ACADEMIC REGULATIONS COURSE STRUCTURE AND DETAILED SYLLABUS

CIVIL ENGINEERING

For

M. Tech. (Structural Engineering)

(Two Year **Full Time** Programme)

JNTUH COLLEGE OF ENGINEERING HYDERABAD
(Autonomous)
Kukatpally, Hyderabad – 500 085, Telangana, India.

2015

JNTUH COLLEGE OF ENGINEERING HYDERABAD
M.Tech. (Structural Engineering) – Full Time w.e.f. 2015-16

I – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Theory of Elasticity	4	0	0	4
2	Structural Dynamics	4	0	0	4
3	Elective – 1	4	0	0	4
4	Elective – 2	4	0	0	4
5	Elective – 3	4	0	0	4
6	Elective – 4	4	0	0	4
7	Advanced Concrete Laboratory	0	0	4	2
8	Soft Skills Lab	0	0	4	2
	Total Credits				**28**

II – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Finite Element Methods	4	0	0	4
2	Analysis of Plates & Shells	4	0	0	4
3	Elective – 5	4	0	0	4
4	Elective – 6	4	0	0	4
5	Elective – 7	4	0	0	4
6	Elective – 8	4	0	0	4
7	CAD Laboratory	0	0	4	2
8	Seminar	0	0	4	2
	Total Credits				**28**

III – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Comprehensive Viva Voce				4
2	Project Phase – I				12
	Total Credits				**16**

IV – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Project Phase – II & Dissertation				18
	Total Credits				**18**

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.TECH (STRUCTURAL ENGINEERING) – FULL TIME W.E.F. 2015-16

Elective – 1
1. Advanced Reinforced Concrete Design
2. Soil Dynamics and Machine Foundations

Elective – 2
1. Advanced Concrete Technology
2. Fracture Mechanics of Concrete Structures

Elective – 3
1. Experimental Stress Analysis
2. Advanced Structural Analysis

Elective – 4
1. Computer Oriented Numerical Methods
2. Optimization Techniques in Structural Engineering

Elective – 5
1. Composite Materials
2. Principles of Bridge Engineering

Elective – 6
1. Rehabilitation and Retrofitting of Structures
2. Earthquake Resistant Design of Buildings

Elective – 7
1. Advanced Steel Design
2. Plastic Analysis and Design
3. Design of Industrial Structures

Elective – 8
1. Design of Pre stressed Concrete Structures
2. Stability of Structures

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

THEORY OF ELASTICITY

Prerequisites: Strength of Materials I & II

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

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

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

UNIT II
Two dimensional problems in rectangular coordinates - solution by polynomials - Saint-Venants principle - determination of displacements - bending of simple beams – Simple Supported and Cantilever Beam.

UNIT III
Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions Edge Dislocation - general solution of two-dimensional problem in polar coordinates - application to Plates with Circular Holes – Rotating Disk. Bending of Prismatic Bars: Stress function - bending of cantilever - circular cross section - elliptical cross section - rectangular cross section.

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

UNIT V
Torsion of Circular Shafts - Torsion of Straight Prismatic Bars – Saint Venants Method - torsion of prismatic bars - bars with elliptical cross sections - membrane analogy - torsion of a bar of narrow rectangular bars - solution of torsional problems by energy method - torsion of shafts, tubes , bars etc.Torsion of Rolled Profile Sections.

References
1. Theory of Elasticity by Timeshenko, McGrawhill Publications.
2. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.
3. Theory of Elasticity by Y.C.Fung.
4. Theory of Elasticity by Gurucharan Singh.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

STRUCTURAL DYNAMICS

Prerequisites: Structural Analysis I & II

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

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

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

UNIT II
Introduction to Structural Dynamics : Fundamental objectives of dynamic analysis -Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.
Single Degree of Freedom Systems : Formulation and solution of the equation of motion - Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

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

UNIT IV
Practical Vibration Analysis: Introduction - Stodola method - Fundamental mode analysis - Analysis of second and higher modes - Holzer method - Basic procedure.
Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions - Principles of application to continuous beams.

UNIT V
Introduction to Earthquake Analysis: Introduction - Excitation by rigid base translation - Lumped mass approach - SDOF and MDOF systems – Theory of Response Spectrum Method - analysis for obtaining response of multi storeyed buildings.

References:
1. Dynamics of Structures by Clough & Penzien, McGraw Hill, New york
2. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.
3. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
4. I.S: 1893 (Part 1) - 2002, "Code of practice for Earthquake resistant design of Structures"

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

ADVANCED REINFORCED CONCRETE DESIGN
(Elective–1)

Prerequisites: Design of Reinforced Concrete Structures

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

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

UNIT I
Basic Design Concepts: Behavior in flexure, Design of singly Reinforced rectangular sections, Design of Doubly Reinforced rectangular sections, Design of flanged bean sections, Design for shear – Design for Torsion**,** Limit state of Serviceability**:** Deflections of Reinforced concrete beams and slabs short term deflections and long term deflection estimation of crack width in RCC members, calculation of crack widths.

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

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

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

UNIT V
Design of Compression Members - Estimation of Effective Length of a Column – Code Requirements on Slenderness Limits,– Design of Short Columns Under Axial Compression – Design of Short Columns Under Compression With Uniaxial Bending – Design of Short Columns Under Axial Compression With Biaxial Bending – Design of Slender Columns.

Design of Combined Footings - Distribution of Soil Pressure - Geometry of Two-column Combined Footing – Design Considerations in Two-Column Footings.

REFERENCE:

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. "Limit State Theory and Design of Reinforced Concrete" Dr. S. R. Karve and V.L Shah. Standard Publishers, PUNE 2004.
4. "Design of Reinforced Concrete Structures" by N.Subramanian, Oxford University Press.
5. Reinforced concrete structural elements – behaviour, Analysis and design by P. Purushotham, Tata Mc.Graw-Hill, 1994.
6. Design of concrete structures – Arthus H. Nilson, David Darwin, and Chorles W. Dolar, Tata Mc. Graw-Hill, 3rd Edition, 2005.
7. Reinforced Concrete design by Kennath Leet, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
8. "Design Reinforced Concrete Foundations" P.C. Varghese Prentice Hall of INDIA Private Ltd.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

SOIL DYNAMICS AND MACHINE FOUNDATIONS
(Elective – 1)

Prerequisites: Soil Machines, Foundation Engineering and Structural Analysis

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

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

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

UNIT II : Wave Propagation and Dynamic Soil Properties: Propagation of seismic waves in soil deposits - Attenuation of stress waves, Stress-strain behaviour of cyclically loaded soils, Strength of cyclically loaded soils, Dynamic soil properties - Laboratory and field testing techniques, Elastic constants of soils, Correlations for shear modulus and damping ratio in sand, gravels, clays.

UNIT III : Foundation Vibration Analyses: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Vertical vibration of circular foundations resting on Elastic Half Space- Lambs, Reissner, Quinlan & Sungs Hsiehs and Lysmers analogies.

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

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

Text Books:

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

References:

1. I.Cshowdhary and S P Dasgupta - Dynamics of Structures and Foundation, 2009.
2. Arya, S. D, O'Neil, M. and Pincus, G.- Design of Structures and Foundations for Vibrating Machines, Gulf Publishing Co., 1979.
3. Prakash, S. and Puri, V. K. - Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.
4. Kameswara Rao, N. S. V. - Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.
5. Richart, F. E. Hall J. R and Woods R. D. - Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
6. Das, B. M. - Principles of Soil Dynamics, PWS KENT publishing Company, Boston.2002.
7. Bharat Bhushan Prasad – Advanced Soil Dynamics and Earthquake Engineering, PHI Learning Pvt. Limited, New Delhi, 2011.

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

ADVANCED CONCRETE TECHNOLOGY
(Elective – 2)

Prerequisites: Concrete Technology

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

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

UNIT – I
Concrete Making Materials : Cement – Bogus Compounds – Hydration Process – Types of Cement – Aggregates – Gradation Charts – Combined Aggregate – Alakali Silica Reaction – Admixtures – Chemical and Mineral Admixtures. Bureau of Indian Standards (BIS) Provisions.

UNIT – II
Fresh And Hardened Concrete: Fresh Concrete – workability tests on Concrete – Setting Times of Fresh Concrete – Segregation and bleeding.
Hardened Concrete : Abrams Law, Gel space ratios, Maturity concept – Stress strain Behaviour – Creep and Shrinkage – Durability Tests on Concrete – Non Destructive Testing of Concrete. BIS Provisions.

UNIT – III
High Strength Concrete – Microstructure – Manufacturing and Properties – Design of HSC Using Erintroy Shaklok method – Ultra High Strength Concrete.
High Performance Concrete – Requirements and Properties of High Performance Concrete – Design Considerations. BIS Provisions.

UNIT – IV
Special Concretes : Self Compacting concrete, Polymer Concrete, Fibre Reinforced Concrete – Reactive Powder Concrete – Requirements and Guidelines – Advantages and Applications.
Concrete Mix Design: Quality Control – Quality Assurance – Quality Audit - Mix Design Method – BIS Method – DOE Method – Light Weight Concrete, Self Compacting Concrete.

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

REFERENCES:
1. Properties of Concrete by A.M.Neville, ELBS publications Oct 1996.
2. Concrete: Micro Structure, Properties and Materials by P.K.Mehta and P.J.Monteiro,. Mc. Graw-Hill Publishing Company Ltd. New Delhi
3. Concrete Technology by M.S.Shetty, S.Chand & Co 2009.
4. Concrete Technology by A.R. Santhakumar, Oxford University Press Oct 2006.
5. Design of Concrete Mixes by N.Krishna Raju, CBS Publications, 2000.
6. Special Structural concretes by Rafat Siddique, Galgotia Publications 2000.
7. Relevant BIS Codes

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

FRACTURE MECHANICS OF CONCRETE STRUCTURES
(Elective – 2)

Prerequisites: Concrete Technology Strength of Materials I & II

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

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

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

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

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

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

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

REFERENCES:

1. Elementary engineering fracture mechanics – David Broek – Sijthoff & Noordhoff – Alphen aan den Rijn – Netherlands
2. Fracture mechanics of concrete structures – Theory and applications – Rilem Report – Edited by L. Elfgreen – Chapman and Hall – 1989.
3. Fracture mechanics – applications to concrete – Edited by Victor, C. Li, & Z.P. Bazant – ACI SP 118.
4. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, N D. New Delhi.
5. Venkataraman and Patel "Structural Mechanics with introduction to Elasticity and Plasticity" – Mcgraw Hill, 1990.
6. Shanes – "Introduction to Solid Mechanics – II Edition, PH, 1989.

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

EXPERIMENTAL STRESS ANALYSIS
(Elective – 3)

Prerequisites: Strength of Materials I & II

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

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

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

UNIT II
Strain Measurement using Strain Gauges: Definition of strain and its relation to Experimental Determinations, properties of strain-gauge systems, Types of strain gauges, Mechanical and Optical strain gauges. Electrical Strain Gauges- Introduction, LVDT - resistance strain gauge - various types - gauge factor, Materials for adhesion base, etc.

Strain Rosettes: Introduction, The three element rectangular Rosette - The delta rosette - Corrections for Transverse strain effects.

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

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

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

REFERENCES:
1. Experimental Stress Analysis by J.W.Dally and W.F.Riley, 2007
2. Experimental Stress Analysis by Dr. Sadhu Singh, Khanna Publishers, New Delhi
3. Experimental Stress Analysis by Dove and Adams 2006, Macmillan Publishing Company

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

ADVANCED STRUCTURAL ANALYSIS
(Elective – 3)

Prerequisites: Structural Analysis I & II

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

Outcome:
The learner will be able to analyse different indeterminate structures using Matrix methods.

UNIT I
Introduction to matrix methods of analysis - statical indeterminacy and kinematical indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations - for truss element, beam element and torsional element.

Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates.

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

UNIT III
Analysis of plane truss - continuous beams with and without settlement - plane frame including side sway grids, by flexibility methods and gables frames by System Approach.

UNIT IV
Analysis of plane truss - continuous beams with and without settlement - plane frame including sides sway, grids and gable frames by stiffness methods.

UNIT V. Special analysis procedures - static condensation and sub structuring - initial and thermal stresses.

Shear walls- Necessity - structural behaviour of large frames with and without shear walls - approximate methods of analysis of shear walls.

REFERENCES
1. Matrix Analysis of Frames structures by William Weaver J.R and James M.Gere, CBS publications.
2. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers.
3. Basic Structural Analysis by C.S.Reddy.
4. Matrix Structural Analysis by Madhu B. Kanchi.
5. Indeterminate Structural Analysis by K.U.Muthu *et al*.,I.K.International Publishng House Pvt. Ltd.
6. Matrix Methods of Structural Analysis by J.Meek.
7. Structural Analysis by Ghali and Neyveli.

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

COMPUTER ORIENTED NUMERICAL METHODS
(Elective – 4)

Prerequisites : Mathematics I & II

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

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

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

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

UNIT III
Finite Difference and their Applications: Introduction- Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation 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 – Application to Simply Supported Beams, Columns & rectangular Plates.

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

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

References:

1. Numerical Methods For Scientific and Engineering Computations. M.K.Jain-S.R.K.Iyengar – R.K.Jain Willey Eastern Limited. New Age International (p) Ltd., Publishers, Reprint 2004,ISBN:81-224-1461-3 56789101112.
2. Numerical Methods for Engineering Problems by N. Krishna Raju and K.U. Muthu, M.C. Millan Publishers, New Delhi
3. Numerical Methods for Engineers Stevan C.Chopra, Raymond P.Canal Mc. Graw Hill Book Company. April 2009
4. C Language and Numerical methods by C.Xavier – New Age International Publisher. Reprint March 2012 ISBN:978-81-224-1174-4.
5. Computer based numerical analysis by Dr. M.Shanta Kumar, Khanna Book publishers New Delhi.

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
4	0	0	4

OPTIMIZATION TECHNIQUES IN STRUCTURAL ENGINEERING
(Elective – 4)

Prerequisites: Mathematics I&II

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

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

UNIT I : Introduction to Optimization: Introduction - Historical developments - Engineering applications of Optimization - Statement of an Optimization problem - Classification of Optimization problems - Optimization Techniques. Optimization by calculus: Introduction - Unconstrained functions of a single variable - Problems involving simple constraints - Unconstrained functions of several variables - treatment of equality constraints - Extension to multiple equality constraints - Optimization with inequality constraints - The generalized Newton-Raphson method.

UNIT II : Linear Programming: Introduction - Applications of linear programming - standard form of a linear programming problem - Geometry of linear programming problems - Definitions and theorems - Solution of a system of Linear simultaneous equations - Pivotal reduction of a general system of equations - Motivation of the Simplex Method - Simplex Algorithm - Two phases of the simplex method. non-Linear Programming: Introduction - Unimodal Function - Unrestricted search - Exhaustive search - Dichotomous search - Interval Halving method - Fibonacci method - Golden section method - Comparison of elimination methods - Unconstrained optimization techniques - Direct search methods - Random search methods - grid search method - Univariate method - Powell's method - Simplex method - Indirect search methods - Gradient of a function - Steepest descent method - Conjugate gradient - Newton's method.

UNIT III : Dynamic Programming: Introduction - Multistage decision processes - concept of sub-optimization and the principle of optimality - computational procedure in dynamic programming - example illustrating the Calculus method of solution - example illustrating the Tabular of solution - conversion of a final value problem into an initial value problem - continuous dynamic programming - Additional applications.

UNIT IV : Network Analysis: Introduction - Elementary graph theory - Network variables and problem types - Minimum-cost route - Network capacity problems - Modification of the directional sense of the network.

UNIT V: Application of Optimization techniques to trusses, Beams and Frames.

REFERENCES

1. Optimization: Theory and Applications by S.S.Rao. New Age International (p) Ltd.
2. Numerical Optimization Techniques for Engineering Design with applications by G.N.Vanderplaats 2007.
3. Elements of Structural Optimization by R.T.Haftka and Z.Gurdal Kluwer academic publishers
4. Optimum Structural Design by U.Kirsch. Tata Mc Graw Hill
5. Optimum Design of Structures by K.I.Majid.
6. Introduction to Optimum Design by J.S.Arora. Academic press, 2012 ISBN : 978-0-12-381375-6.

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
0	0	4	2

ADVANCED CONCRETE LABORATORY

Prerequisites: Concrete Technology Lab

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

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

1. Gradation Charts of Aggregates.
2. Bulking of fine Aggregate.
3. Aggregate Crushing and Impact value
4. Workability Tests on Fresh Self Compacting Concrete
6. Air Entrainment Test on Fresh Concrete
7. Rapidly Chloride Permeability Test.
8. Non Destructive Testing of Concrete.
9. Accelerated Curing of Concrete (Demo).
10. Behavior of Under Reinforced, over Reinforced and Shear Behavior of Beams.
11. Influence of W/C Ratio on Strength and Aggregate / Cement Ratio on Strength & Workability.
12. Influence of Different Chemical Admixtures on Concrete
13. Marsh Cone Test.

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M.Tech. I Year I-Sem (Structural Engineering)

L	T	P	C
0	0	4	2

SOFT SKILLS LAB
(Activity-based)

Course Objectives

- To improve the fluency of students in English
- To facilitate learning through interaction
- To illustrate the role of skills in real-life situations with case studies, role plays etc.
- To train students in group dynamics, body language and various other activities which boost their confidence levels and help in their overall personality development
- To encourage students develop behavioral skills and personal management skills
- To impart training for empowerment, thereby preparing students to become successful professionals

Learning Outcomes

- Developed critical acumen and creative ability besides making them industry- ready.
- Appropriate use of English language while clearly articulating ideas.
- Developing insights into Language and enrich the professional competence of the students.
- Enable students to meet challenges in job and career advancement.

INTRODUCTION

Definition and Introduction to Soft Skills – Hard Skills vs Soft Skills – Significance of Soft/Life/Self Skills – Self and SWOT Analysis ***and***

1. **Exercises on Productivity Development**
   - Effective/ Assertive Communication Skills (Activity based)
   - Time Management (Case Study)
   - Creativity & Critical Thinking (Case Study)
   - Decision Making and Problem Solving (Case Study)
   - Stress Management (Case Study)
2. **Exercises on Personality Development Skills**
   - Self-esteem (Case Study)
   - Positive Thinking (Case Study)
   - Emotional Intelligence (Case Study)
   - Team building and Leadership Skills (Case Study)
   - Conflict Management (Case Study)
3. **Exercises on Presentation Skills**
   - Netiquette
   - Importance of Oral Presentation – Defining Purpose- Analyzing the audience- Planning Outline and Preparing the Presentation- Individual & Group Presentation- Graphical Organizers- Tools and Multi-media Visuals
   - One Minute Presentations (Warming up)
   - PPT on Project Work- Understanding the Nuances of Delivery- Body Language – Closing and Handling Questions – Rubrics for Individual Evaluation (Practice Sessions)
4. **Exercises on Professional Etiquette and Communication**
   - Role-Play and Simulation- Introducing oneself and others, Greetings, Apologies, Requests, Agreement & Disagreement….etc.

- Telephone Etiquette
- Active Listening
- Group Discussions (Case study)- Group Discussion as a part of Selection Procedure- Checklist of GDs
- Analysis of Selected Interviews (Objectives of Interview)
- Mock-Interviews (Practice Sessions)
- Job Application and Preparing Resume
- Process Writing (Technical Vocabulary) – Writing a Project Report- Assignments

5. Exercises on Ethics and Values

Introduction –– Types of Values - Personal, Social and Cultural Values - Importance of Values in Various Contexts

- Significance of Modern and Professional Etiquette – Etiquette (Formal and Informal Situations with Examples)
- Attitude, Good Manners and Work Culture (Live Examples)
- Social Skills - Dealing with the Challenged (Live Examples)
- Professional Responsibility – Adaptability (Live Examples)
- Corporate Expectations

☞ Note: Hand-outs are to be prepared and given to students.

☞ Training plan will be integrated in the syllabus.

☞ Topics mentioned in the syllabus are activity-based.

SUGGESTED SOFTWARE:

☞ The following software from **'train2success.com'**

- Preparing for being Interviewed
- Positive Thinking
- Interviewing Skills
- Telephone Skills
- Time Management
- Team Building
- Decision making

SUGGESTED READING:

1. Alex, K. 2012. *Soft Skills.* S. Chand Publishers
2. *Management Shapers*. 2011. Collection of 28 Books by different Authors. Universities Press.
3. Sherfield, Robert M. *2005. et al Cornerstone: Developing Soft Skills*. Pearson
4. Suresh Kumar,E; Sreehari, P. & Savithri, J. 2011. *Communication Skills and Soft Skills- An Integrated Approach.* New Delhi: Pearson
5. The ACE of Soft Skills by Gopalaswamy Ramesh & Mahadevan Ramesh. 2013. Pearson Publishers. New Delhi.
6. Patnaik, P. 2011. *Group Discussion and Interview Skills.* New Delhi: Foundation
7. Sudhir Andrews. 2009. *How to Succeed at Interviews.* New Delhi: Tata McGraw Hill
8. **Sasikumar, V & Dhamija, P.V. 1993. *Spoken English - A Self-Learning Guide to Conversation Practice.* New Delhi: Tata McGraw-Hill**
9. *Dixson, Richard J. Everyday Dialogues in English. Prentice Hall India Pvt Ltd*
10. Mukhopadhyay. L *et al. 2012. Polyskills. New Delhi: CUP India Pvt Ltd*
11. Rizvi, M. A. 2005. *Effective Technical Communication.* New Delhi: Tata McGraw Hill
12. *The Hindu Speaks on Education* by the Hindu Newspaper
13. Naterop, B. Jean and Revell, Rod. 2004. *Telephoning in English*. Cambridge: CUP

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FINITE ELEMENT METHODS

Prerequisites: SA- I &II Advanced Structural Analysis

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

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

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

UNIT II
One dimensional FEM: Stiffness matrix for beam and bar elements - shape functions foe ID elements.
Two dimensional FEM: Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions - convergent and compatibility requirements - geometric invariance - natural coordinate system - area and volume coordinates - generation of element stiffness and nodal load matrices

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

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

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

REFERENCES:
1. Concepts and Applications of Finite Element Analysis by Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons Singapour
2. Finite element Methods by OC Zienkiewicz- Tata Mcgraw Hill 2005, 6th Edition
3. Finite element analysis, theory and programming by GS Krishna Murthy Tata Mcgraw Hill 2005, 7th Edition.
4. Introduction to Finite element Method by Tirupathi Chandra Patila and Belugunudu Prentice Hall of India Pvt Ltd - 2007
5. Introduction to Finite element Method by JN Reddy Tata Mcgraw Hill 2005, 3rd Edition

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ANALYSIS OF PLATES & SHELLS

Prerequisites: Theory of Elasticity, Structural Analysis

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

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

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

UNIT III
Buckling of Plates: Governing equation for Bending of plate under the combined action of in-plane loading and lateral loads – Buckling of rectangular plates by compressive forces acting in one and two directions in the middle plane of plate

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 Design of concrete shell roofs By Billington – Tata MC Graw Hill, New York
2 Shell Analysis By N.K.Bairagi. Khanna Publishers, New Delhi.
3. Theory of Plates and Shells by Timoshenko- Tata MC Graw Hill, College
4. Analysis and design of concrete shell roofs By G.S.Ramaswami. CBS publications.
5. Design of concrete shell roofs By Chaterjee. Oxford and IBH.

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COMPOSITE MATERIALS
(Elective – 5)

Prerequisites: Reinforced Concrete Design

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

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

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

UNIT - II
Macro mechanical Properties of composite Laminae: Introduction, Assumptions and Idealizations, Stress Strain relationships for composite Laminae- Isotropic, Orthotropic laminae, Strength Characteristics- Basic concepts, Strength hypothesis for isotropic and Orthotropic laminae. Macro mechanical Analysis of composite Laminae: Introduction, Assumptions and Limitations, Stiffness characteristics of glass reinforced laminae- Stress-Strain relationships in continuous, discontinuous fibre laminae, Strength characteristics of glass reinforced laminae- Strengths in continuous, discontinuous fibre laminae.

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

UNIT - IV
GRP properties relevant to structural Design: Introduction, Short-term strength and stiffness-Tensile, Compressive, Flexural and Shearing. Long term strength and stiffness properties, Temperature effects, Effect of fire, Structural joints- Adhesive, mechanical, Combinational, Transformed sections.

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

Design of Stressed skinned roof structure: Introduction, loading and material properties, preliminary design, and computer analysis.

References:
1. GRP in Structural Engineering M.Holmes and D.J.Just.
2. Mechanics of Composite materials and Structures by Madhujith Mukhopadhyay; Universities Press 2007.

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PRINCIPLES OF BRIDGE ENGINEERING
(Elective – 5)

Prerequisites: Structural Analysis I &II, Reinforced Concrete Design

Objectives:
To impart knowledge about different types of bridges, their analysis and design for combination of different loading condition as per codal provisions.

Outcomes:
The learner will be in a position to understand and design different types of bridges.

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

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

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

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

UNIT V
Design of Bearings: Sub-srtucture of bridges: Substructure- Beds block-Piers- Pier Dimensions- Design loads for piers- Abutments- Design loads for Abutments.

References
1. Essentials of Bridge Engineering by D.Johnson Victor, Oxford and IBH Publishing Co. Pvt. Ltd
2. Design of Concrete Bridges by M.G.Aswani, V.N.Vazirani and M.M.Ratwani. Khanna Publications 2004
3. Bridge Deck Behaviour by E.C.Hambly.
4. Concrete Bridge Design and Practice by V.K.Raina Tata Mc Graw Hill Publishing co
5. Bridge Engineering by Ponnusamy Tata Mc Graw Hill Publishing co
6. Design of Bridges by N.Krishna Raju, Oxford and IBH Publishing Co. Pvt. Ltd
7. Bridge Engineering by V.V.Sastry, DhanPat Rai & Co.

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REHABILITATION AND RETROFITING OF STRUCTURES
(Elective – 6)

Prerequisites: Reinforced Concrete Design, Steel Design, Concrete Technology

Objectives:
To impart knowledge about different types of determination of structures testing the structures for the deter ration of structures testing the structures for the diagnosis defects and different types of repairing methods.

Outcomes:
The learner will be understand about different types of distresses in structures, their causes, testing of structures for different problems and suggest suitable repair method.

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

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

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

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

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

REFERENCES:
1. Concrete Technology by A.R. Santakumar, Oxford University press
2. Defects and Deterioration in Buildingts, 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).

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EARTHQUAKE RESISTANT DESIGN OF BUILDINGS
(Elective – 6)

Prerequisites: Structural Dynamics, Reinforced Concrete Design

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

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

UNIT - I
Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonics- Seismic waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales-Energy released-Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph-Characteristics of strong ground motions- Seismic zones of India.
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 – Masonry, Steel Structures. Design Earthquake Loads – Basic Load Combinations – Permissible Stresses.
Seismic Methods of Analysis – Static Method – Equivalent Lateral Force Method. Dynamic Analysis – Response Spectrum Method – Modal Analysis Torsion.

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 – 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 – Coupled Shear Walls. Introduction to non-linear static Oush Over Analysis.

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- Seismic Evaluation and Retrofitting.

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) -2002. “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:13920-1993, “ Ductile detailing of concrete structures subjected to seismic force” – Guidelines, B.I.S., New Delhi.

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ADVANCED STEEL DESIGN
(Elective – 7)

Prerequisites: Design of Steel Structures & Structural Analysis

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

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

UNIT I:
SIMPLE CONNECTIONS – RIVETED, BOLTED PINNED AND WELDED CONNECTIONS : Riveted 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:
ECCENTRIC AND MOMENT CONNECTIONS : Introduction – Beams – Column Connections – Connections Subjected to Eccentric Shear – Bolted Framed Connections – Bolted Seat Connections – Bolted Bracket Connections. Bolted Moment Connections – Welded Framed Connections- Welded Bracket Connections – Moment Resistant Connections.

UNIT III: ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS:
Dead loads, live loads and wind loads on roofs. Design wind speed and pressure, wind pressure on roofs; wind effect on cladding and louvers; Design of angular roof truss, tubular truss, truss for a railway platform.Design of purlins for roofs, design of built up purlins, design of knee braced trusses and stanchions. Design of bracings.

UNIT IV: DESIGN OF STEEL TRUSS GIRDER BRIDGES:
Types of truss bridges, component parts of a truss bridge, economic Proportions of trusses, self weight of truss girders, design of bridge Compression members, tension members; wind load on truss girder Bridges; wind effect on top lateral bracing; bottom lateral bracing; portal Bracing; sway bracing.

UNIT V: DESIGN OF STEEL BUNKERS AND SILOS :
Introduction – Janssen's Theory – Airy's Theory – Design of Parameters – Design Criteria – Analysis of Bins – Hopper Bottom – Design of Bins.

References:
1. Design of Steel Structures. P.Dayaratnam, Publisher : S. Chand, Edition 2011-12.
2. Design Steel Structures Volume – II, Dr. Ramachandra & Vivendra Gehlot Scientitic Publishes Journals Department..
3. Limit State Design of Steel Structures S.K. Duggal Mc Graw Hill Education Private Ltd. NewDelhi.
4. Design of Steel Structures Galyord & Gaylord, Publisher : Tata Mc Graw Hill, Education. Edition 2012.
5. Indian Standard Code – IS – 800-2007.

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PLASTIC ANALYSIS AND DESIGN
(Elective – 7)

Prerequisites: Design of Steel Structures & Structural Analysis I & II

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

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

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

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

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

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

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

References:
1. Plastic Design of Steel Frames, L.S.Beedle.
2. Plastic Analysis, B.G.Neal.
3. Plastic Analysis, Horve.

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DESIGN OF INDUSTRIAL STRUCTURES
(Elective – 7)

Prerequisites: Design of Steel Structures & Structural Analysis

Objectives:
To impart knowledge about different types of industrial structures their analysis and design for different conditions as per codal provision.

Outcomes:
The learner will be able to plan different types of industrial structures such as cold framed members, RC buckers, Soil, Chimneys. Cylindrical shells and design them.

UNIT 1
Planning of Industrial Structures – types of industrial structures – different components of industrial structures – Bracings of Industrial Buildings – Design of Steel Industrial Buildings.

UNIT 2
Thin Walled / Cold Formed Steel Members : Definitions – Local Bucking of Thin-Elements-Post Buckling of Thin-Elements – Light Guage Steel Columns and Compression Members – Form-Factor for Columns and Compression Members – Behaviour of Stiffened Elements Under Uniform Compression – Multiple Stiffened Compression Elements –Effective Length of Light Gauge Steel Compression Members – Light Gauge Steel Tension Members.

UNIT 3
RC Bunkers & Silos : Introduction – Janssen's Theory – Airy's Theory – Design of Square, Rectangular and Circular Bunkers ; Design of Silos.

UNIT 4
RC Chimneys : Introduction – Wind Pressure – Stresses in Chimney Shaft Due to Self-Weight and Wind – Stresses in Horizontal Reinforcement Due to Wind Shear – Stresses Due to Temperature Difference – Combined Effect of Self Load, Wind and Temperature – Temperature Stresses in Horizontal Reinforcement Problems.

UNIT 5
Design Principles of Cylindrical Shells & Design Problems.

References:
1. Advanced Reinforced Concrete Design, By N. Krishna Raju (CBS Publishers & Distributors) 2005.
2. Design of Steel Structures, By Ram Chandra and Virendra Gehlot vol-II, 2007.
3. Design of Steel Structures, By Duggal - Tata McGraw-Hill publishers – 2010

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DESIGN OF PRESTRESSED CONCRETE STRUCTURES
(Elective – 8)

Prerequisites: Reinforced Concrete Design & Structural Analysis

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

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

UNIT I:
Introduction – Prestressing Systems – Pretensioning Systems – Postensioning 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 and Poles : Circular prestressing- Types of Prestressed Concrete Pipes- Design of Prestressed Concrete Pipes - Prestressed Concrete Poles.

UNIT V:
CONTINUOUS BEAMS: Advantage of Continuous Members – Effect of Prestressing Inderterminate 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.

References :

1. Prestressed Concrete by Krishna Raju – Fifth Edition - Tata Mc Graw Hill Book – Co ., New Delhi.
2. Design of Prestress Concrete Structures by T.Y. Lin and Burn, John Wiley, New York.
3. Prestressed Concrete by N. Rajagopalan, Narosa Publishing House
4. IS 1343 -2012, Prestressed Concrete – Code of Practice, Bureau of Indian Standards.
5. Prestressed Concrete: Analysis and Design Practice by Karuna Moy Ghosh, Prentice Hall of India

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STABILITY OF STRUCTURES
(Elective – 8)

Prerequisites: Theory of Elasticity & Advanced Structural Analysis

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

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

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

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

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

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

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

References
1. Theory of elastic Stability by Timshenko & Gere-Mc Graw Hill
2. Stability of metallic structures by Blunch- Mc Graw Hill
3. Theory of Beam- Columns Vol I by Chem. & Atste Mc. Graw Hill

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CAD LABORATORY

Prerequisites: Advanced Structural Analysis

Objectives:
To impart knowledge on the use of various softwares

Outcomes:
The learner will be able to understand and design the structures using the software.

1. Program for design of slabs. Using Excel
2. Program for design of beams. Using Excel
3. Program for design of column using Excel
4. Analysis of truss using STAAD Pro
5. Analysis of Multistoreyed space frame, using STAAD Pro, ETABS
6. Analysis of Bridge deck slab
7. Analysis of Plane frames using STAAD. Pro.
8. Program for Design of a combined footing using ETABS Excel
9. Program for Design of column using Excel.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year II-Sem (Structural Engineering)

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SEMINAR

Prerequisites: None.

OBJECTIVE:
To understand the topic on thrust area by reviewing about 8-10 research papers and relevant books and material in the website and present the topic and prepare technical report.

OUTCOME:
At the end of the course, the student will be able to undertake a critical review of literature on a chosen topic. Present topics of relevance to a group of professionals. Prepare a technical report.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. II Year I-Sem (Structural Engineering) **L T P C**
4

COMPREHENSIVE VIVA

Prerequisites: None.

OBJECTIVE:
To test the knowledge gained and to evaluate analyzing skills on the subjects studied in the masters programme.

OUTCOME:
The student will be able to undertake a assimilate knowledge of different courses studied, Develop overall comprehension about Geotechnical Engineering, Analyze real life geotechnical problems with theoretical knowledge learned, Interpret and articulate solutions to real life geotechnical problems.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. II Year I-Sem (Structural Engineering) **L T P C**
12

PROJECT PHASE-I

Prerequisites: None.

OBJECTIVE: To identify the topic by reviewing literature (Journal/ Conferences/ Articles etc.) and based on the topic, setting objectives and developing methodology to carryout project thesis work

OUTCOME: The student will be able to identify topics in thrust areas of Geotechnical engineering. Take up critical review of literature on the chosen topic. Carryout independent research work on the topic by experimental / analytical approaches. Documentation and presentation of the research work

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year III-Sem (Structural Engineering) **L T P C**
18

PROJECT PHASE – II & DISSERTATION

Prerequisites: None.

OBJECTIVE:
To carryout experimental/analytical programme and critical analysis of results on the identified topic in thrust areas of Geotechnical engineering.

OUTCOME:
Take up critical review of literature on the chosen topic carryout independent research work on the topic by experimental / analytical approaches. Preparation of document and critical analysis of the results of research work and presentation.