VIGNANA BHARATHI INSTITUTE OF TECHNOLOGY

(AUTONOMOUS)

M.Tech – STRUCTURAL ENGINEERING

COURSE STRUCTURE (R22 Regulations)

I YEAR I SEMESTER

Sr.No	Course Code	Course Name	Core/Elective	L	T	P	Credits
1.	22SE6111	Advanced Structural Mechanics	Professional Core-I	3	0	0	3
2.	22SE6112	Theory of Elasticity and Plasticity	Professional Core-II	3	0	0	3
3.	22SE6171 22SE6172 22SE6173	Theory of Plates and Shells Computer Oriented Numerical Methods Structural Stability	Professional Elective-I	3	0	0	3
4.	22SE6174 22SE6175 22SE6176	Advanced Reinforced Concrete Design Advanced Foundation Engineering Structural Optimization	Professional Elective-II	3	0	0	3
5.	22MC6111	Research Methodology and IPR	MC	2	0	0	2
6.	22SE6151	Computer Aided Design Laboratory	Lab-I	0	0	4	2
7.	22SE6152	Structural Engineering Laboratory	Lab-II	2	0	4	2
8.	22AU6101	Audit Course-I	Audit-I	2	0	0	0
		Total Credits		16	0	8	18

I YEAR II SEMESTER

Sr.No	Course Code	Course Name	Core/Elective	L	T	P	Credits
1.	22SE6211	Finite Element Analysis	Professional Core-III	3	0	0	3
2.	22SE6212	Structural Dynamics	Professional Core-IV	3	0	0	3
3.	22SE6271 22SE6272 22SE6273	Advanced Structural Steel Design Structural Reliability Design of High-Rise Buildings	Professional Elective-III	3	0	0	3
4.	22SE6274 22SE6275 22SE6276	Advanced Prestressed Concrete Design Structural Health Monitoring Design of Bridges	Professional Elective-IV	3	0	0	3
5.	22SE6291	Mini Project with Seminar	MPWS	0	0	4	2
6.	22SE6251	Numerical Analysis Laboratory	Lab-III	0	0	4	2
7.	22SE6252	Advanced Structural Analysis and Design Laboratory	Lab-IV	0	0	4	2
8.	22MC6201	Audit Course-II	Audit-II	2	0	0	0
		Total Credits		14	0	12	18

II YEAR I SEMESTER

	III Semester			L	T	P	Credits
Sr.No	**Course Code**	**Course Name**	**Core/Elective**				
1.	22SE7171 22SE7172 22SE7173	Earthquake Resistant Design of Structures Pre-Engineered Buildings Rehabilitation and Retrofitting of Structures	Professional Elective-V	3	0	0	3
2.	-	Open Elective	Open Elective	3	0	0	3
3.	22SE7181	Dissertation Work Review - I	Dissertation	0	0	12	6
		Total Credits		6	0	12	12

II YEAR I SEMESTER

	IV Semester			L	T	P	Credits
Sr.No	**Course Code**	**Course Name**	**Core/Elective**				
1.	22SE7281	Dissertation Work Review - II	Dissertation	0	0	12	6
2.	22SE7282	Dissertation Viva-Voce	Dissertation	0	0	28	14
		Total Credits		0	0	40	20

For Dissertation Work Review – I, please refer 7.10 in R22 Academic Regulations

Open Electives Offered by the Department:

1. Green Buildings
2. Construction Project Management
3. Safety and Construction Practice Regulations

Audit Course I & II

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

22SE6111: ADVANCED STRUCTURAL MECHANICS

M.Tech. I Year I Sem. **L T P C**
3 0 0 3

Pre-requisites: Structural Analysis I & II

Course Objectives:

1. To understand the concept of unsymmetrical bending and shear center in beams.
2. To analyze the stresses and deflections in curved beams and beams on elastic foundations.
3. To learn the concept of column buckling and the factors affecting column stability.
4. To introduce the matrix methods of structural analysis, focusing on static and kinematic indeterminacies.
5. To apply the direct stiffness method for the analysis of trusses, beams, and frames.

Course Outcomes: After completion of the course, students should be able to

1. Identify and analyze bending stresses in beams subjected to unsymmetrical loading.
2. Analyze the circumferential and radial stresses in curved beams and analyze their deflections.
3. Evaluate the buckling behavior of columns under various end constraints and loading conditions.
4. Apply matrix methods for the analysis of statically indeterminate structures.
5. Use the direct stiffness method to analyze trusses, beams, and frames in structural engineering.

UNIT – I Unsymmetrical Bending:

Definition of Shear Center in Bending - Symmetrical and Nonsymmetrical Bending - Bending Stresses in Beams Subjected to Nonsymmetrical Bending - Deflections of Straight Beams Subjected to Nonsymmetrical Bending

UNIT - II

Advanced Analysis of Beams : Curved Beams: Circumferential Stresses in a Curved Beam - Radial Stresses in Curved Beams - Correction of Circumferential Stresses in Curved Beams Having I-, T-, or Similar Cross Sections - Deflections of Curved Beams on Elastic Foundations - Infinite Beam Subjected to a Concentrated Load: Boundary Conditions - Infinite Beam Subjected to a Distributed Load Segment

UNIT - III

Column Buckling: Concept of Column Buckling - Deflection Response of Columns to Compressive Loads - Euler Buckling of Columns with General End Constraints - Local Buckling of Columns - Inelastic Buckling of Columns

UNIT - IV

Matrix methods of analysis: Static indeterminacy and kinematic indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations-Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates - Assembly of stiffness matrix from element stiffness matrix – Analysis of trusses, beams and frames by stiffness matrix methods

UNIT – V

Direct stiffness method: General procedure - banded matrix - semi bandwidth - assembly by direct stiffness matrix method -Application of direct stiffness method to trusses, simple and continuous beams and frames

REFERENCES

1. Structural Analysis by Devdas Menon, Narosa Publishing Housing Pvt Ltd.
2. Indeterminate Structural Analysis by K U. Muttu,IK International Publishing House Pvt.ltd Matrix Analysis of Frames structures by William Weaver J.R and James M.Gere, CBS publications
3. Matrix Structural Analysis by Madhu B. Kanchi
4. Matrix Methods of Structural Analysis by J.Meek

5. Structural Analysis by Ghali and Neyveli

22SE6112: THEORY OF ELASTICITY AND PLASTICITY

M.Tech. I Year I Sem. **L T P C**
3 0 0 3

Prerequisites: Strength of Materials I & II

Course Objectives:

1. To understand the fundamentals of stress, elasticity, stress transformation and concentration factors.
2. To understand the strain components, strain transformation and the compatibility conditions in different coordinate systems.
3. To understand the stress-strain relationships and material behavior under different loading conditions.
4. To apply elasticity theory for solving two-dimensional and three-dimensional structural problems.
5. To introduce the concepts of plasticity and various yield criteria for different materials.

Course Outcomes: After completion of the course, students should be able to

1. Analyze stress components, stress tensors, and their transformations in 2D and 3D.
2. Describe strain components, strain tensors, and compatibility conditions, and apply strain transformation.
3. Develop stress-strain relationships for various materials and understand material symmetries and idealizations.
4. Analyze complex elasticity problems using stress function approaches, including beam bending and torsion problems.
5. Apply the fundamental concepts of plasticity and evaluate yield criteria for pressure-dependent and independent materials.

UNIT - I

Stress: Introduction to Elasticity – Definition of Kinetics and Kinematics - Notation for forces and stress - Components of stresses – Stress tensor - Differential equations of equilibrium in 2D & 3D in Cartesian coordinates and in polar coordinates - boundary conditions – Cauchy's postulate – Stress transformation – Direction Cosines -Principal stresses – Stress invariants – Decomposition of stresses-Hydrostatic and Deviatoric stresses – Octahedral stresses – stress concentration factors

UNIT - II

Strain: Notation for strain - Components of strain – Strain tensor – Strain Components -Strain - displacement relations - Strain Compatibility Conditions - Strain transformation – Direction Cosines - Principal strains – Strain invariants - Octahedral strains – Strain Rosette

UNIT - III

Stress -Strain Relationship: Navier's equation for stress-strain relationships – Relationship between Material constants – Stress - strain relations in 2D and 3D – Complementary conditions for shear - Material symmetry -Reduction of Material constants from anisotropic to orthotropic, monoclinic, isotropic and transversely isotropic – Plane stress, Plane strain and axi-symmetric idealizations - Mohr circle in 2D and 3D – Airy's stress function – Potential function -

UNIT - IV

Solution of 2D and 3D elasticity problems: Problem solving using stress function approach: Beam bending problems – Symmetric stress distribution problems, Plane problems.

Torsion problems in Elasticity – Membrane analogy approach – Application to non- circular thin walled sections

UNIT - V

Plasticity: Introduction to plasticity – Yield criteria for pressure dependent and independent materials– Tresca's criterion – Von mises criterion – Mohr-Coulomb criterion -Rankine criterion -Flow rule –

Associative and Non-Associative-Hardening rules and consistency conditions -Introduction to iterative and return mapping.

REFERENCES:

1. Theory of Elasticity by Timeshenko, McGraw-Hill Publications
2. Theory of Elasticity by Y.C.Fung
3. Advanced Mechanics of solids by LS Srinath,
4. Elasticity and Plasticity for structural Engineers by Wang & Chen

22SE6171: THEORY OF PLATES AND SHELLS
(Program Elective – I)

L	T	P	C
3	0	0	3

M.Tech. I Year I Sem.

Pre-requisites: Theory of Elasticity, Structural Analysis

Course Objectives:

1. To introduce the fundamental concepts in shell theory, space curves and surfaces.
2. To apply the governing equations for small deflection theory of thin plates under various loading conditions.
3. To analyze circular plates subjected to symmetrical bending and different loading scenarios.
4. To understand the structural behavior, classification, and analysis methods for different types of shells.
5. To understand the geometry, analysis, and design of shells of double curvature and axi-symmetrical shells.

Course Outcomes: After completion of the course, students should be able to

1. Understand the basic concepts of shell theory, including strain-displacement relations and equilibrium equations.
2. Analyze the governing differential equations for thin rectangular plates under small deflections.
3. Analyze the bending of circular plates subjected to various loads using differential equations.
4. Analyze cylindrical and other shells using different analytical methods, understanding their merits and demerits.
5. Apply membrane theory for the analysis and design of shells of double curvature and axi-symmetrical structures such as cooling towers.

UNIT - I

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

UNIT - II

Small Deflection Theory of Thin Rectangular Plates : Assumptions – Derivation of governing differential equation for thin plates – Boundary conditions – simply supported plate under sinusoidal load – Navier solution – Application to different cases – Levy's solution for various boundary conditions subjected to different loadings like uniform and hydrostatic pressure.

UNIT - III

Circular Plates: Differential Equation for symmetrical bending of Laterally loaded circular Plates – Uniformly loaded circular plates –circular plate concentrically loaded – circular plate loaded at center

UNIT - IV

Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation.

Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugges simulations equations.

UNIT - V

Introduction to the shells of Double curvatures: Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type.Axi- Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application to spherical shell and hyperboloid of revolution cooling towers.

REFERENCES:

1. Theory of Plates & Shells –Stephen, P. Timoshenko, S. Woinowsky-Krieger – Tata MC Graw Hill Edition
2. Analysis and design of concrete shell roofs By G. S. Ramaswami, CBS publications.
3. Design of concrete shell roofs By Billington – Tata MC Graw Hill, New York
4. Design of Shells and Folded Plates by P.C. Varghese, PHI Learning Pvt. Ltd

22SE6172: COMPUTER ORIENTED NUMERICAL METHODS
(Program Elective – II)

L	T	P	C
3	0	0	3

M.Tech. I Year I Sem.

Pre-requisites: Mathematics I and II

Course Objectives:

1. To understand and apply direct and iterative methods for solving systems of linear equations.
2. To learn various methods for finding eigenvalues and eigenvectors and perform interpolation for data fitting.
3. To use finite difference methods for differentiation and integration and apply these methods to solve engineering problems.
4. To develop numerical differentiation and integration techniques and understand their applications.
5. To solve ordinary differential equations (ODEs) using various numerical methods and apply these techniques to structural engineering problems.

Course Outcomes: After completion of the course, students should be able to

1. Apply direct and iterative methods to solve linear systems of equations.
2. Calculate Eigen values and Eigenvectors of matrices using different numerical methods and perform various interpolation techniques.
3. Use finite difference methods for numerical differentiation and integration to solve problems in structural analysis.
4. numerical differentiation and integration methods to obtain accurate results for various engineering applications.
5. Solve ordinary differential equations using methods such as Euler's, Runge-Kutta.

UNIT - I:
Solutions of linear equations: Direct method – Cramer's rule, Guass – Elimination method- Gauss – Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Siedel iteration, Successive over –relaxation method -Applications

UNIT - II:
Eigen values and eigen vectors: Jacobi method for symmetric matrices- Given's method for symmetric matrices-Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method, Fast Fourier Transform (FFT)
Interpolation: Linear Interpolation - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.

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

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

UNIT - V:

Ordinary Differential Equation: Euler's method – Backward Euler method – Midpoint method – single step method, Taylor's series method, Runge-Kutta method Predictor-Corrector Method -Trapezoidal and Midpoint method – Implicit Runge Kutta method – Boundary value problem – Difference method – Shooting method -Structural Engineering Applications

REFERENCES:

1. Numerical Methods for Scientific and Engineering Computations. M. K. Jain - S. R. K. Iyengar
2. – R. K. Jain Willey Eastern Limited.
3. Applied numerical Analysis by – Curtis I. Gerala- Addission Wasley – published campus.
4. Numerical Methods for Engineers Stevan C. Chopra, Raymond P. Canal Mc. Graw Hill book company.
5. C Language and Numerical Methods by C. Xavier – New age international publisher.
6. Numerical methods using MATLAB by George Lindfield and John penny, Academic press

22SE6173: STRUCTURAL STABILITY
(Program Elective – I)

L T P C
3 0 0 3

M.Tech. I Year I Sem.

Pre-requisites: RCC Design and Analysis

Course Objectives:

1. To understand the fundamental criteria for the design of structures, stability, strength and stiffness.
2. To analyze the stability of columns under axial, flexural, and torsional loads.
3. To understand the stability of frames, including member buckling and global buckling behavior.
4. To study the stability of beams and plates under various loading conditions.
5. To introduce the concepts of inelastic buckling and dynamic stability in structural elements.

Course Outcomes: After completion of the course, students should be able to

1. Understand the concepts of structural stability, strength, and stiffness in both discrete and continuous systems.
2. Analyze the buckling behavior of columns under different loading and support conditions.
3. Evaluate the stability of frame structures by understanding the difference between member buckling and global buckling.
4. Assess the lateral torsional buckling of beams and the buckling of plates under axial, shear, and combined loads.
5. Understand the principles of inelastic buckling and dynamic stability in the context of structural design.

UNIT – I

Criteria for Design of Structures: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behavior.

UNIT – II

Stability of Columns: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.

UNIT – III

Stability of Frames: M**e**mber Buckling versus Global Buckling, Slenderness Ratio of Frame Members.

UNIT – IV

Stability of Beams: lateral torsion buckling.
Stability of Plates: axial flexural buckling, shear flexural buckling, buckling under combined loads.

UNIT – V

Introduction to Inelastic Buckling and Dynamic Stability.

REFERENCE BOOKS:

1. Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
2. Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
3. Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
4. Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York.

22SE6174: ADVANCED REINFORCED CONCRETE DESIGN
(Program Elective – II)

L	T	P	C
3	0	0	3

M.Tech. I Year I Sem.
Pre-requisites: Design of Reinforced Concrete Structures

Course Objectives:

1. To introduce the fundamental concepts of limit state analysis and design of reinforced concrete (R.C.) structures.
2. To understand the limit state of flexure I.S. code provisions for various structural elements.
3. To analyze slabs using inelastic methods, including yield line theory, and design ribbed and flat slabs.
4. To design R.C. sections for shear, bond, and torsion using limit state concepts and proper reinforcement detailing.
5. To design short and slender columns, considering limit state of compression and the effects of slenderness.

Course Outcomes: After completion of the course, students should be able to

1. Apply the limit state method for the design of R.C. structures, understanding different load combinations and safety factors.
2. Design R.C. beams and deep beams using I.S. code provisions for the limit state of flexure.
3. Perform inelastic analysis of various slab types using yield line theory and design ribbed and flat slabs.
4. Design R.C. members for shear, bond, and torsion, incorporating appropriate reinforcement detailing.
5. Design short and slender columns, considering the limit state of compression and using methods for slender column design.

UNIT - I

Limit state Analysis of R.C. Structures: Introduction- Loads – Different types of Loads and load combinations – Different methods of Design- Working Stress Method and Limit State Method –- Materials - Characteristic Values – Reliability based methods of design - Partial safety factors –Stress Block Parameters - Plastic hinge, Redistribution of moments, moment rotation characteristics of RC member

UNIT - II

Limit state of Flexure: I.S. code provisions, loading pattern, Bending Moment Envelop, Application for Fixed Beams and Continuous Beams, Deep Beams and Corbels

UNIT - III

Inelastic Analysis of Slabs :Yield line criterion – Virtual work and equilibrium methods of analysis – For square circular, Rectangular, Triangular and Hexagonal with simple and continuous end conditions- Reinforcement details - Ribbed slabs : Analysis of the Slabs for Moment and Shears, Ultimate Moment of Resistance, Design for shear, Deflection, Arrangement of Reinforcements, Flat slabs: Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears- Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip sketch showing reinforcement details.

UNIT - IV

Limit state of Shear, Bond and Torsion: Design for Shear, Bond and Torsion - Mechanism of shear and bond failure - Design of shear using limit state concept – Design for Bond –Anchorage and Development length of bars - Design of sections for torsion - Detailing of reinforcement

UNIT - V

Limit State of Compression: Design of Short and Long columns - slenderness limits, Methods of Design of Slender Columns, Additional Moment Method, Procedure for Design of Slender Columns.

REFERENCES:

1. "Reinforced Concrete Design" S. Unnikrishna Pillai & Devdas Menon; Tata Mc. Graw-Hill Publishing Company Ltd. New Delhi 2010.
2. "Advanced Reinforced Concrete" P.C. Varghese Prentice Hall of INDIA Private Ltd. 2008.
3. "Design of Reinforced Concrete Structures" by N.Subramanian, Oxford University Press.
4. "Limit State Theory and Design of Reinforced Concrete" Dr. S. R. Karve and V.L Shah. Standard Publishers, PUNE 2004.
5. Design of concrete structures – Arthus H. Nelson, David Darwin, and Chorles W. Dolar, Tata Mc. Graw-Hill, 3rd Edition, 2005.
6. Reinforced Concrete design by Kennath Leet, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
7. "Design Reinforced Concrete Foundations" P.C. Varghese Prentice Hall of INDIA Private Ltd.
8. IS 456- 2000 Plain and Reinforced concrete book of Practice.
9. SP 16 - Design Aids for Reinforced Concrete to IS 456
10. SP 34 - Hand Book as Concrete Reinforcement and retaining

22SE6175: ADVANCED FOUNDATION ENGINEERING
(Program Elective – II)

L T P C
3 0 0 3

M.Tech. I Year I Sem
Pre-requisite: Soil Mechanics
Course Objectives:

1. Identify a suitable foundation system for a structure
2. Evaluate the importance of raft foundation and principles of design for buildings and tower structures.
3. Analyze and design pile foundations.
4. Examine and discuss various machine foundations.
5. Analyze and design Sheet piles and cofferdams.

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

1. Identify a suitable foundation system for a structure
2. Evaluate the importance of raft foundation and principles of design for buildings and tower structures.
3. Analyze and design pile foundations.
4. Examine and discuss various machine foundations.
5. Analyze and design Sheet piles and cofferdams.

UNIT – I

Foundation design basics: Criteria for choice of foundation, bearing capacity, total and differential settlements, tolerance for various types of structures, Interpretation of soil profile from design parameters like modulus of compressibility, Modulus of subgrade reaction, Poisson's ratio, etc.

UNIT – II

Raft foundations: Raft foundations for building and tower structures, including effects of soil-structure interaction and nonlinearity, different types of rafts.

UNIT – III

Deep foundations : Pile foundation-types, methods of installation, codal practices for permissible load under vertical and lateral loads, stresses during pile driving, load carrying capacity of pile groups, negative skin friction, under-reamed piles, Foundation for heavy structures, well foundations, caisson foundations, equipment used for construction of these foundation systems.

UNIT – IV

Machine foundations: Theory of vibrations, free and forced vibrations with and without damping for a single degree freedom system, types of machine foundations, their design criteria, permissible amplitudes and bearing pressure.

UNIT - V

Cantilever sheet piles and anchored bulkheads: Earth pressure diagram, determination of depth of embedment in sands and clays, timbering of trenches, Earth pressure diagrams, forces in struts. Cofferdams: Stability, bearing capacity, settlements (qualitative treatment only, no designs).

TEXT BOOKS

1.Das, B.M., "Principles of Foundation Engineering", 4 th Edition, PWS Publishing, Singapore, 1999
2.Bowles, J.E., "Foundation Analysis and Design", 5 th Edition, McGraw- Hill International, 2000
3.Shamsher Prakash, "Soil Dynamics", 3 rd Edition, John Wiley publications, 2000

REFERENCES

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", 4 th Edition ,Sai Krupa Technical Consultants, 2000
2. Venkataramah, C., "Geotechnical Engineering", 5th Edition, New Age International Pvt. Ltd., 2009
3. Swami Saran, "Analysis and Design of Substructures", 2nd Edition, Oxford & IBH Publishing Company Pvt. Ltd., 2009.
4. Gopal Ranjan & ASR Rao, "Basic and Applied Soil Mechanics", 3 rd Edition, New Age International Pvt. Ltd, Publishers, 2002.
5. Srinivasulu, P and Vaidyanathan, G.V., "Handbook of Machine Foundations", 2 ndEdition, Tata McGraw Hill, 1999

22SE6176: STRUCTURAL OPTIMIZATION
(Program Elective – II)

L	T	P	C
3	0	0	3

M.Tech. I Year I Sem.
Pre-requisites: RCC and numerical methods

Course Objectives:

1. To introduce the concepts of simultaneous failure modes and classical external problems in structural design.
2. To understand the principles of calculus of variations and their application in optimization with constraints.
3. To explore various programming techniques, including linear, integer, nonlinear, and dynamic programming.
4. To study advanced optimization methods like geometric and stochastic programming.
5. To apply optimization techniques to the design of structural steel and concrete members, trusses, and frames.

Course Outcomes: After completion of the course, students should be able to

1. Analyze simultaneous failure modes and apply classical problem-solving methods in structural design.
2. Utilize variational principles and calculus of variations in structural optimization with constraint.
3. Apply linear, integer, nonlinear, and dynamic programming techniques to solve complex engineering problems.
4. Implement geometric and stochastic programming for advanced structural optimization.
5. Optimize the design of structural elements like steel and concrete members, trusses, and frames, considering various design constraints and layouts.

UNIT – I
Introduction: Simultaneous Failure Mode and Design, Classical External Problems.

UNIT – II
Calculus of Variation: Variation Principles with Constraints,

UNIT – III
Linear Programming, Integer Programming, Nonlinear Programming, Dynamic Programming,

UNIT – IV
Geometric Programming and Stochastic Programming.

UNIT – V
Applications: Structural Steel and Concrete Members, Trusses and Frames.
Design: Frequency Constraint, Design of Layouts.

REFERENCE BOOKS:

1. Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer
2. Variational methods for Structural optimization, Cherkaev Andrej, Springer

22MC6111: RESEARCH METHODOLOGY AND IPR

L T P C
2 0 0 2

M.Tech. I Year I Sem.

Course Objectives:

1. To understand the fundamentals of selecting and defining research problems.
2. To develop effective literature review skills while emphasizing research ethics and the importance of avoiding plagiarism.
3. To enhance technical writing skills, including report writing and the development of research proposals.
4. To familiarize students with the nature of intellectual property (IP), including patents, designs, copyrights, and the process of patenting.
5. To explore patent rights, licensing, and new developments in intellectual property rights (IPR), including case studies and applications in technology.

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

1. Identify and formulate relevant research problems using appropriate criteria and methodologies.
2. Conduct thorough literature reviews and understand ethical considerations in research practices.
3. Write effective technical reports and research proposals, presenting them confidently to review committees.
4. Explain the nature and process of intellectual property, including the procedure for obtaining patents both nationally and internationally.
5. Analyze patent rights, licensing issues, and recent developments in IPR.

UNIT- I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT- II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT- III:

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT- IV:

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

UNIT- V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

REFERENCE BOOKS:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
7. T. Ramappa, “Intellectual

22SE6151: COMPUTER AIDED DESIGN LABORATORY

L	T	P	C
0	0	4	2

M.Tech. I Year I Sem

Pre-Requisites:

- Computer Aided Civil Engineering Drawing Principles
- Microsoft Excel
- Structural Engineering -1, Structural Engineering - 2

Course Objectives: The objectives of the course are to

1. Learn the usage of any fundamental software for design
2. Create geometries using pre-processor
3. Analyse and Interpret the results using post processor
4. Design the structural elements
5. Design the roof trusses

Course Outcomes: After the completion of the course student should be able to

1. Model the geometry of real world structure Represent the physical model of structural element/structure
2. Perform analysis
3. Interpret from the Post processing results
4. Design the structural elements and system as per IS Codes
5. Design the roof trusses

List of Experiments:

1. Analysis and design of determinate and indeterminate beams & development of Excel template
2. Analysis and design of plane frames and development of Excel template.
3. Analysis and design of space frame and development of Excel template
4. Analysis and design of a multi-storeyed building subjected to DL, LL and WL
5. Analysis and design of multi-storeyed building subjected to DL, LL and EQ
6. Analysis and design of Roof trusses including WL calculation in Excel Spreadsheet
7. Analysis and design of Gantry girder and development of spread sheet

22SE6152: STRUCTURAL ENGINEERING LABORATORY

L	T	P	C
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M.Tech. I Year I Sem.

Pre-requisites: Concrete Technology.

Course Objectives:

1. To understand the behaviour of cementitious composite systems inclusive of the effects of particulate and fibrous ingredients
2. To analyze and evaluate the performance of structural elements in the laboratory
3. To analyze and evaluate the performance compression strength concrete
4. To analyze and evaluate the performance compression strength concrete
5. To conduct Non-Destructive Tests on existing concrete structures

Course Outcomes: After completion of the course, students should be able to

1. Design normal and special concretes
2. Evaluate the parameters affecting its performance
3. Evaluate the compression strength concrete
4. Evaluate the flexure strength of concrete under reinforced, Over reinforced and balanced beams
5. Conduct Non-Destructive Tests on existing concrete structures

List of Experiments/Assignments:

A. Tests on following fresh concretes

Self- Compacting Concrete, High Strength Concrete, Normal Strength Concrete The tests shall include

1. Mix Design
2. Workability tests
3. Material characterization of ingredients
    a. Specific gravity test
    b. Water absorption test
    c. Gradation Analysis (Sieve Analysis)
    d. Tests on setting times

B. Tests on Hardened Concrete:

1. Compression test on High strength Concrete Cubes and Cylinders
2. Flexure tests on Normal strength concrete under reinforced, Over reinforced and balanced beams
3. Flexure tests on Normal strength concrete beams with and without Shear reinforcement

C. Non-Destructive testing of concrete using rebound hammer & ultrasonic pulse velocity

REFERENCE BOOKS:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.
3. Concrete Technology by A.R. Santha kumar, Oxford University Press.

22SE6211: FINITE ELEMENT ANALYSIS

L	T	P	C
3	0	0	3

M.Tech. I Year II Sem

Course Objectives: The objectives of this course is to impart knowledge of

1. Analyze 2-D and 3-D deformable body problems using equilibrium equations and strain-displacement relations
2. Evaluate finite element formulations for 1-D and 2-D problems using variational methods and approximation techniques
3. Construct and validate isoparametric elements for quadrilateral and higher-order elements using shape functions and numerical integration
4. Formulate and apply 3-D finite element models for tetrahedral and hexahedral elements, including stiffness matrices and load conditions
5. Critically assess FEM models and results through the use of FEA software for complex 1-D, 2-D, and 3-D numerical problems

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

1. Distinguish different types of deformations and forces in 2-D and 3-D elastic bodies, applying equilibrium equations and boundary conditions.
2. Apply variational methods like Rayleigh-Ritz to derive finite element formulations for 1-D and 2-D problems.
3. Analyze isoparametric elements by constructing shape functions and evaluating stiffness and load matrices for various elements.
4. Formulate finite element models for 3-D elements, including tetrahedral and hexahedral elements, and compute their strain-displacement relationships.
5. Interpret and analyze FEM results from software simulations for 1-D, 2-D, and 3-D models, using post-processing techniques.

UNIT – I

Introduction to FEM: Types of Problems – Types of Materials – Elastic / Inelastic situations – Types of forces: Body forces / Surface Traction / Point loads – Deformable bodies – Types of Deformations Homogeneous / Non homogeneous Problems – Equations of equilibrium for elastic 2-D / 3-D continua - Equilibrium equations for 2-D / 3-D boundary elements – Boundary conditions – Strain- displacement relation for 2-D / 3-D – Stress-strain relation for 2-D / 3-D – Plane stress / Plane strain problems.

Virtual Work Formulation: Application to problems of plane trusses with static indeterminacy not exceeding three.

UNIT – II

Variational Formulation: Approximate methods of Analysis- Weighted residual method - Rayleigh- Ritz Method -Strong form weak form -Variational principle - Stationarity Functional or Differential equation

Finite element formulation for1-D problems: Minimum Potential Energy Approach, week form approach, introduction to natural coordinates -Finite element approximations in one dimension- Lagrangian approximation-Hermitian approximations, FE formulation for Axial bar, Euler Bernoulli beam -Numerical Examples

Finite element formulation for 2-D problems: FE Approximation in 2-Dimension, Pascals triangle, Convergence criterion, Compatible and incompatible elements, FE Formulation for plane stress, plane strain and Axi-symmetrical problems, Shape functions for 2-Dimensional CST Element-4 noded quadrilateral element -Highier order triangular and rectangular elements- Consistent Nodal load vector - Numerical Examples

UNIT – III

Iso-parametric elements:

Quadrilateral elements: FE Formulation for linear and quadratic isoparametric elements- Construction of shape functions using natural coordinates/Strain-displacement matrices/Load matrices for body force and surface traction/ Expressions for stiffness matrix, load matrices for 4- noded quadrilateral elements/ Gauss Quadrature of numerical integration / Problems with rectangular elements, kinematic indeterminacy not exceeding three- Determination of shape functions for 2nd order quadrilateral elements and for elements of

with serendipity / Strain-displacement matrices / Load matrices for body force and surface traction.

UNIT – IV

Finite element formulation for 3 -D elements:

FE Formulation for Tetrahedral and Hexahedral elements: Volume coordinates, Strain-displacement matrix, stiffness matrix, load matrices due to body force and surface traction/ introduction to Hexahedron (brick) elements

Galerkin's Method of Weighted Residuals – Application to problems of mathematics / structural engineering, number of trial functions not exceeding two.

Weak form of Trial Function - Application to problems of mathematics / structural engineering, number of elements limited to two - Strain-displacement relationship/stress-strain relationship / determination of stiffness matrix for 3-noded ring element and load matrices for body force and surface traction/ Problems with kinematic indeterminacy not exceeding three for 3-noded ring elements only

UNIT – V

Numerical examples: Simple 1-D model, 2-D model and a 3-D model/ analysis and post processing of the results using commercially available FEA software and available codes.

TEXT BOOKS:

1. Reddy, J. N, (1993). ―An Introduction to the Finite Element Method‖, McGraw Hill, New York.
2. Cook, R. D. (1981). ―Concepts and Application of Finite Element Analysis‖, John Wiley and Sons.
3. Zienkiewicz, O. C. And Taylor, R. L, (1989). ―The Finite Element Method‖, Vol.1, McGraw Hill Company Limited, London.
4. Chandrupatla, T. R. And Belegundu, A. D, (2001). ―Introduction to Finite Elements in Engineering‖, Prentice Hall of India, New Delhi.
5. Seshu. P, (2003). ―Finite Element Analysis‖, Prentice Hall of India Private Limited, New Delhi.
6. David V. Hutton, (2005). ―Fundamentals of Finite Element Analysis‖, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Bathe, K. J, (2006). ―Finite Element Procedures‖, Prentice Hall of India, New Delhi

22SE6212: STRUCTURAL DYNAMICS

L T P C
3 0 0 3

M.Tech. I Year II Sem

Prerequisites: Structural Analysis I & II, Mathematics

Course Objectives:

1. To introduce fundamental concepts in vibratory systems and dynamic analysis.
2. To explore free, damped, and forced vibrations in single degree of freedom (SDOF) systems.
3. To teach the formulation of multi-degree of freedom (MDOF) systems and solve for natural frequencies and mode shapes.
4. To familiarize students with practical vibration analysis techniques like the Stodola and Holzer methods.
5. To introduce continuous system dynamics by analyzing flexural vibrations of beams with different boundary conditions.

Course Outcomes: After completion of the course, students should be able to

1. Analyze vibratory systems and formulate equations of motion using multiple methods.
2. Solve problems involving free, damped, and forced vibrations of SDOF systems, and evaluate vibration isolation.
3. Formulate and solve MDOF systems for natural frequencies, mode shapes, and dynamic response.
4. Apply practical methods like the Stodola and Holzer techniques for vibration analysis of structures.
5. Derive and solve governing equations for flexural vibrations of continuous systems with various boundary conditions.

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

UNIT - II

Single Degree of Freedom Systems: Free vibrations of single degree of freedom system - undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems – Half Power (Band-Width) Method-Harmonic excitation - Vibration Isolation – Response to support motion-Force transmitted to the foundation-Transmissibility-Dynamic magnification factor – Phase angle.

Response to General Dynamic Loading – Duhamel's Integral-Constant Force, Rectangular load, Triangular load, Response to Periodic loading- Fourier series expression of periodic loading- Response to Fourier series loading

UNIT - III

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

UNIT - IV

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

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.

REFERENCES:

1. Dynamics of Structures by Ray W.Clough & Joseph Penzien, Second Edition, CBS Publishers & Distributors
2. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
3. Structural Dynamics by Mario Paz and William Leigh, Fifth Edition, Springer
4. Theory of Vibrations by W.T. Thomson, Pearson
5. Fundamentals of Structural Dynamics by Roy. R. Craig, John wiley & sons

22SE6271: ADVANCED STRUCTURAL STEEL DESIGN
(Program Elective – III)

L T P C
3 0 0 3

M.Tech. I Year II Sem

Pre-requisites: Design of Steel Structures & Structural Analysis

Course Objectives:

1. To introduce the design principles for simple bolted, pinned, and welded connections in structural members.
2. To understand the fundamentals of plastic analysis and its application to various structures.
3. To analyze and design eccentric and moment connections for structural elements.
4. To design industrial buildings considering loads such as dead, live, and wind loads, including the design of roof trusses and bracing systems.
5. To provide knowledge on the design of steel truss girder bridges, focusing on the design of compression and tension members and wind load considerations.

Course Outcomes: After completion of the course, students should be able to

1. Analyze and design bolted, pinned, and welded connections, considering load transfer mechanisms, joint strength, and failure modes.
2. Apply plastic analysis techniques to determine the collapse load of beams and frames subjected to various load conditions.
3. Design beams-to-column connections under eccentric and moment loads using bolted and welded connections.
4. Design industrial structures, including roof trusses and purlins, to resist dead, live, and wind loads.
5. Design steel truss girder bridges by considering truss proportions, self-weight, and wind loads, and designing compression and tension members.

UNIT - I

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

UNIT - II

Plastic Analysis:

Introduction – Plastic Theory – Plastic neutral Axis plastic moment, Elastic & Plastic Section modulii shape factors plastic Hinge – Fundamental condition conditions in plastic analysis, methods of plastic analysis – collapse load – simply supported, propped cantilever beam, fixed beams continuous beams, portal frame single bay single storey portal frame at different level subjected to vertical and horizontal loads.

UNIT - III

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

UNIT - IV

Analysis and Design of Industrial Buildings:

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

UNIT - V

Design of Steel Truss Girder Bridges:

Types of truss bridges, component parts of a truss bridge, economic Proportions of trusses, self-weight of truss girders, design of bridge Compression members, tension members; wind load on truss girder Bridges; wind effect on top lateral bracing; bottom lateral bracing; portal Bracing; sway bracing Design of Lacing.

REFERENCES:

1. Limitstate Design of Steel Structures by N. Subramanian
2. Limit State Design of Steel Structures S.K. Duggal Mc Graw Hill Education Private Ltd. New Delhi.
3. Design of Steel Structures. P.Dayaratnam, Publisher : S. Chand, Edition 2011-12.
4. Design Steel Structures Volume – II, Dr. Ramachandra & Vivendra Gehlot Scientific Publishes Journals Department.
5. Design of Steel Structures Galyord & Gaylord, Publisher: Tata Mc Graw Hill, Education. Edition 2012.
6. Indian Standard Code – IS – 800-2007.
7. Indian Standard Code – IS – 875 – Part III – 2015

22SE6272: STRUCTURAL RELIABILITY
(Program Elective – III)

L	T	P	C
3	0	0	3

M.Tech. I Year II Sem

COURSE OBJECTIVES:

1. To introduce the fundamental concepts of structural safety, including statistical methods and probability theory.
2. To understand the statistical properties of materials such as concrete, steel, and masonry and how they affect structural safety.
3. To explore basic structural reliability concepts and apply Monte Carlo methods to structural safety analysis.
4. To learn advanced reliability methods, including first-order second-moment (FOSM) approaches.
5. To develop the ability to design structures based on reliability principles, incorporating safety factors and checking formats.

COURSE OUTCOMES: After completion of the course, students should be able to

1. Analyze structural safety using statistical and probability theory methods for data reduction and correlation.
2. Evaluate the resistance distributions of materials like concrete and steel and assess allowable stresses based on reliability.
3. Apply Monte Carlo methods to compute structural reliability and safety under variable conditions.
4. Utilize first-order second-moment (FOSM) methods for reliability analysis in structural design.
5. Design structures using reliability-based criteria, determining optimal safety factors and checking formats based on standards like IS code for RCC 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 - Extremal distribution.

UNIT - II

Resistance Distributions and Parameters: Introduction - Statistics of properties of concrete, steel, strength of bricks and mortar - dimensional variations - characterization of variables - Allowable stresses based on specified reliability.

UNIT - III

Basic Structural Reliability: Introduction - Computation of Structural reliability- Monte Carlo Study of Structural Safety: General- Monte Carlo method - Applications.

UNIT - IV

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.

TEXT BOOKS:

1. R. Ranganathan, Structural Reliability Analysis and Design, Jaico Publishing House, 2006.
2. R.E. Melchers, Structural Reliability – Analysis & Prediction, 2/e, Wiley – Blackwell, 1999.

REFERENCES:

1. Maurice Lemaire, Structural Reliability,Wiley (2009).
2. Dan M. Frangopol, Mitsuo Kawatani & Chul-Woo Kim, Reliability and Optimization of Structural Systems, Taylor & Francis (2006)

22SE6273: DESIGN OF HIGH-RISE BUILDINGS
(Program Elective – III)

L T P C
3 0 0 3

M.Tech. I Year II Sem

Pre-requisites: Structural analysis I and II

Course Objectives:

1. To understand various loading conditions and design principles, including static and dynamic approaches for high-rise structures.
2. To explore the behavior of different structural systems such as rigid frames, shear walls, and hybrid systems in tall buildings.
3. To develop skills in approximate and accurate analysis techniques for high-rise buildings, considering interactions among structural subsystems.
4. To learn the design principles for structural elements, accounting for deflection, cracking, creep, shrinkage, and temperature effects.
5. To analyze the stability of tall buildings, considering overall buckling, second-order effects, and P-Delta analysis.

Course Outcomes: After completion of the course, students should be able to

1. Apply design principles under different loading conditions, such as gravity, wind, and earthquake loads, using static and dynamic approaches.
2. Analyze the behavior of high-rise structural systems like braced frames, shear walls, and outrigger systems under various conditions.
3. Model and analyze high-rise buildings as a total structural system, considering member forces, drift, twist, and interaction of subsystems.
4. Design structural elements, considering resisting capacity, deflection, cracking, and effects like creep, shrinkage, and fire resistance.
5. Perform stability analysis of tall buildings, accounting for buckling, P-Delta effects, torsional instability, and the impact of foundation rotation

UNIT - I

Loading and Design Principles: Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach - Analytical and wind tunnel experimental methods - Design philosophy - working stress method, limit state method and plastic design.

UNIT - II

Behaviour of Various Structural Systems: Factors affecting growth, height and structural form. High rise behaviour, Rigid Frames, braced frames, In filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

UNIT - III

Analysis and Design: Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist - Computerized three dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis.

UNIT - IV

Structural Elements: Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT - V

Stability of Tall Buildings: Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

REFERENCES:

1. Taranath B.S., "Structural Analysis and Design of Tall Buildings", McGraw Hill, 1988.
2. Beedle.L.S., "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1986.
3. Bryan Stafford Smith and Alexcoull, "Tall Building Structures - Analysis and Design", John Wiley and Sons, Inc., 2005.
4. 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.
5. Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley, 1988.

22SE6274: ADVANCED PRESTRESSED CONCRETE DESIGN
(Program Elective – IV)

L	T	P	C
3	0	0	3

M.Tech. I Year II Sem
Pre-requisites: Reinforced Concrete Design & Structural Analysis.

Course Objectives:

1. To understand the principles of prestressing systems, including pre-tensioning, post-tensioning, and load balancing in concrete structures.
2. To learn how to predict and control deflections in prestressed concrete members and analyze the ultimate flexural strength of beams.
3. To explore the design and analysis of composite constructions, focusing on flexural strength, shear strength, and deflection behavior.
4. To provide knowledge of the design of prestressed concrete slabs and pipes, including one-way, two-way slabs, and circular prestressing techniques.
5. To develop an understanding of continuous prestressed concrete beams, secondary moments, and anchorage zone stresses.

Course Outcomes: After completion of the course, students should be able to

1. Analyze prestressing systems, compute resultant stresses, and understand the concept of load balancing in prestressed concrete structures.
2. Predict short-term and long-term deflections of prestressed concrete members and calculate the ultimate flexural strength of beams.
3. Design and analyze composite constructions, addressing differential shrinkage, shear strength, and deflection of composite beams.
4. Design prestressed concrete slabs and pipes, applying concepts of one-way and two-way slabs and circular prestressing methods.
5. Analyze continuous prestressed concrete beams, calculate secondary moments, and design anchorage zone reinforcement using methods like Magnel's and Guyon's.

UNIT - I:
Introduction – Prestressing Systems – Pre-tensioning Systems – Post-tensioning Systems – High Strength Steel and Concrete - Analysis of Prestress - Resultant Stresses at a Section – Pressure Line or Thrust Line – Concept of Load Balancing.
Losses of Prestress – Loss Due to Elastic Deformation of Concrete – Shrinkage of Concrete – Creep – Relaxation of Stress in Steel – Friction – Anchorage Slip.

UNIT - II:
Deflections of Prestressed Concrete Members: Importance of Control of Deflections – Factors Influencing Deflection – Short-term Deflections of Uncracked Members – Prediction of Long-time Deflections – Deflections of Cracked Members – Requirements of IS 1343-2012.
Ultimate Flexural Strength of Beams: Introduction, Flexural theory using first principles – Simplified Methods – Ultimate Moment of Resistance of untensioned Steel.

UNIT - III:
Composite Constructions: Introduction, Advantages, Types of Composite Construction, Analysis of Composite beams- Differential shrinkage- Ultimate Flexural and shear strength of composite sections- Deflection of Composite Beams. Design of Composite sections.

UNIT - IV:
Prestressed Concrete Slabs: Types Of Prestressed Concrete Floor Slabs- Design of Prestressed Concrete One Way and Two Way Slabs.
Prestressed Concrete Pipes: Circular prestressing- Types of Prestressed Concrete Pipes- Design of Prestressed Concrete Pipes.

UNIT - V:

Continuous Beams: Advantage of Continuous Members – Effect of Prestressing Indeterminate Structures – Methods of Achieving Continuity – Methods of Analysis of Secondary Moments – Concordant Cable Profile – Guyon's Theorem, Redistribution of moments in a continuous beam.

Anchorage Zone Stresses in Beams: Introduction, Stress distribution in End Block – Anchorage zone stresses –Magnel's method- Guyon's Method - Anchorage zone Reinforcement as per IS1343- 2012.

REFERENCES:

1. Prestressed concrete, Krishnanraju N., Tata Mc Graw Hill, New Delhi.
2. Prestressed concrete by K.U. Muthu, PHI Learning Pvt. Ltd
3. Design of prestressed concrete structure, Lin T. Yand Burns, Asia Publication house, 1995.
4. Limit state design of prestressed concrete, Gutan Y, Applied science publishers, 1972.
5. IS:1343-2012-code of practice for Prestressed concrete

22SE6275: STRUCTURAL HEALTH MONITORING
(Program Elective – IV)

L	T	P	C
3	0	0	3

M.Tech. I Year II Sem.
Pre-requisites: Concrete Technology.

Course Objectives:

1. To understand the factors affecting the health of structures and the importance of regular maintenance.
2. To introduce the concepts and methods of Structural Health Monitoring (SHM) and structural auditing.
3. To learn about static field testing methods for assessing structural integrity.
4. To explore dynamic field testing techniques and remote health monitoring systems.
5. To understand repair and rehabilitation methods for damaged structures using smart materials and techniques.

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

1. Identify factors leading to structural distress and implement strategies for regular maintenance.
2. Apply structural health monitoring concepts and perform structural audits to assess the condition and safety of structures.
3. Conduct static field testing to evaluate the structural response and detect possible issues.
4. Perform dynamic field testing and use remote monitoring systems for real-time structural health assessment.
5. Understand and apply repair and rehabilitation techniques using advanced materials.

UNIT – I
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT – II
Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT – III
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.

UNIT – IV
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT – V
Introduction to Repairs and Rehabilitations of Structures: Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

REFERENCE BOOKS:

1. Structural Health Monitoring, Daniel Balageas, Claus_Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006
2. Health Monitoring of Structural Materials and Components_Methods with Applications,
3. Douglas E Adams, John Wiley and Sons, 2007.
4. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
5. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc,2007.

22SE6276: DESIGN OF BRIDGES
(Program Elective – IV)

L T P C
3 0 0 3

M.Tech. I Year II Sem

Prerequisites: Structural Analysis I &II, Reinforced Concrete Design

Course Objectives:

1. To introduce the types of concrete bridges, loading conditions, and general design requirements, including the analysis and design of solid slab bridges.
2. To understand the design and analysis methods for RCC girder bridges, including Courbon's theory and grillage analogy.
3. To learn the design of single-cell box culverts, focusing on design loads, moments, shears, and thrusts.
4. To explore the design of prestressed concrete bridges, covering principles, composite sections, and prestressing techniques.
5. To provide knowledge on the design of the substructure of bridges, including piers, abutments, and the loads acting on these elements.

Course Outcomes: After completion of the course, students should be able to

1. Analyze and design concrete bridges considering various loads, such as dead, live, wind, seismic, and temperature effects, and apply methods for solid slab bridges.
2. Design RCC girder bridges using Courbon's theory and grillage analogy, accounting for load distribution and structural behavior.
3. Perform design calculations for single-cell box culverts, considering critical sections, moments, shears, and thrusts.
4. Design prestressed concrete bridges, including composite sections and addressing specific requirements for road bridges.
5. Analyze and design the substructure of bridges, including the design of piers and abutments, considering design loads and structural dimensions.

UNIT - I

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

UNIT - II

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

UNIT - III

Box Culverts: - Single Cell Box Culvert – Design Loads, Design Moments, Shears and Thrusts. Design of Critical sections.

UNIT - IV

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

UNIT - V

Sub-structure of bridges: Substructure- Beds block-Piers- Pier Dimensions- Design loads for piers-Abutments- Design loads for Abutments.

REFERENCES:

1. Design of Concrete Bridges by M. G. Aswani, V. N. Vazirani and M. M. Ratwani.
2. Bridge Deck Behaviour by E. C. Hambly.
3. Concrete Bridge Design and Practice by V. K. Raina.
4. Essentials of Bridge Engineering by Johson Victor, Oxford & IBH
5. Design of Bridges by V. V. Sastry, Dhanpat Rai & Co.

22SE6251: NUMERICAL ANALYSIS LAB
(Lab - III)

L T P C
0 0 4 2

M.Tech. I Year II Sem

Course Objectives:

1. To introduce MATLAB for performing matrix operations and solving engineering problems using computational techniques.
2. To apply numerical methods for solving systems of linear equations in structural analysis, including beams and frames.
3. To develop problem-solving skills for determining slopes, deflections, and reactions in structures using root-finding methods like Newton-Raphson.
4. To explore Eigenvalue problems and their application in determining natural frequencies and mode shapes in multistory buildings.
5. To understand numerical integration and differential equation solving techniques, and their applications in structural engineering.

Course Outcomes: After completion of the course, students should be able to

1. Perform matrix operations in MATLAB to solve simultaneous equations and analyze forces an reactions in structures.
2. Apply Gauss Elimination and Gauss Seidal methods to analyze indeterminate beams and portal frames.
3. Use the Newton-Raphson method to find slopes and deflections in beams and solve non-linear equations in structural analysis.
4. Solve Eigenvalue problems to determine time periods and mode shapes in multi-story RC buildings.
5. Apply numerical integration techniques and solve differential equations using MATLAB for structural analysis and graphical visualization.

LIST OF EXPERIMENTS:

1. Overview of MATLAB, Matrix operations (Addition, Subtraction, Multiplication, Transpose)
2. Solution of simultaneous equations using matrix inversion – Resolution of forces and moments and finding the reactions on a beam.
3. Solution of system of linear equations using Gauss Elimination method - Application to the analysis of indeterminate beams
4. Solution of System of linear equations using Gauss Seidal iteration Method – Application to the analysis of portal frames
5. Finding the Roots of non-linear equations using Newton – Raphson Method - Application for finding the slopes and deflections in determinate beams
6. Finding the Solution of an Eigen Value problem – Application to a multistory RC building for determining the Time periods and Mode shapes.
7. Numerical Integration using Trapezoidal & Simpson's Rule – Application for finding the Areas and Volumes of a given plot.
8. Numerical solution of ordinary differential equations by Runge- Kutta method
9. Numerical solution of second and higher order differential equations
10. Plotting Simple Graphs, Basic 2D Plots, 3D Plots

22SE6252: ADVANCED STRUCTURAL ANALYSIS AND DESIGN LAB
(Lab – IV)

L	T	P	C
0	0	4	2

M.Tech. I Year II Sem

Pre-requisites: RCC and Steel design

Course Objectives:

1. To understand and apply grillage analogy for the analysis of bridge decks.
2. To analyze and design pre-engineered buildings (PEB) considering structural efficiency and economy.
3. To develop the skills to analyze and design gantry girders subjected to dynamic loads.
4. To learn the analysis and design principles for high-rise multi-storied buildings, including the use of shear walls and flat slab systems.
5. To explore the design of raft foundations for high-rise buildings, focusing on both flat slab and beam slab systems.

Course Outcomes: After completion of the course, students should be able to

1. Analyze bridge decks using grillage analogy and perform the necessary structural design.
2. Design pre-engineered buildings (PEB) by considering practical applications in industrial structures.
3. Perform the analysis and design of gantry girders for industrial facilities subjected to heavy loads.
4. Analyze and design high-rise multi-storied buildings, incorporating shear walls and flat slab systems for improved stability.
5. Design flat slab and beam slab raft foundations, ensuring the structural integrity of high-rise buildings

List of Experiments

1. Analysis of a Bridge Deck by Grillage Analogy
2. Analysis and Design of a PEB Structure
3. Analysis and design of a High Rise Multi storied Building
4. Analysis and design of a Highrise Multi storey Building with shear wall
5. Analysis and design of a Highrise Multi storey Building with Flat Slab System
6. Analysis and design of Flat Slab Raft foundation
7. Analysis and design of Beam Slab Raft foundation

22SE7171: EARTHQUAKE RESISTANT DESIGN OF STRUCTURES
(Program Elective – V)

L	T	P	C
3	0	0	3

M.Tech. II Year I Sem
Pre-requisites: Structural Dynamics, Reinforced Concrete Design

Course Objectives:
1. To explain the possible causes for earthquakes understanding seismology
2. To understand the principles of earthquake resistant design of RC and masonry buildings
3. To learn to evaluate base shears using IS methods
4. To detail the structural members for ductile requirements
5. identify effective measures to mitigate potential damage

Course Outcomes: After completion of the course, students should be able to:
1. Predict the sources of earthquakes understanding seismology and conceptually design the buildings
2. Apply the Response Spectrum Analysis Method and static equivalent method for the determination of lateral loads on the buildings
3. Assess seismic performance by using Design shear wall
4. Apply ductility requirements for the design of structural components
5. Assess seismic performance of non-structural components and structural components and

UNIT - I
Engineering Seismology: Earthquake phenomenon cause of Earthquakes-Faults- Plate tectonics- Seismic waves- Terms associated with Earthquakes-Magnitude/Intensity of an earthquake-scales- Energy released- Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph- Characteristics of strong ground motions- Seismic zones of India.
Introduction-Functional planning-Continuous load path-Overall form-simplicity and symmetry- elongated shapes-stiffness and strength - Seismic design requirements-regular and irregular configurations-basic assumptions.

UNIT - II
Conceptual Design - Horizontal and Vertical Load Resisting Systems - System and Members for Lateral Loads and High Rise / Tall Structures. Twisting of Buildings – Flexible Building and Rigid Building Systems.
Strength and Stiffness – Ductility – Definition – Ductility Relationships – Choice of construction Materials – Unconfined Concrete & Confined Concrete - Design Earthquake Loads – Basic Load Combinations – Permissible Stresses. Seismic Methods of Analysis – Static Method – Equivalent Lateral Force Method. Dynamic Analysis – Response Spectrum Method.

UNIT - III
Introduction to Earthquake Resistant Design – Seismic Design Requirements and Methods. RC Buildings – IS Code based Method.- Vertical Irregularities – Mass Irregularity Torsional Irregularity Plan Configuration Problem - Design Lateral Force, Base Shear Evaluation – Lateral Distribution of Base Shear – Structural Walls Strategies and the Location of Structural Walls – Sectional Shapes.
Projects/Assignments (Behaviour of Unreinforced and Reinforced Masonry Walls – Behaviour of Walls Box Action and Bands Behaviour of infill Walls - Non Structural Elements – Failure Mechanism of Nonstructural Elements Effects of Nonstructural Elements on Structural System – Analysis – Prevention of Damage to Nonstructural Elements – Isolation of Non-Structures).

UNIT - IV

Design of Shear walls: Classification according to Behavior, Loads in Shear walls, Design of Rectangular and Flanged Shear walls, Derivation of Formula for Moment of Resistance of Rectangular Shear walls – Behaviour of Coupled Shear Walls.

UNIT - V

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920. Behavior of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquake.

Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns- Case studies.

REFERENCES:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.
3. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons
4. Masory and Timber structures including earthquake Resistant Design –Anand S.Arya, Nem chand & Bros
5. Earthquake –Resistant Design of Masonry Building –Miha Tomazevic, Imperial college Press.
6. Design of Reinforced Concrete Structures by N. Subramanian, Oxford University Press.
7. Earthquake Tips – Learning Earthquake Design and Construction C. V. R. Murty

REFERENCE CODES:

1. IS: 1893 (Part-1) -2016. “Criteria for Earthquake Resistant – Design of structures.” B.I.S., New Delhi.
2. IS:4326-1993, “Earthquake Resistant Design and Construction of Building”, Code of Practice B.I.S., New Delhi.
3. IS:13920-2016, “Ductile detailing of concrete structures subjected to seismic force” – Guidelines, B.I.S., New Delhi.

22SE7172: PRE-ENGINEERED BUILDINGS
(Program Elective – V)

L	T	P	C
3	0	0	3

M.Tech. II Year I Sem

Pre-requisites: Design of Steel Structures & Structural Analysis

Course Objectives:

1. To distinguish between conventional steel buildings and PEB's
2. To identify the Pre-Engineered Building components
3. To estimate the loads on Pre-Engineered Buildings
4. To identify the various design parameters of PEB frames
5. To degign Design the PEB's

Course Outcomes: After completion of the course, students should be able to

1. Understand the functions of Primary system, Secondary system and Bracing system of PEB components.
2. Calculate the Dead, Live, Wind and Seismic loads acting on PEB's
3. Check the structural stability of PEB's
4. Analyze and Design the PEB's
5. Understand the different floor system

UNIT - I:

Introduction to Pre-Engineered Buildings: Introduction – History - Advantages of PEB - Applications of PEB – Materials used for manufacturing of PEB. Difference between Conventional Steel Buildings and Pre-Engineered buildings.

UNIT - II:

Pre-Engineered Building Components: Primary System: Main frames, Gable End Frame - Secondary frame system: Sizes and Properties of Purlins & Girts – Bracing System: Rod, angle, Portal, Pipe bracing – Sheeting and Cladding: Roof Sheeting and Wall sheeting – Accessories: Turbo Ventilators, Ridge vents, Sky Lights, Louvers, Insulation, Stair cases, Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads. Serviceability Limits as per code., Design Parameters of PEB Frames - Depth of the section, Depth to Flange width ratios, Thickness of Flange to thickness of Web ratio. d/tw, bf/tf ratios of sections as per IS code. Section Sizes as per Manufacturing Limitations, Analysis and Design of Rigid Frames.

UNIT - III:

Peb Frame Connection Design Methodology: Rigid Frame Moment Connection, Shear Connection, High strength bolts & grades, Lever arm, bolt Patten its effect on connection design, thickness of connection plate, Selection of governing forces for connection design.

UNIT - IV:

Mezzanine Floor Systems: Design of Mezzanine Beams, Columns and joists – Mezzanine decking, Different types of Mezzanine Floor systems – Grating, Chequered plate and Rigid floor System, Types of base plate Pinned , Fixed, strength bolts, different types of bolts & grades, Lever arm, bolt Patten its effect on connection design, thickness of connection plate, base plate size, Selection of governing forces for base connection design & Anchor bolt.

UNIT - V:

Analysis and Design Of Pre-Engineered Buildings: 2D and 3D Modelling of Portal Frames, Optimization Techniques, Comparison of software output with manual calculations. Design of Cold Formed Sections i.e., Purlins and Girts, Design of Roof Sheeting, trapezoidal , Standing seam sheeting, Welding technology, Manufacturing process , Erection Procedures

REFERENCES:

1. Pre-Engineered Steel Building, K.S. Vivek and P.Vyshnavi, LAP Lamdert Academic Publishing.
2. Metal building systems: Design and Specifications, Third edition, Alexander Newman, McGraw- Hill Education.
3. Pre-Engineered Metal Building Systems, Labsori

22SE7173: REHABILITATION AND RETROFITTING OF STRUCTURES
(Program Elective – V)

L T P C
3 0 0 3

M.Tech. II Year I Sem

Prerequisites: Reinforced Concrete Design, Steel Design, Concrete Technology

Course Objectives:

1. To impart knowledge about different types of distress in structures
2. Testing the structures for the deterioration of structures
3. Testing the structures for the diagnosis of defects and different types of repairing methods.
4. identify different types of repairs and retrofitting technique
5. identify different types of material and retrofitting technique

Course Outcomes: After studying this course, students will be able to:

1. Understand the cause of deterioration of concrete structures.
2. Able to assess the damage for different type of structures
3. identify different retrofitting technique
4. Summarize the principles of repair and rehabilitation of structures
5. Recognize ideal material for different repair and retrofitting technique

UNIT – I

Introduction – Definition of Repair, Retrofitting, Strengthening and rehabilitation, Deterioration of Structures – Distress in Structures – Causes and Prevention, Mechanism of Damage – Types of Damage, Physical and Chemical Causes of deterioration of concrete structures, Evaluation of structural damages to the concrete structural elements due to earthquake

UNIT – II

Corrosion of Steel Reinforcement – Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation, Damage Assessment -,Purpose of assessment, Rapid assessment, Investigation of damage, Evaluation of surface and structural cracks, Damage assessment procedure, destructive, non-destructive and semi destructive testing systems -Influence on Serviceability and Durability- Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection.

UNIT – III

Maintenance and Retrofitting Techniques: Definitions: Maintenance, Facts of Maintenance and importance of Maintenance Need for retrofitting, retrofitting of structural members i.e., column and beams by Jacketing technique, Externally bonding(ERB) technique, near surface mounted (NSM) technique, External post- tensioning, Section enlargement and guidelines for seismic rehabilitation of existing building, Inspection and Testing – Symptoms and Diagnosis of Distress - Damage assessment – NDT.

UNIT – IV

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

UNIT – V

Materials for Repair and Retrofitting: Artificial fibre reinforced polymer like CFRP, GFRP, AFRP and natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack,
vacuum concrete, Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning- Health Monitoring of Structures – Use of Sensors – Building Instrumentation.

REFERENCES:

1. Concrete Technology by A.R. Santakumar, Oxford University press
2. Defects and Deterioration in Buildings, E F & N Spon, London
3. Non-Destructive Evaluation of Concrete Structures by Bungey - Surrey University Press
4. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.
5. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W. H. Ranso, (1981)
6. Building Failures: Diagnosis and Avoidance, EF & N Spon, London, B. A. Richardson, (1991).
7. "Deterioration, Maintenance and Repair of Structures ", Sidney, M. Johnson
8. "Concrete Structures – Materials, Maintenance and Repair"- Denison Campbell, Allen & Harold Roper, Longman Scientific and Technical.
9. "Learning for failure from Deficiencies in Design, Construction and Service" R.T.Allen and S.C. Edwards, "Repair of Concrete Structures"-Blakie and Sons Raiker R.N., - R&D Center (SDCPL).

DISSERTATION PHASE – I

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

1. Identify structural engineering problems reviewing available literature.
2. Identify appropriate techniques to analyze complex structural systems.
3. Apply engineering and management principles through efficient handling of project

Syllabus Contents:

Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.

Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.

DISSERTATION PHASE – II

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

1. Solve complex structural problems by applying appropriate techniques and tools.
2. Exhibit good communication skill to the engineering community and society.
3. Demonstrate professional ethics and work culture.

Syllabus Contents:

Dissertation – II will be extension of the work on the topic identified in Dissertation – I.

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

ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)

Prerequisite: None

Course objectives: Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT-I:

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

DISASTER MANAGEMENT (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches,
5. planning and programming in different countries, particularly their home country or the countriesthey work in

UNIT-I:

Introduction:

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-II:

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III:

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-IV:

Risk Assessment Disaster Risk:

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT-V:

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXT BOOKS/ REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall ofIndia, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep &DeepPublication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

Prerequisite: None

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

VALUE EDUCATION (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course outcomes: Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

UNIT-I:

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT-II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT-III:

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT-V:

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

TEXT BOOKS/ REFERENCES:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford UniversityPress, New Delhi

M. Tech. (SE)

CONSTITUTION OF INDIA (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble**,** Salient Features.

UNIT-II:

Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies, Directive Principles of State Policy**,** Fundamental Duties.

UNIT-III:

Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

UNIT-IV:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT-V:

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

M. Tech. (SE)

PEDAGOGY STUDIES (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy makingundertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT-II:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional development: alignment with classroom practices and follow-up support, Peer support,Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

TEXT BOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher educationresearch project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

M. Tech. (SE)

STRESS MANAGEMENT BY YOGA (Audit Course - I & II)

Prerequisite: None

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

Course Outcomes: Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

UNIT-I:
Definitions of Eight parts of yog. (Ashtanga)

UNIT-II:
Yam and Niyam.

UNIT-III:
Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:
Asan and Pranayam

UNIT-V:

i) Various yog poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS/ REFERENCES:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

M. Tech. (SE)

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Audit Course - I & II)

Prerequisite: None

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course Outcomes: Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

1. Verses- 19,20,21,22 (wisdom)
2. Verses- 29,31,32 (pride & heroism)
3. Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

1. Verses- 52,53,59 (dont's)
2. Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

1. Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
2. Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
3. Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

1. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
2. Chapter 12 -Verses 13, 14, 15, 16,17, 18
3. Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

1. Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
2. Chapter 4-Verses 18, 38,39
3. Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:

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3. Prabhupāda, Bhaktivedanta Swami. " Bhagavad-Gita As It Is