction, need of FEM, applications of FEM, advantages & disadvantages - Energy principles, discretization – Rayleigh-Ritz method, method of functional approximation- Weight Residual Techniques, basic steps of FEM, finite element modelling- Application to structural problems

UNIT–II: One Dimensional Problems- Bars and Beams.

Co-ordinates & shape functions, one dimensional scalar variable problems, element stiffness of bar element due to axial loading, formulation of stiffness matrix of bar element by direct stiffness method, minimum potential energy principle, beams derivation of stiffness matrix for beams by strain energy concept & direct stiffness method and problems on these concepts.

UNIT–III: One Dimensional Problems -Frames & Trusses

Derivation of stiffness matrix for trusses, stress calculations, temperature effects and problems on these concepts. Derivation of stiffness matrix for a plane frame element, formulation of finite element equation and analyzing procedure for frame structure-Problems.

UNIT–IV: Two Dimensional Problems

Finite element modeling of 2-D elements, derivation of shape functions for two dimensional linear element (Triangular) by area coordinates , Problems on these concepts.

Derivation of shape functions for CST element, stress strain relationship matrix formulation for 3D & 2D systems, stiffness matrix for CST element.

UNIT–V: Axisymmetric & Isoparametric Problems

Introduction, axisymmetric formulation, derivation of shape function for axisymmetric triangular element, stress -strain relationship matrix, stain & stress displacement matrices & Problems on these concepts. Isoperimetric formulation, higher order elements, derivation of shape functions for a four noded quadrilateral element using natural coordinates, strain displacement matrix for four noded quadrilateral element, stress-strain relationship matrix, stiffness matrix for isoperimetric element, numerical integration , gauss quadrature method for rectangular elements, simple problems

Text books:

1. Sk.Md ,Jalaludin ,"Finite Element Analysis", Anuradha Publishers (Units I,II,III,IV&V)
2. TirupatiR.Chandrapatla and Ashok D.Belgaundu,"Finite Elements Methods in Engineering" by (Units II, III & IV)

References:

1. C.S.Krishna Murthy ,"FEA –Theory & Programming",Tata Mcgraw Hill, New Delhi.
2. S.S. Bhavakatti ,"FEA",New age international publishers 3. FEA by David V Hutton,TataMcgraw Hill, New Delhi.

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THEORY OF PLATES AND SHELLS

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course objectives

To make the students

- familiarize the behaviour of the plates and shells with different geometry under various types of loads.

Learning Outcomes

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

- evaluate the deflection of plates for different loadings.
- understand the concept of folded plates.
- determine various forces in shells.
- explain the concept of curvature in shells.
- gain knowledge on beams, theory of cylindrical shells.

Course Content

UNIT – I: Rectangular Plates

Pure bending of Plates – Relations between bending moments and curvature – Derivation of governing differential equation for plate – Slope and curvature of slightly bent plates. Rectangular Plates: Plates under uniformly distributed load with different boundary conditions. Navier and Levy's type of solutions for various boundary condition.

UNIT – II: Circular Plates

Circular plates: Symmetrically loaded, Circular plates under various loading conditions, Circular plate with a circular hole at center.

UNIT – III: Folded Plates

Structural behaviour of folded plates; Equation of three shears; Application of Simpson's and Whitney's methods.

UNIT – IV: Introduction to Shells

Introduction to shells -Classification of shells- Equations of Equilibrium of shells: Derivation of stress resultants, principles of membrane theory and bending theory.

UNIT – V: Cylindrical Shells

Cylindrical Shells: Derivation of the governing DKJ equation for bending theory, details of Schorer's theory. Beam method of analysis.

Text books:

1. Timoshenko and Krieger,"Theory of plates and shells", McGraw-Hill bookcompany, INC, New York.[Unit – I,II]
2. P.C. Varghese,"Design of Reinforced Concrete Shells and Folded plates", PHI Learning Private Limited, New Delhi (2010).[Unit - III]
3. S.S.Bhavikatti ,"Theory of plates and shells", New Age International, New Delhi.[Unit –III, IV,V]

References:

1. J. Ramchandran ,"Thin Shells Theory and Problems", Universities Press. "Stresses in shells", Flugge, 2nd Edition, Springer.
2. Bairagi. K," Plate Analysis", Khanna Publisher, New Delhi.
3. Ramaswamy. G.S ,"Design and Construction of Concrete Shell Roofs" ,Mc Graw K.Chandra sekhara.

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RESEARCH METHODOLOGIES

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course objectives

To make the students

- familiarize with the objectives, motivation and significance of research.
- know research methodologies.
- define research problem and perform data analysis.
- write a research paper and report.

Learning Outcomes

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

- understand research approaches
- understand various research methodologies
- define a research problem
- perform data analysis
- write research papers and reports

Course Content

UNIT – I: Introduction

Introduction, objectives and motivation of research, types of research, research approaches, significance of research methods.

UNIT – II: Research Methodology

Research methods versus methodology, research and scientific method, importance of knowing how research is done, research process. criteria for good research.

UNIT – III: Defining Research Problem

The research problems, necessity of defining the problem, technique involved in defining a problem, review of related literature, purpose of literature survey, identifying the current status, presentation of literature survey findings. critique, survey and peer review process.

UNIT – IV: Research Design and Data Analysis

Meaning of research design, features of good design, important concepts relating to research design, different research designs, basic principles of experimental designs.

Methods of data collection - collection of primary data, observation method, interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedules, some other methods of data collection, collection of secondary data, selection of appropriate method for data collection, case study method.

Processing and analysis of data **-** processing operations, some problems in processing, elements, types of analysis, statistics in research.

UNIT – V: Research Paper and Report Writing

Final paper presentation. significance of report writing, different steps in writing report, layout of the research report, types of report, precautions for writing research reports.

Textbook :

1. C.R.Kothari, “Research Methodology Methods and Techniques”, Wishwa Prakashan Publishers, Second Edition (Units – I,II,III,IV,V).

Refernces:

1. Panner Selvam R, “Research Methodology”PHI Learning Private Limited. Newdelhi.
2. Ramalh C and Murali Krishna P “Research Methodology”-Text and cases Student help line publishing , Hyderabad.

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Professional Elective - II

ADVANCED DESIGN OF STEEL STRUCTURES

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course objectives

To make the students

- impart the concepts of designing water tanks, bridges, transmission line towers and chimneys.
- familiarize on plastic behavior, plastic moment and plastic mechanism of steel structures like simple beams and portal frames.

Learning Outcomes

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

- apply the design principles to elevated steel water tanks.
- identify the configuration of truss bridges and understand the design principles of truss elements.
- develop the methodology of designing transmission line tower structures.
- understand the design concepts of self supporting chimneys & foundations.
- adopt principles of plastic analysis, plastic mechanism and apply to simple beams & frames.

Course Content

UNIT - I: Water Tanks

Design of elevated water storage steel tanks – Rectangular & cylindrical – Design of staging – Lacing – Battering.

UNIT - II: Truss Bridges

Through type truss bridge (Pratt & Warren type) - Dead load and equivalent live loads – Design of compression and tension members, Top & bottom lateral bracings and top portal bracing.

UNIT - III: Towers

Towers Loading, Analysis & Design of Transmission line towers – Simple problems

UNIT - IV: chimneys

Design of self supporting steel chimneys including foundation connections.

UNIT - V: Plastic Analysis

Plastic analysis of steel structures – Plastic bending in beams, collapse mechanism – Fully plastic Moment – Shape factor and Plastic moment – Ultimate load carrying capacity of simple beams and portal frames.

Note: Designs are by limit state method as per IS 800-2007.

Text Books:

1. Ramchandra, "Design of Steel Structures Vol. II,Standard book house.(Units I,II,III,IV,V)
2. A.S.Arya & J.L.Ajmani Nem ,"Design of Steel Structures" by chand & Brothers, Roorkee.

Reference Books:

1. B.C.Punmia, Ashok kumar jain & Arun kumar jain ,"Comprehensive Design of steel structures" Laxmi publications, New Delhi.
2. P.Dayaratnam ,"Design of Steel Structures" ,Wheeler publishing, New Delhi.
3. V.N.Vazirani & M.M.Ratwani, "Steel Structures", Khanna publications, New Delhi.
4. Relevant steel codes of Bureau of Indian standard.

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Professional Elective - II

PRE-STRESSED CONCRETE

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course objectives

To make the students

- impart the knowledge on pre-stressing techniques and materials required for pre-stressing.
- familiarize with the losses of pre-stress, design of beams & slabs and deflections.

Learning Outcomes

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

- gain the knowledge on materials, pre-stressing Systems, end anchorages.
- gain the knowledge on losses of pre-stress.
- analyze and design of sections for flexure and shear.
- compute deflections in pre-stressed concrete.
- apply the concept to pre-stress for designing of compression members and slabs.

Course Content

UNIT - I: Introduction

Historic development – Need for High strength steel and concrete- Advantages and limitations of pre-stressed concrete –Materials: High strength steel and concrete . I.S.Code provisions, methods and systems of pre-stressing; Pre-tensioning and post-tensioning methods and its applications – systems of pre-stressing - Hoyer system, Magnel-Blaton system, Freyssinet system and Gifford – Udall system.

UNIT - II: Losses of Prestress

Loss of pre-stress in pre-tensioned and post-tensioned members-elastic Deformation of concrete, shrinkage of concrete, creep of concrete, Relaxation of stress in steel, Anchorage slip and frictional losses.-Total losses allowed for design.

Analysis of sections for flexure; Elastic analysis of concrete beams pre-stressed with straight, concentric, eccentric, bent and parabolic tendons-Pressure line-load balancing concept.

UNIT - III: Design of Section for Flexure and Shear

Types of flexural failures-determination of flexural strength using IS code method—Shear and Principle stresses-ultimate shear resistance of pre-stressed concrete-design of shear reinforcement –Design of section for flexure.

UNIT- IV: Deflections

Importance of control of deflections, factors influencing deflection, codal provisions, short term and long term deflections of un cracked members

Continuous Beams: advantages of continuous members- code provisions – Analysis of two span span continuous beams- concordant cable profiles.

UNIT - V: Compression Members and Slabs

Compression Members **:**Introduction – design of PSC short columns

Slabs: Introduction –types of pre-stressed concrete floor slabs- code provisions-design of PSC floor slabs-one way and two way slabs.

Text books:

1. N. Krishnam Raju, “Prestressed Concrete “, TMH, 5th Edition. (Units I,II,III,IV,V).

References:

1. Lin., T.Y., “Design of Prestressed Concrete Structures”, John Wiley & Sons, 3rd Edition.
2. Edward G. Nawy, “Prestressed Concrete A Fundamental Approach”,Prentice Hall, 5th Edition.
3. Rajagopalan. N, “Prestressed Concrete”, Narosa publications, 2nd Edition.

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Professional Elective - II

FRACTUE MECHANICS OF CONCRETE

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- impart knowledge on the mechanisms of failure and non linear fracture mechanics.

Learning Outcomes

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

- understand the behaviour of concrete with tension and compression failure surfaces
- gain the concepts of CTOD and CMD.

Course Content

UNIT – I: Introduction to Fracture Mechanics

Fundamentals of fracture mechanics, mechanisms of fracture and crack growth

UNIT – II: Fracture and Cracking

Cleavage fracture, ductile fracture, fatigue cracking, environment assisted cracking, quasi brittle materials.

UNIT – III: Failure Analysis

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 modelling of quasi brittle materials.

UNIT – IV: Nonlinear Fracture Mechanics

Nonlinear fracture mechanics – Discrete crack concept/smeared crack concept, size effect, plasticity models for concrete – Associated and non-associated flow, failure surfaces for quasi brittle materials.

UNIT – V: Concept of CTOD and CMD

Concept of CTOD and CMD, material models, crack models, band models and models based on continuum damage mechanics.

Text books:

1. David Broek – Sijthoff & Noordhoff – Alphen aan den Rijn,"Elementary engineering fracture mechanics",Netherlands(Units I,II,III,IV,V)
2. Rilem Report, "Fracture mechanics of concrete structures – Theory and applications" ,Edited by L. Elfgreen ,Chapman and Hall – 1989.

References:

1. Victor, C. Li, & Z.P. Bazant ,"Fracture mechanics" , 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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Professional Elective - III

DESING OF SUB-STRUCTURES

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- impart the knowledge on soil exploration and design principles of shallowand pile foundations.
- introduce vibration concept in soils.

Learning Outcomes

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

- gain the knowledge on method of soil exploration.
- evaluate the bearing capacity of soil.
- gain the knowledge on mode of vibration and analysis of machinefoundation.
- gain the knowledge on concept of load carrying capacity of pile group.

Course Content

UNIT – I: Soil Exploration

Soil Exploration – Importance, terminology, methods of boring. Soil sampling – Types of samples, design considerations of open drive samplers.

UNIT – II: Shallow Foundations

Shallow Foundations –Bearing capacity – Terzaghi's, Meyerhof's, Hansen's,Vesic's and IS code methods- Bearing capacity based on standard penetration.

UNIT – III: Footings

Principle of design of footing, proportioning footings for equal settlement, matfoundation - Rectangular and trapezoidal combined footings, common type ofRaft foundations, bearing capacity and differential settlement of mat foundation.

UNIT – IV: Pile Foundations

Pile foundations-Classification of piles-factors influencing choice-Load carryingcapacity of single pile in clayey and sandy soils using static & dynamic pileformulae- Group of piles – Pile cap - Efficiency of pile groups- load carryingcapacity and settlement of pile groups in cohesive and non cohesive soils.

UNIT – V: Vibrations in Soils

Fundamentals of Vibration; Free and Forced Vibration with and without damping;Natural frequency of foundation; Types of machine foundation; I.S. Code ofpractice for design and construction of block foundation for reciprocating and impact type machines for high speed rotary machines.

Text books:

1. Braja M. Das ,"Principles of Foundation Engineering", Cengage Learing. (Unit-I, II, III, IV)
2. J.E. Bowles," Foundation Analysis and Design", McGraw Hill PublishingCo.,(Unit –V)

References:

1. K.R.Arora,"Soil Mechanics and Foundation Engineering", standard publishers and Distributors, Delhi.
2. Terzagi and Peck , "Soil Mechanics in Engineering Practice", John wiley& sons.
3. Wayne C. Teng, "Foundation Design" , Prentice – Hall.
4. Swami Saran , "Analysis and Design of sub structures", Oxford & IBH.

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Professional Elective - III

DESING OF BRIDGE STRUCTURES

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- impart overall knowledge on analysis and design of RC bridges.
- familiarize students with the knowledge of bridge sub structure andbearings.

Learning Outcomes

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

- gain the knowledge on different IRC loading standards
- design slab bridge decks.
- acquire knowledge on general considerations for prestressed concrete bridges.
- design the open well foundations.

Course Content

UNIT - I: Introduction

Definition, histroy, classification, planning and stages, preliminary / conceptual design, detailed design.

UNIT - II: Bridge loading standards

Evaluation, IRC standards, highway bridge standards, impact factors, comparitive analysis, irailway bridge standards.

UNIT - III: Reinforced concrete slab bridge decks

General features, design coefficients, analysis of slab desks, design aids, minimum reinforcements, design of reinforce concrete culverts for IRC class AA & A loads.

UNIT - IV: Prestressed Concrete Bridges

General aspects, advantages of prestressed concrete bridges, pretensioned and post-tensioned concrete bridge decks, design of post tensioned concrete beam and slab bridge deck.

UNIT - V: Bridge Foundations

Types of foundations- Well foundation, open well foundation, components ofwell foundation – Pile foundations (designs not included) - Reinforcement detailingand bar bending schedule need to be prepared

Text Books:

1. Krishnam Raju N., "Design of Bridges", 4th edition, Oxford and IBHPublishing Co., Ltd.(Units II, III, IV & V)
2. Ponnu Swamy, "Bridge Engineering", 4th edition, Mc Graw-Hill Publication(Units I).

Reference Books:

1. Johnson victor D, "Essentials of Bridge Engineering", 7th edition, Oxford, IBH Publishing Co., Ltd.
2. Vazirani, Ratvani & Aswani, "Design of Concrete Bridges", 5th edition, Khanna Publishers.
3. Swami Saran, "Analysis and Design of sub-structures", 2nd edition, OxfordIBH Publishing co ltd.

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Professional Elective - III

HIGH RISE BUILDINGS

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- impart the overall knowledge about the material, elements and systems with planning, analysis and design involved in Tall Buildings.

Learning Outcomes

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

- introduce various systems of tall buildings
- know about different types of loads, materials and design philosophy
- impart knowledge about static, dynamic and stability analysis of various systems
- know about recent topics of research of tall buildings

Course Content

UNIT I: Introduction

Design Philosophy - History - Advantages and disadvantages - Vertical city concepts - Essential amenities - Fire safety - Water supply - Drainage and garbage disposal - Service systems - Structural and foundation systems. Factors affecting height, Growth and form - Human comfort criteria.

UNIT II: Loads and Materials

Gravity loading - Dead and Live load - calculation - Impact and construction loads. Wind loading - static and dynamic approach - Analytical and wind tunnel experimental method. Earthquake loading - Equivalent lateral force, Modal analysis - Combination of loading in various design philosophies. Materials for tall buildings - High strength concrete - Light weight concrete - Fibre reinforced concrete Composite Materials.

UNIT III: Structural Systems

Behavior of High Rise structures - Different system for load distribution in steel and concrete - Vertical and horizontal load resistant systems – Rigid frames - Braced

frames - Infilled frames - Shear walls - wall frames – Tubular systems - Outrigger braced systems - Mega systems.

UNIT IV: Analysis and Design

Analysis and Design principles of various horizontal load transfer systems - Approximate methods - Modeling for accurate analysis - 3D analysis -Member forces - Displacements. Analysis for various secondary effects -Creep, shrinkage and temperature. Stability Analysis - Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity loading, P - effect and various methods of analysis - Influence of foundation instability, Out of plumb effects - Elastic Deformations. Dynamic Analysis - Principles of design of tall braced frames for earthquake and blast resistant design.

UNIT V: Advanced Topics

Structural systems for future generation buildings - Expert systems for consultations - Economics - Research needs in tall building materials, systems and designs.

Text books:

1. Schuller.W.G., "High Rise Building Structures", John Wiley & sons, 1977(Units I,II,III,IV)
2. Lynn.S. Beedle, "Advances in Tall Buildings", CBS Publishers and Distributors, New Delhi, 1996(Units V)

References:

1. Gupta.Y.P.,(Editor), "Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities", New Age International Limited, New Delhi,1995.
2. Smith .B.S. and Coull .A., "Tall Building Structure", 'Analysis and Design', John Wiley & Sons, Inc., 1991
3. Taranath .B.S., "Structural Analysis and Design of Tall Buildings", McGraw Hill Co. 1988

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COMPUTER APPLICATIONS IN STRUCTURAL ENGINEERING LAB

II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

To make the students

- apply the civil engineering software to some of the structural engineering problems.

Learning Outcomes

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

- analysis the structural elements using software designs.
- design the structures for the dynamic loads using software's.
- solve the finite elements application problems of structural engineering by software's.

Any 10 of the following problems are to be solved using Computer Programs / Application software like STAAD/SAP/ETABS/ NISA (Civil) etc.

List of Experiments:

1. Introduction to software's
2. Analysis of determinate beam to different types of loading.
3. Analysis of continuous beam subjected to different types of loading.
4. Analysis of 2-D building frame for gravity loads.
5. Analysis of 3-D frame for gravity loads
6. Lateral forces on a building due to an earthquake using equivalent static method
7. Wind analysis of 3-D frames.
8. Analysis and Design of steel girder
9. Analysis of pin jointed plane trusses
10. Analysis and design of simple bridge deck.
11. Design of reinforced concrete retaining wall (cantilever type)
12. Open ended experiment.

References:

1. Prof. Sham Tickoo, “Learning Bentley Staad.Pro V8I for Structural Analysis” dreamtech press.
2. S.Ramamrutham,R. Narayan, “Theory of structures” Dhanpat rai publishing company.
3. Punmia.B.C , Design of steel structures, Laxmi publicationsList of Experiments:

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