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 2014-15)

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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ACADEMIC REGULATIONS

M.Tech - Structural Engineering

ACADEMIC REGULATIONS

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** 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 80 credits and the student shall have to complete the two year course work and earn all the 80 credits for the award of M.Tech Degree.

4. Attendance Regulations

4.1 A student shall be eligible to appear for End Semester 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 a committee duly appointed by the college. 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) Out of 40 marks for internal assessment, 20 marks are for continuous assessment in the form of assignment and seminar and 20 marks are based on two mid-term examinations.

ii) Of the 20 marks for continuous assessment, 10 marks each for assignment and seminar.

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 the 75% marks of best scored mid-term examination and 25% marks of other mid-term examination are scaled down for 20 marks.

***External Assessment*:**

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

5.2 Laboratory Course:

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, 30 marks shall be for day-to-day performance (20 marks for day-to-day evaluation and 10 marks for Record) and 10 marks for an internal laboratory test conducted towards the end of semester.

ii) Semester End examination shall be conducted by the teacher concerned and external examiner for 60 marks.

5.3 Seminar:

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 two weeks before the end of the 3rd 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 50 marks in the form of viva-voce examination and assessment of report and its presentation. There will be NO external evaluation.

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 4th semester or subsequent semesters. He has to submit a fresh report two weeks before the end of that semester and appear for the evaluation by the committee.

5.4 Comprehensive Viva-Voce:

Comprehensive Viva-Voce examination is conducted for 50 marks at the end of third semester in all the subjects of first two semesters of the course by a committee consisting of two senior faculty members of the department. There will be NO external evaluation.

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 4th semester or subsequent semesters and undergo Viva-Voce examination towards the end of that semester.

5.5 Project Work:

Every candidate shall be required to submit a thesis or 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 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 comprehensive viva-voce 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/ drawing / design course / laboratory 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 / comprehensive 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 Course (%)	Laboratory (%)	Grade Points	Letter Grade
³ 90	³ 90	10	S
³ 80 & < 90	³ 80 & < 90	9	A
³ 70 & < 80	³ 70 & < 80	8	B
³ 60 & < 70	³ 60 & < 70	7	C
³ 50 & < 60	³ 50 & < 60	6	D
< 50	< 50	0	F (Fail)

S : Outstanding **A** : Excellent **B** : Very Good
C : Good **D** : Fair

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:

SGPA = $\frac{\sum(CR \times GP)}{\sum CR}$ 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 M.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 **80** credits and secured all **80** credits.

(c) Students, who fail to complete their Two years Course of study within Four years or fail to acquire the **80** 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:

CGPA = $\frac{\sum(CR \times GP)}{\sum CR}$ 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 M.Tech Degree and shall be placed in one of the following grades:

CGPA	Class	Letter Grade	Description
³ 7.5	First Class with Distinction	A	Excellent
³ 6.5 & < 7.5	First Class	B	Good
³ 6.0 & < 6.5	Second Class	C	Fair

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. Readmission 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 should 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.

10.1 A student who is following JNTUK curriculum and detained due to shortage of attendance at the end of the first semester of first year shall join the autonomous batch of first year first semester. Such students shall study all the courses prescribed for the batch in which the student joins and considered on par with regular candidates of Autonomous stream and will be governed by the autonomous regulations.

10.2 A student who is following JNTUK curriculum, detained due to shortage of attendance at the end of the second semester of first year shall join with the autonomous batch in the second semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in place of them as decided by the Board of Studies. The student has to clear all his backlog subjects of first semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree. The total number of credits to be secured for the award of the degree will be sum of the credits of first semester under JNTUK regulations and the credits prescribed in second semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

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, his examinations results and degree will be withheld.

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, cameras, bluetooth devices etc. 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. 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. 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 impostor is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles 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. 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 performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/ Assistant Chief 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.	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. 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 clauses 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.
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 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) Physically challenged candidates who have availed additional examination time and a scribe during their BE / B.Tech or equivalent examinations will be given similar concessions on production of relevant proof/ documents. 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.

14. 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.

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

COURSE STRUCTURE

&

SYLLABUS

M.Tech - Structural Engineering

COURSE STRUCTURE

I Semester

Sl. No.	Name of the Course / Laboratory	No.of Periods per week		No.of Credits
		L	P	
1	Computational Methods in Engineering	4	-	3
2	Theory of Elasticity	4	-	3
3	Advanced Concrete Technology	4	-	3
4	Structural Dynamics	4	-	3
5	Elective - I	4	-	3
6	Elective - II	4	-	3
7	Advanced Structural Engineering Lab	-	6	3
	Total	**24**	**6**	**21**

II Semester

Sl. No.	Name of the Course / Laboratory	No.of Periods per week		No.of Credits
		L	P	
1	Finite Element Methods	4	-	3
2	Earthquake Resistant Design	4	-	3
3	Stability of Structures	4	-	3
4	Theory of Plates and Shells	4	-	3
5	Elective - III	4	-	3
6	Elective - IV	4	-	3
7	Computer Applications in Structural Engineering Lab	-	6	3
	Total	**24**	**6**	**21**

III Semester

Sl. No.	Name of the Course / Laboratory	No.of Credits
1	Seminar	2
2	Comprehensive Viva-Voce	2
3	Dissertation (Initiated in third semester)	-
	Total	**4**

IV Semester

Sl. No.	Name of the Course / Laboratory	No.of Credits
1	Dissertation (Carried out in third & fourth semesters)	34
	Total	**34**

Electives:

I Semester	II Semester
Elective - I	**Elective - III**
Advanced Structural Analysis	Pre-Stressed Concrete
Advanced Foundation Engineering	Advanced Design of Steel Structures
Structural Optimization	Repair & Rehabilitation of Structures
Elective - II	**Elective - IV**
Advanced Design of Concrete Structures	Industrial Structures
Structural Reliability	Design of Bridge Structures
Earth Retaining Structures	Design of Off Shore Structures

SYLLABUS

COMPUTATIONAL METHODS IN ENGINEERING

I – Semester

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

Course Objectives:

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

Learning Outcomes:

Students will be able to

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

UNIT - I: Introduction to numerical methods applied to engineering Problems

Solving sytem 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 least squares.

UNIT - II: Numerical Solutions of Ordinary Differential Equations

Boundary Value Problems : 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 Nicolsen method.

UNIT - IV: Applied Statistics

Correlation Analysis - Correlation Coefficient – coefficient of Correlation for 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 Problem – Simplex Method, Artificial variable method – Big-M Method, Integer Programming Problem – Branch and Bound Method, Linear Fractional Programming Problem.

Text books:

1. Steven C.Chapra, Raymond P.Canale “Numerical Methods for Engineers” Tata Mc-Graw Hill
2. Curtis F.Gerald, Partick.O.Wheatly,”Applied numerical analysis” , Addison-Wesley,1989
3. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI.
4. Basic Statistics – Agarrval, B.L. Wiley 1991, 2nd edition.
5. Operations Research – S.D. Sarma.

Reference Books:

1. Douglas J.Faires,Riched Burden”Numerical methods”, Brooks/Cole publishing company,1998.Second edition.
2. Ward Cheney and David Kincaid “Numerical mathematics and computing” Brooks/Cole publishing company1999, Fourth edition.
3. Riley K.F,. M.P.Hobson and Bence S.J,”Mathematical methods for physics and engineering”, Cambridge University press,
4. Kreyszig, Advanced Engineering Mathematics.

THEORY OF ELASTICITY

I – Semester

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

Course Objectives:

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

Learning Outcomes:

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.
- gain the knowledge on stress-strain relations for linearly elastic solids and Torsion.

UNIT - I: Elasticity

Elasticity – Notation for forces and stresses – components of stresses and strains – Hooke's law - plane stress and plane strain- analysis and differential equations of equilibrium – boundary conditions – 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 – director surface – determination of principal stresses – 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 – uniqueness of solution.

UNIT - V: Torsion

Torsion of Straight bars – bars with elliptical cross section – other elementary solution – membrane analogy – torsion of rectangular bars – solution of torsional problems by energy method – use of soap films in solving torsional problems.

Text books:

1. Theory of Elasticity- Timoshenko & Goodier, Mc Graw Hill Publications.
2. Theory of Elasticity – Sadhu Singh, Khanna Publications.

Reference Books:

1. "Theory of Elasticity", Valiappan, Mc. Graw Hill Publications.
2. "Applied Elasticity" by C.T. Wang, McGraw-Hill Publications.
3. "Elasticity" Theory, Applications and Numeric- Martin H. Sadd, Oxford Punlications.

ADVANCED CONCRETE TECHNOLOGY

I – Semester

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

Course Objectives:

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

Learning Outcomes:

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.

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. "Concrete Technology" Neville,A.M. and Brookes,J.J., , 2nd Edition, Pearson Education.
2. "Concrete Technology*" Theory* and Practice -Shetty, M.S., , 3rd Edition, S.Chand Publications.

Reference Books:

1. "Properties of Concrete" Neville,A.M., , 5th Edition, Pearson Education Limited.
2. *"Concrete Technology",* Shanta Kumar,A.R., 2nd Edition, Oxford University Press, New Delhi.
3. " Design of Concrete Mixes" Krishna Raju.N., 2nd Edition, CBS Publishers and Distributors.
4. Concrete Technology**"-** M L Gambhir 2nd Edition, Tata McGraw Hill Publishers, New Delhi.
5. Concrete- Microstructure, properties and Material- P.K. Mehta, Paulo J M M- McGraw Hill publications.

STRUCTURAL DYNAMICS

I – Semester

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

Course Objectives:

- To create an understanding on degrees of freedom & dynamic loading and ability to formulate the equations of motion and apply them to simple dynamic problems.
- To 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 systems.

Learning Outcomes:

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 excitation and other types of dynamic loading.
- understand how to formulate stiffness and mass matrices and carry out free vibration analysis.
- obtain response against forced motion applying mode super position method.

UNIT - I: Introduction

Introduction – degrees of freedom, simple harmonic motion - Single degree of freedom system – undamped system - springs in parallel or in series, Newton's Law of motion, D.Alembert's principle, free body diagram, solution to differential equation of motion – frequency, time period and amplitude of motion - Damping – Viscous damping, equation of motion, critical damping, logarithmic decrement.

UNIT - II: Single Degree Freedom System

Response of single degree of freedom system to harmonic excitation – Undamped and damped systems - Dynamic load factor.

Response to general dynamic loading - Duhamel's Integral – Impulsive loading - Constant force, rectangular and triangular loads for undamped systems.

UNIT - III: Multi Degrees of Freedom System

Free vibration of a shear building – stiffness equations – **Multi Degrees of Freedom System** – Formulation of stiffness and mass matrices for a shear building – Equations of motion.

Undamped free vibration – Solution of Eigen value problem for natural frequencies and mode shapes – Orthogonality property of normal modes – Examples on two degree freedom systems – Rayleigh's Quotient.

UNIT - IV: Forced Motion of Shear Buildings

Multi degrees of freedom system - Undamped forced motion – Mode super position method – Examples on forced vibration of undamped two degree freedom systems.

UNIT - V: Vibrations on Beams

Flexural Vibration of uniform beams – Solution of the equation of motion in undamped free vibration – Natural frequencies and mode shapes for uniform beams with different end conditions – Both ends simply supported, both ends free, both ends fixed and one end fixed, other end free (cantilever) - Orthogonality condition between normal modes – Principle of virtual work – Generalized single degree freedom system of rigid body - Natural frequency by Rayleigh's method.

Text Books:

1. Mario Paz, William Leigh., "Structural Dynamics: Theory and Computation", 5th edition, Springer.
2. S.R.Damodarasamy & S.Kavitha "Structural Dynamics and Aseismic Design" PHI Learning private Ltd., New Delhi.

Reference Books:

1. Chopra A.K., "Dynamics of Structures", 3rd Edition, Pearson edition.
2. Raymond W.Clough, Joseph Penzien, "Dynamics of Structures", M.C.Graw-Hill Book Company.
3. Roy R.C.Craig "Structural Dynamics – An introduction to computer methods", John Wiley & Sons.
4. Patrick Paultre "Dynamics of Structures" John Wiley India (P) Ltd., New Delhi.

Elective - I

ADVANCED STRUCTURAL ANALYSIS

I – Semester

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

Course Objectives:

- To familiarize the inclined leg and gable frames by moment distribution method and energy methods.
- To familiarize the concept of matrix analysis to solve the structural problems.

Learning Outcomes:

Students will be able to

- analyze the inclined leg and gable frames by moment distribution method.
- analyze the trusses, frames and continuous beams by flexibility method and stiffness method.
- explain the approximate methods for analysis of shear wall.

UNIT - I: Moment Distribution Method

Analysis of portal frames with inclined legs and gable frames-simple applications

UNIT - II: Strain Energy Method

Analysis of continuous beams and simple portal frames-examples

UNIT - III: Stiffness Method

Introduction to matrix methods of analysis - static indeterminacy and kinematic indeterminacy - degree of freedom - coordinate system - structure idealization -stiffness and flexibility matrices - suitability element stiffness equations - element flexibility equations – Combination of loads - displacement equations for truss element, beam element and tension member—Simple problems using Stiffness method.

UNIT - IV: Flexibility Method

Analysis of plane truss - continuous beam - plane frame by flexibility methods.

UNIT - V: Shear Walls

Classification of Shear walls - Shear walls- necessity - structural behavior of large frames with and without shear walls -Approximate methods of analysis of shear walls.

Text books:

1. Matrix methods of Structural Analysis by Pandit and Gupta – Tata Mc.Graw Hill Publications.
2. Matrix Analysis of framed structures by William Weaver J.R and James M.Geve, CBS publications.
3. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers.

Reference Books:

1. Matrix Structural Analysis by Kanchi.
2. Matrix Methods of Structural Analysis by J.Meek.
3. Structural Analysis by Ghali and Neyve

Elective - I

ADVANCED FOUNDATION ENGINEERING

I – Semester

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

Course Objectives:

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

Learning outcomes:

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 machine foundation.
- gain the knowledge on concept of load carrying capacity of pile group.

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, mat foundation - Rectangular and trapezoidal combined footings, common type of Raft foundations, bearing capacity and differential settlement of mat foundation.

UNIT - IV: Pile Foundations

Pile foundations-Classification of piles-factors influencing choice-Load carrying capacity of single pile in clayey and sandy soils using static & dynamic pile formulae- Group of piles – Pile cap - Efficiency of pile groups- load carrying capacity 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 of practice for design and construction of block foundation for reciprocating and impact type machines for high speed rotary machines.

Text Books:

1. Principles of Foundation Engineering by Braja M. Das, Cengage Learing.
2. Foundation Analysis and Design by J.E. Bowles McGraw Hill Publishing Co.,

Reference Books:

1. Soil Mechanics and Foundation Engineering by K.R.Arora, standard publishers and Distributors, Delhi.
2. Soil Mechanics in Engineering Practice by Terzagi and Peck, John wiley & sons.
3. Foundation Design by Wayne C. Teng, Prentice – Hall.
4. Analysis and Design of sub structures by Swami Saran, Oxford & IBH.
5. Design Aids in Soil Mechanics and Foundation Engineering by Shanbaga R.Kaniraj,Tata Mc. Graw Hill.
6. A short course in Foundation Engineering by Simmons and Menzes – ELBS.

Elective - I

STRUCTURAL OPTIMIZATION

I – Semester

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

Course Objectives:

- To familiarize the student on various methods of optimization and design of structural members.

Learning Outcomes:

Students will be able to

- derive optimized structure using classical and modern methods of optimization.
- gain the knowledge on Formulation of Structural Optimization problems.
- gain the knowledge on the concept of classical methods of optimization for multivariable with equality or inequality constraints: solution by method of Lagrange Multiplier - Applications in structural engineering, Kuhn-Tucker conditions.

UNIT - I: Introduction

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

UNIT - II: 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

Unconstrained and constrained methods of optimization Univariate search, Steepest Descent Methods, Kuhn Tucker conditions – Penalty functions, slack variables and Lagrangian Multiplier methods simple examples.
Geometric and Dynamic Programming- examples.

UNIT - IV: Structural Optimization on Beams

Structural design of rectangular timber and reinforced concrete beams optimization applied to concrete mix proportioning procedure of optimization for reinforced concrete deep beams.

UNIT - V: Structural Optimization on Slabs

Optimum structural design of reinforced concrete T and L beams optimization of planner trusses Procedure of optimization for structural grid and slab floor Systems.

Text books:

1. “Engineering Optimization”, S.S. Rao, New Age Internationals Publications.
2. “Systems Analysis for Civil Engineers”, Paul, J.O., John Wiley & Sons Arora, J.S Publications.

Reference Books:

1. “Introduction to Optimum Design”, 2nd Edition, McGraw-Hill Book Company.
2. MorrIs A.J., “Foundations of Structural Optimization - A UnifiedApproach”, 3rd Edition, John Wiley and Sons.

Elective - II

ADVANCED DESIGN OF CONCRETE STRUCTURES

I – Semester

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

Course Objectives:

- To learn the concept of designing structures for fire resistance and familiarize with the design principles of grid floors, raft and pile foundations.

Learning Outcomes:

Students will be able to

- 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 raft and Tower foundations.

UNIT - I: Bunkers and Silos

Introduction, Design of rectangular and circular bunkers and silos
Chimneys: Introduction, Design factors, Stresses due to self weight, wind and temperature changes.

UNIT - II: Crack width and Redistribution of Moments

Estimation of crack width in Reinforced Concrete Members:
Introduction, Factors affecting crack width in beams, Mechanisms of flexural cracking, Estimation of crack width in beams by empirical method and IS 456 method, Shrinkage and thermal cracking.

Redistribution of Moments in Reinforced Concrete Beams:
Introduction, Redistribution of moments in fixed beam, Positions of points of contra flexures, Final shape of redistributed bending moment diagram, Moment redistribution for a two-span continuous beam, Advantages and disadvantages of moment redistribution, Moment-curvature (M - y), Relation of reinforced concrete sections.

UNIT - III: Approximate analysis of Grid Floors

Introduction, Analysis of rectangular grid floors by Timoshenko's plate theory and stiffness matrix method Comparison of methods of analysis, Reinforcement detailing in grid floor.

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 detailing from tabulated data, Analytical determination of the ultimate bending moment, moment carrying capacity of reinforced concrete beams under fire- other considerations.

UNIT - V: Towers

Design of tower: general design principles, competation of moments due to wind loads, wind load analysis of tower with circular of columns- designs

Text Books:

1. "Advanced Reinforced Concrete Design" by P.C. Varghese, Prentice Hall publication
2. "Advanced Reinforced concrete Design" by N.Krishnam Raju, CBS publication.

Reference Books:

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

Elective - II

STRUCTURAL RELIABILITY

I – Semester

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

Course Objectives:

- To learn the importance of reliability in Civil engineering and concepts of computing structural reliability.

Learning Outcomes:

Students will be able to

- understand the importance of reliability in Civil engineering.
- apply the concepts of computation of structural reliability for solving engineering problems.
- gain the knowledge of reliability based structural design.

UNIT - I: Concepts of Structural Safety

General, Design methods. Basic Statistics: Introduction, Data reduction, Histograms, Sample correlation.
Probability Theory: Introduction, Random events, Random variables, Functions of random variables, Moments and expectation, Common probability distribution, External distribution.

UNIT - II: Resistance Distributions and Parameters

Introduction, Statistics of properties of concrete, Statistics of properties of steel, Statistics of strength of bricks and mortar, Dimensional variations, Characterization of variables, Allowable stresses based on specified reliability. Probabilistic Analysis of Loads: Gravity loads, Wind load.

UNIT - III: Basic Structural Reliability

Introduction, Computation of structural reliability. Monte Carlo Study of Structural Safety: General, Monte Carlo method, Applications.

UNIT - IV: Level 2 Reliability Methods

Introduction, Basic variables and failure surface, First-order second-moment methods (FOSM).

UNIT - V: Reliability Based Design

Introduction, Determination of partial safety factors, Safety checking formats, Development of reliability based design criteria, Optimal safety factors, Summary of results of study for Indian standard – RCC design. Reliability of Structural Systems: Preliminary concepts as applied to simple structures.

Text Books:

1. “Structural Reliability Analysis and Design” by Ranganatham, R, Jaico Publications.

Reference Books:

1. **“Structural Reliability” by Melchers, R.E, wiley Publications.**

Elective - II

EARTH RETAINING STRUCTURES

I – Semester

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

Course Objectives:

- To understand the concept on stability of retaining walls and principle of active & passive earth pressure.
- To impart knowledge on concepts of sheet piles, braced cuts and cofferdams.

Learning outcomes:

Students will be able to

- calculate the earth pressures by Rankine's and Coulomb's Theories and check the stability of retaining wall.
- analyze cantilever sheet pile and braced cuts.
- explain the stability of single wall cofferdams.

UNIT - I: Earth Pressures

Earth pressures – Different types and earth pressure coefficients- Classical theories of earth pressure – Rankine's and Coulomb's theories for active and passive earth pressure- Graphical solutions for Coulomb's theory in active and passive conditions.

UNIT - II: Retaining Walls

Retaining walls – types of Retaining - Type of Failures of Retaining Walls – Stability conditions- cantilever and counter fort Retaining walls.

UNIT - III: 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.

UNIT - IV: Braced Cuts

Lateral Pressure in Braced cuts – Design principles of various components of a Braced cut – Stability of Braced cuts – Bottom Heave in cuts.

UNIT - V: Cofferdams

Types of cofferdams, suitability, merits and demerits – Design of single wall cofferdams and their stability aspects – TVA and Cummins' methods.

Text Books:

1. Principles of Foundation Engineering by Braja M. Das, Cengage Learing.
2. Analysis and Design of Foundations and Retaining Structures, Prakash. S – Saritha Prakashan, Mearut, swets & zeitlinger publications.

Reference Books:

1. Foundation analysis and design – Bowles, JE – McGraw Hill Publications.
2. Soil Mechanics in Engineering Practice – Terzaghi, K and Rolph, B.peck 2nd Edn. – John Wiley & Co.,

ADVANCED STRUCTURAL ENGINEERING LAB

I – Semester

Practical	: 6	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives:

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

Learning Outcomes:

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 Boxtest, U box test, Slump test
4. Mix design methods using a) I.S. Code method b) ACI Code method- Road Note method
5. Measurement of Cover and bar diameter by poroscope/re bar locator
6. Buckling of columns
7. Determination of horizontal thrust in two and three hinged arches
8. Identification of Dynamic Mode shapes and frequencies for rigid type structure
9. Identification of Dynamic Mode shapes and frequencies for flexible structure
10. Repair and rehabilitation of concrete beam

FINITE ELEMENT METHODS

II – Semester

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

Course Objectives:

- To apply the concepts of Finite element method for solving structural Engineering problems.

Learning Outcomes:

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.
- determine solution for higher order elements problems by numerical techniques.

UNIT - I: Fundamental Concepts

Introduction, Need of FEM, Historical background, Applications of FEM, Advantages & disadvantages energy principles, Discretization – Rayleigh – Ritz Method, Method of functional approximation- Weight Residual Techniques, Basic steps of FEM.

UNIT - II: One Dimensional Problems

Finite element modeling, Co-ordinates & shape functions, one dimensional scalar variable problems. Application to structural 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.

UNIT - III: Beams & Trusses

Derivation of stiffness matrix for beams by strain energy concept & direct stiffness method and problems on these concepts, Derivation of stiffness matrix for trusses, stress calculations, temperature effects and problems on these concepts

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. Finite Element Analysis by Sk.Md ,Jalaludin , Anuradha Publishers
2. Finite Elements Methods in Engineering by TirupatiR.Chandrapatla and Ashok D.Belgaundu

Reference Books:

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

EARTHQUAKE RESISTANT DESIGN

II – Semester

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

Course Objectives:

- To impart the knowledge of designing earthquake resistant structures and familiarize the code provisions.

Learning Outcomes:

Students will be able to

- describe various terms of engineering seismology.
- design earthquake-resistant structures.
- gain the knowledge on seismic codal provisions and detailing.
- acquire the knowledge in structural irregularities in seismic planning and shear wall concept.
- understand seismic evaluation and retrofitting techniques.

UNIT - I: Engineering Seismology

Introduction, Structure of earth, Plate tectonics, Elastic rebound theory, Earthquake terminology- Source, Focus, Epicentre, 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 the latest Indian Seismic code IS: 1893 – 2002 (Part- I) provisions for buildings, earthquake design philosophy, assumptions, design by Seismic coefficient and response spectrum methods, displacements and drift requirements. Analysis of multi storeyed building using Seismic coefficient method.

Review of latest Indian Seismic code IS: 13920 provisions for ductile detailing of beam, column and joints.

UNIT - III: 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, reentrant 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, detailing 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 like 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.

Text Books:

1. Agarwal pankaj & shrikhande Manish "Earthquake Resistant Design of Structures", 2nd Edition, Eswar Press.
2. Duggal S.K., "Earthquake Resistant Design of Structures" 2nd Edition, Oxford University Press.

Reference Books:

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

STABILITY OF STRUCTURES

II – Semester

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

Course Objectives:

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

Learning Outcomes:

Students will be able to

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

UNIT - I: Criteria For Design Of Structures

Classical concept of stability, strength, and stiffness - Stability of discrete systems - linear and nonlinear behaviour.
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 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.

UNIT - III: In-Elastic Buckling

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.

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. Theory of Stability of Structures by Alexander ChaJes, PHI Publications.
2. Theory of Elastic stability by Timshenko & Gere-Mc Graw Hill Publications.
3. Chajes,A., “Principles of elastic stability”, 1st Edition, Prentice Hall, NJ.

Reference Books:

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, Oxford University 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.

THEORY OF PLATES AND SHELLS

II – Semester

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

Course Objectives:

- To familiarize with the concepts of plates and shells and designing of shells.

Learning Outcomes:

Students will be able to

- analyze and design for plates for different loadings.
- analyze and design of shells.
- explain the concept of curvature in shells.
- gain knowledge on beams, theory of cylindrical shells.

UNIT - I: Rectangular Plates

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.

UNIT - II: Circular Plates

Circular plates: Symmetrically loaded, Circular plates under various loading conditions, Annular plates.

UNIT - III: Introduction to Shells

Introduction to shells- Single and double curvature- Equations of Equilibrium of shells: Derivation of stress resultants, Principles of membrane theory and bending theory.

UNIT - IV: Cylindrical Shells

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.

UNIT - V: 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.

Text Books:

1. Theory of plates and shells – Timoshenko and Krieger, McGraw-Hill book company, INC, New Yark.
2. A Text Book of Plate Analysis – Bairagi, K, Khanna Publisher, New Delhi.
3. Design and Construction of Concrete Shell Roofs – Ramaswamy, G.S, Mc Graw K.Chandra sekhara

Reference Books:

1. "Thin Shells Theory and Problems", J. Ramchandran, Universities Press. "Stresses in shells", Flugge, 2nd Edition, Springer .

Elective - III

PRE - STRESSED CONCRETE

II – Semester

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

Course Objectives:

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

Learning Outcomes:

Students will be able to

- analyze and design pre-stressed concrete members.
- gain the knowledge on materials, prestressing Systems, end anchorages.
- gain the knowledge on losses of pre-stress.
- analyze and design of sections for flexure.
- apply the concept of prestress for designing of slabs.

UNIT - I: Introduction

Historic development – General principles of prestressing, pretensioning and post tensioning – Advantages and limitations of prestressed concrete – Materials – High strength concrete and high strength steel. I.S. Code provisions, Methods and Systems of Prestressing; Pre-tensioning and post tensioning methods – systems of prestressing - Hoyer system, Magnel system, Freyssinet system and Gifford – Udall system.

UNIT - II: Losses Of Prestress

Loss of prestress in pre-tensioned and post-tensioned members - elastic shortage of concrete, shrinkage of concrete, creep of concrete, Relaxation of steel, slip in anchorage and frictional losses.
Analysis of sections for flexure; Elastic analysis of concrete beams prestressed with straight, concentric, eccentric, bent and parabolic tendons

UNIT - III: Design of Section for Flexure and Shear

Allowable stress, Design criteria as per I.S.Code – Elastic design of simple rectangular and I-section for flexure, shear and torsion – design for shear in beams – Kern, cable profile.

UNIT - IV: Deflections

Importance of deflections, factors influencing deflection, codal provisions, short term and long term deflections.

Continuous Beams: advantages of continuous members- code provisions – design of two span and three span continuous beams- concordant cable profiles. Load-Balancing method.

UNIT - V: Compression Members

Introduction – design of PSC columns

Slabs: Introduction –types-circular, rectangular and flat slabs-cracking and strength- code provisions-design of PSC floor slabs, one way and two way slabs and simple flat slabs.

Text Books:

1. Krishnam Raju,N., "Design of Prestressed Concrete Srtuctures",4th Edition, TMH.
2. Lin., T.Y., "Design of Prestressed Concrete Structures", 2nd Edition, John Wiley & Sons.

Reference Books:

1. Edward G. Nawy, "Prestressed Concrete A FundamentalApproach", 1st Edition, Prentice Hall.
2. Rajagopalan. N, "Prestressed Concrete", 2nd Edition, Narosa publications.

Elective - III

ADVANCED DESIGN OF STEEL STRUCTURES

II – Semester

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

Course Objectives:

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

Learning Outcomes:

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.
- develop confidence levels in understanding the plastic analysis, plastic mechanism and apply to simple beams & frames.

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

Loading, Analysis & Design of Transmission line towers – simple problems

UNIT - IV: Chimneys

Design of self supporting steel chimneys – Design of steel siols - foundations.

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. B.C.Punmia, Ashok kumar jain & Arun kumar jain "Comprehensive Design of steel structures" Laxmi publications, New Delhi.
2. S.K.Duggal " Design of Steel Structures" Tata Mc Graw Hill, New Delhi.

Reference Books:

1. A.S.Arya & J.L.Ajmani "Design of Steel Structures" Nemchand & Brothers, 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.

Elective - III

REPAIR & REHABILITATION OF STRUCTURES

II – Semester

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

Course Objectives:

- To familiarize the students with various types of deteriorations and need for rehabilitation.
- To familiarize the student with Non – destructive testing and repairs.

Learning Outcomes:

Students will be able to

- assess the damage intensity
- select proper rehabilitation and repair measures for different types of deteriorations.
- apply the Seismic Retrofitting techniques on reinforced concrete building.

UNIT - I: Introduction

Deterioration of concrete and steel structures with aging, types of deterioration, systematic approach for diagnosis, causes for deterioration, Need for rehabilitation,

UNIT - II: Distress In Concrete /Steel Structures

Importance - Types of damages, causes for damages; effects of damages; Case studies Non destructive evaluation - Concrete behaviour under corrosion, disintegrated mechanisms.

UNIT - III: Damage Assessment And Evaluation Models

Damage testing methods; Non-destructive testing methods. – Visual investigation- Acoustical emission methods- Corrosion activity measurement-chloride content – Depth of carbonation- Impact echo methods – Rebound Hammer test - Ultrasonic pulse velocity methods- Pull out tests.

UNIT - IV: Rehabilitation Methods

Grouting; Detailing; Imbalance of structural stability; Case studies . Strengthening and stabilization- Techniques- design considerations- Beam shear capacity strengthening- Shear Transfer strengthening stress reduction techniques- Column strengthening-flexural strengthening- Connection stabilization and strengthening,

UNIT - V: Methods of Repair

Short creting Guniting; Epoxy injection; Crack ceiling **Seismic Retrofitting of reinforced concrete buildings :** Introduction, sources of weakness in framed buildings, Damage due to discontinuous load path, lack of deformation, Structural damage due to inadequate quality of workmanship and materials.

Retrofitting techniques and strategies for RC buildings – Structural level (global) retrofit methods; Member level (local) retrofit methods; Comparative analysis of methods in retrofitting

Text books:

1. Diagnosis and treatment of structures in distress by R.N.Raikar, Published by R&D Centre of Structwel Designers & Consultants Pvt.Ltd., Mumbai.
2. Handbook on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi.
3. Repair and protection of concrete structures by Noel P.Mailvaganam, CRC press London.
4. Concrete repair and maintenance Illustrated by Peter.H.Emmons, Galgotia publishers.
5. Handbook on seismic retrofit of buildings, Narosa Publishing House.

Reference Books:

1. Concrete technology- Neville & Brooks, Pearson Education Publications.
2. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice- Hall of India.
3. Failures and repair of concrete structures by S.Champion, John wiley and sons
4. Special Structural concrete- Rafat Siddique
5. Concrete repair and maintenance illustrated- Peter H Emmons

Elective - IV

INDUSTRIAL STRUCTURES

II – Semester

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

Course Objectives:

- To impart the knowledge on planning and functional requirement of industrial structures.
- To familiarize the student with prefabrication and construction techniques of industrial structures.

Learning Outcomes:

Students will be able to

- gain the knowldge on design, constructional aspects, planning and functional requirements of industrial structures.
- apply the knowledge of Loads in designing Industrial structures.
- equip with the knowledge of Tower cranes, Transmission line and Communication towers.

UNIT - I: Planning And Functional Requirements

Classification of Industrial structures - Choice of site – General requirements of different types of industries for safety, space requirements, services and land/ planing for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines from Factories Act. Codes of practice in the design and construction

Materials: Properties of Concrete, Steel, R.C.C, Prestressed Concrete, Aluminum, PVC that affect the structural performance – relative merits and demerits – suitability as construction material in Industrial Structures.

UNIT - II: Loads On Industrial Buildings, Various Configurations

Loads on Industrial structures – Gravity load, Live load, wind load and Earthquake load - Configuration of various Industrial buildings, Need for large column free areas -Various types of Floors, Roofs and Roof coverings.

UNIT - III: Steel Portal Frames

Introduction to Plastic Analysis -Shape factor collapse Mechanism – Plastic moment carrying capacity of simple beams and portal frames – Design of steel portal frames with and without Gantry girders.

UNIT - IV: Steel Truss

Tower Cranes and Transmission line and Communication towers. Analysis and design of bracing systems in industrial sheds.

UNIT - V: Prefabrication And Construction Techniques

Pre-casting techniques - Planning, Analysis and design considerations suitability for Industrial structures. Handling techniques – Transportation, Storage and erection of structures. Test on precast elements - Quality control - Repairs and economical aspects on prefabrication.

Text Books:

1. Duggal, S.K., Design of Steel Structures Tata McGraw-Hill Publications, 3rd Edition.
2. Krishna Raju N. "Advanced Reinforced Concrete Design", CBS Publishers, 2nd Edition.

Reference Books:

1. "Teaching Resource for Structural Steel Design" – INSDAG, Kolkatta.
2. IS: 456 – 2000, IS: 800 – 2007, IS: 875 – 1964, BIS, New Delhi
3. "National Building Code", BIS, New Delhi.
4. Subrahmanyam, N., "Space Structures", Wheeler & Co., Allahabad, 1st Edition.
5. Tall Chimneys- Design and construction – S.N. Manohar, Mc Graw Hill Publications.
6. Transmission Line Structures- A.R. Santakumar and S.S. Murthy

Elective - IV

DESIGN OF BRIDGE STRUCTURES

II – Semester

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

Course Objectives:

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

Learning Outcomes:

Students will be able to

- gain the knowledge on different IRC loading standards
- design slab bridges, box culverts and bridges.
- acquire knowledge on general considerations for prestressed concrete bridges.
- design the culverts.
- design the open well foundations.

UNIT - I: Introduction

Types of bridges, materials of construction, codes of practice (Railway and Highway Bridges), loading standards, (IRC). 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)

UNIT - II: Super Structures

Slab bridge- Wheel loads 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.,

UNIT - III: Boxgirder Bridges

Box girder bridge deck: evolution of box girders, preliminary design and analysis, structural action, analysis for individual actions, analysis and design of simple box girder deck.

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: Bidge Founcations

Types of foundations- well foundation, open well foundation, components of well foundation – pile foundations (designs not included) - Reinforcement detailing and bar bending schedule need to be prepared

Text Books:

1. Johnson victor D, "Essentials of Bridge Engineering", 7th edition, Oxford, IBH Publishing Co., Ltd.
2. Krishnam Raju N., "Design of Bridges", 4th edition, Oxford and IBH Publishing Co., Ltd.

Reference Books:

1. Ponnu Swamy, "Bridge Engineering", 4th edition, Mc Graw-Hill Publication.
2. Vazirani, Ratvani & Aswani, "Design of Concrete Bridges", 5th edition, Khanna Publishers.
3. Swami Saran, "Analysis and Design of sub-structures", 2nd edition, Oxford IBH Publishing co ltd.

Elective - IV

DESIGN OF OFF SHORE STRUCTURES

II – Semester

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

Course Objectives:

- To analyze the installation, strengthening, repairs and construction process of offshore structures**.**

Learning outcomes:

Students will be able to

- understand the Environmental aspects on Materials and offshore construction equipments.
- demonstrate the methods of installation of piles in marine and offshore Structures.
- identify the failures and strengthening processes required to repair off shore structures.
- develop principles, procedures to acquire safety, risk, reliability and quality control at various stages of construction.

UNIT - I: Introduction for offshore structures

Physical and Environmental aspects of Marine and offshore construction- Materials and offshore construction equipment – Marine operations – Sea floor modification and improvements.

UNIT - II: Marine and Offshore construction equipment

Basic motions in sea- Buoyancy, Draft and freeboard- Stability- Damage control- Barges - Crane - offshore Derrick – Catamaran and Semi submersible Barges- Jack up Barges- launch barges- offshore Dredges- Floating Concrete Plant .

UNIT - III: Installation of Piles in marine and offshore Structures

Fabrication of tubular steel piles- Transportation- Installation- Methods of increasing penetration – Inserting and anchoring into rock and hardpan- Prestresses concrete piles for marine construction- Handling and Positioning of Piles Review of basic and concepts

UNIT - IV: Underwater repairs & Strengthening Existing structures

Repairs to steel Jacket- type structures- Repairs to steel piling- Repairs to concrete offshore structures- repairs to foundations- Fire damage- Pipeline repairs, Strengthening of offshore platforms and terminals, members or assembles- Increasing capacity of piles for axial loads- Increasing lateral capacity of piles and structures in interaction- seismic retrofitting.

UNIT - V: Constructability

Construction stages- Principles- Assembly and Jointing procedures- access- tolerances- survey control- quality control and assurance- safety- risk and reliability evaluation

Text books:

1. *Construction of Marine and offshore Structures- 2e- Ben-C. Gerwick, Jr CRC press*
2. *Basic Coastal Engineering* by R. M. Sorensen, published by Chapman & Hall.

References Books:

1.Chakrabarti, S.K., "Hydrodynamics of Offshore Structures", Computational mechanics,

2. Thamas H Dawson, "Offshore Structural Engineering", Prentice Hall Inc. Englewood, Cliffs, N.J.

3. API Recommended Practice for Planning, "Designing and Constructing Fixed Offshore Platform", American Petroleum Institute Publication, RP2A, Dallas, Texas.

COMPUTER APPLICATIONS IN STRUCTURAL ENGINEERING LAB

II – Semester

Practical	: 6	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives:

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

Learning Outcomes:

Students will be able to

- analysis the structural elements using software designs.
- design the structures fir 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/ NISA (Civil) etc.

List of Experiments:

1. Design of reinforced concrete beam (Singly/Doubly)
2. Design of reinforced concrete slab (One-way/Two-way)
3. Design of reinforced concrete column subjected to uniaxial and biaxial bending
4. Design of reinforced concrete retaining wall (cantilever type)
5. Design of steel welded plate girder
6. Lateral forces on a building due to an earthquake using equivalent static method
7. Lateral forces on a building due to wind
8. Analysis of pin jointed plane trusses
9. Analysis of rigid jointed plane frames
10. Plane stress analysis of using CST element
11. Plane stress analysis using four noded isoparametric element
12. Plate bending analysis using four noded isoparametric element
13. Free vibration analysis of a shear building
14. Forced vibration (steady-state response) analysis of a shear building subjected to harmonic excitation using mode superposition technique
15. Time-history analysis of single degree of freedom system subjected horizontal ground motion.