A18

M.Tech. (STRUCTURAL ENGINEERING)

M.Tech. Amended R18 [A18] CBCS Curriculum

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous, ISO 9001:2015 & QS I-Gauge Diamond Rated Institute, Accredited by NAAC with 'A++' Grade
NBA Accreditation for B.Tech. CE, EEE, ME, ECE, CSE, EIE, IT Programmes
Approved by AICTE, New Delhi, Affiliated to JNTUH, NIRF 135th Rank in Engineering Category
Recognized as "College with Potential for Excellence" by UGC
Vignana Jyothi Nagar, Pragathi Nagar, Nizampet (S.O), Hyderabad – 500 090, TS, India.
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VISION OF THE INSTITUTE

To be a World Class University providing value-based education, conducting interdisciplinary research in cutting edge technologies leading to sustainable development of the nation

MISSION OF THE INSTITUTE

- To produce technically competent and socially responsible engineers, managers and entrepreneurs, who will be future ready.

- To involve students and faculty in innovative research projects linked with industry, academic and research institutions in India and abroad.

- To use modern pedagogy for improving the teaching-learning process.

DEPARTMENT OF

CIVIL ENGINEERING

VISION OF THE DEPARTMENT

To develop Civil Engineering Department as a Centre of excellence for imparting value based education to the students at undergraduate and post-graduate level to meet industry needs and to develop as a major research center meeting national and international standards.

MISSION OF THE DEPARTMENT

- To impart in-depth and up-to-date knowledge of Civil Engineering concepts with focus on character enhancement, leadership qualities, effective communication, social responsibility and pursuit of lifelong learning and professional development.

- To provide a platform to the students to engage in original innovative research.

M.TECH.
(STRUCTURAL ENGINEERING)

M.TECH. (STRE)

PROGRAM EDUCATIONAL OBJECTIVES

PEO-I: To provide proficiency in the basic principles and advanced courses of technology in Structural Engineering so that students are able to formulate, analyse and solve the societal problems for sustainable development related to structural Engineering.

PEO-II: To expose the students to the latest innovations and trends with a view to inculcate strong research orientation in structural engineering as well as in multidisciplinary streams.

PEO-III: To produce Structural Engineers who integrate and build on the program's core curricular concepts in the pursuit of professional leadership, teamwork, life-long learning, and successful career advancement.

M.TECH. (STRE)

PROGRAM OUTCOMES

PO-1: The graduate is capable of applying the core and multidisciplinary knowledge for understanding the problems in structural engineering and allied fields.

PO-2: The graduates will possess critical thinking skills, problem solving abilities, and familiarity with the computational procedures essential to the field.

PO-3: The graduate is able to formulate, analyse, design and execute the construction of various types of engineering structures with appropriate consideration for public health and safety and cultural, societal and environmental conditions.

PO-4: Use research based knowledge and research methods to conduct experiments and to analyze and interpret experimental data.

PO-5: The student gets hands on training on various structural analysis and project management software's.

PO-6: Apply reasoning informed by the appropriate knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to structural engineering practice.

PO-7: Environment and Sustainability: As the students possess substantial knowledge in multidisciplinary areas, one is able to plan the various projects well, keeping in view its environmental effects on other related fields.

PO-8: Apply ethical principles and commitment to professional responsibilities.

PO-9: Capable of working productively as individual, as member or leader in driver set teams and in multi- disciplinary settings.

PO-10: The student achieves excellence in expressing his ideas, writing technical reports with great communication skills and managerial skills.

PO-11: Graduates will be able to understand the critical issues in professional practice such as analyzing the critical design problems, procurement of works and the execution of a project and the financial managerial capabilities.

PO-12: Student will maintain an awareness of contemporary issues and recognize the need for and engage in life-long learning to update with or develop technologies to meet the growing and changing needs of society

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(STRUCTURAL ENGINEERING)

I SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-I	A18PC1ST01	Advanced Structural Analysis	3	0	0	3
Professional Core-II	A18PC1ST02	Theory of Elasticity	3	0	0	3
Professional Core-III	A18PC1ST03	Advanced Concrete Technology	3	0	0	3
Professional Elective-I	A18PE1ST01	Theory of Thin Plates and Shells	3	0	0	3
	A18PE1ST02	Fracture Mechanics of Concrete Structures				
	A18PE1ST03	Theory of Structural Stability				
Professional Elective -II	A18PE1ST04	Design of Advanced Concrete Structures	3	0	0	3
	A18PE1ST05	Structural Optimization				
	A18PE1MT01	Analytical and Numerical Methods for Structural Engineering				
Professional Core Lab-I	A18PC2ST01	Advanced Concrete Technology Laboratory	0	0	3	1.5
Professional Core Lab-II	A18PC2MT01	Numerical Analysis Laboratory	0	0	3	1.5
Project	A18PW4ST01	Technical Seminar	0	0	4	2
Audit	A18AU5CS01	Research Methodology and IPR	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(STRUCTURAL ENGINEERING)

II SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-IV	A18PC1ST04	FEM in Structural Engineering	3	0	0	3
Professional Core-V	A18PC1ST05	Structural Dynamics	3	0	0	3
Professional Core-VI	A18PC1ST06	Design of Prestressed Concrete Structures	3	0	0	3
Professional Elective-III	A18PE1ST06	Earthquake Resistant Design of Buildings	3	0	0	3
	A18PE1ST07	Design of High Rise Structures				
	A18PE1ST08	Structural Health Monitoring				
Professional Elective-IV	A18PE1ST09	Design of Advanced Steel Structures	3	0	0	3
	A18PE1ST10	Design of Masonry Structures				
	A18PE1ST11	Pre-Engineered Buildings				
Professional Core Lab-III	A18PC2ST02	Model Testing Laboratory	0	0	3	1.5
Professional Core Lab-IV	A18PC2ST03	Structural Design Laboratory	0	0	3	1.5
Project	A18PW4ST02	Mini-Project	0	0	4	2
Audit	A18AU5EN01	English for Academic and Research Writing	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. II YEAR COURSE STRUCTURE AND SYLLABUS

(STRUCTURAL ENGINEERING)

III SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Elective-V	A18PE1ST12	Repair, Rehabilitation and Retrofitting of Structures	3	0	0	3
	A18PE1ST13	Bridge Engineering				
	A18PE1ST14	Construction Technology and Project Management				
Open Elective	A18OE1CN01	Business Analytics	3	0	0	3
	A18OE1AM01	Industrial Safety				
	A18OE1AM02	Operations Research				
	A18OE1AM03	Composite Materials				
	A18OE1PS01	Waste to Energy				
Project	A18PW4ST03	Project Part - I	0	0	16	8
Total			**6**	**0**	**16**	**14**

IV SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Project	A18PW4ST04	Project Part - II	0	0	28	14
Total			**0**	**0**	**28**	**14**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1ST01) ADVANCED STRUCTURAL ANALYSIS

COURSE OBJECTIVES:
- To learn how to calculate static and kinematic indeterminacies of various types of structures
- To formulate the stiffness matrix for continuous beams, portal frames and trusses
- To formulate the flexibility matrix for continuous beams, portal frames and trusses
- To obtain the global stiffness matrix by assembling the element stiffness matrices

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Formulate the stiffness and flexibility matrices for various types of structures
CO-2: Analyze the continuous beams, portal frames and trusses by stiffness method (structure approach)
CO-3: Analyze the continuous beams, portal frames and trusses by flexibility method (structure approach)
CO-4: Solve the Trusses, Continuous beams, Portal frames using element approach of stiffness method

UNIT–I:
Introduction to Matrix Methods of Analysis: Types of framed structures, Forces and Displacements, Conditions of equilibrium, Compatibility of deformations, Degree of freedom, Static indeterminacy and Kinematic indeterminacy for Continuous beams, Portal frames and Trusses, Concept of Stiffness and Flexibility methods, Generation of Stiffness and Flexibility matrices.

UNIT–II:
Stiffness Method (Structure Approach): Analysis of continuous beams, plane frames, plane trusses.

UNIT–III:
Flexibility Method (Structure Approach): Analysis of continuous beams, plane frames, plane trusses.

UNIT–IV:
Stiffness Method (Element Approach-Trusses): Local and global coordinates, Formulation of element stiffness matrix, Transformation matrix for plane truss element, Assembly of element stiffness matrices to generate global stiffness matrix, Application to the analysis of trusses.

UNIT–V:
Stiffness Method (Element Approach-Beams): Formulation of element stiffness matrix, Assembly of element stiffness matrices to generate global stiffness matrix, Application to the analysis of continuous beams.

UNIT–VI:
Stiffness Method (Element Approach-Frames): Formulation of element stiffness matrix, Transformation matrix for plane frame element, Assembly of element stiffness matrices to generate global stiffness matrix, Application to the analysis of portal frames.

TEXT BOOKS:
1. Structural Analysis: A Matrix Approach, G. S. Pandit, S. P. Gupta, Tata McGraw-Hill
2. Matrix Analysis of Framed Structures, William Weaver, James M. Gere, CBS Publications

REFERENCES:

1. Structural Analysis, Devdas Menon, Narosa Publishers
2. Matrix Methods of Structural Analysis, P. N. Godbole, PHI Learning Pvt. Ltd.
3. Structural Analysis, A. Ghali, A. M. Neville and T. G. Brown, Spon Press
4. Matrix Methods of Structural Analysis, M. B. Kanchi, New Age International

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1ST02) THEORY OF ELASTICITY

COURSE OBJECTIVES:
- To define stresses, strains, equilibrium and compatibility
- To derive the governing equilibrium equations in Two-dimensional & in three dimensional problems
- To solve the problems in plane stress, plane strain, torsion, bending
- To apply the concepts of elasticity & Plasticity to solve Structural Engineering problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Solve simple problems of elasticity and understanding the basic concepts
CO-2: Apply numerical methods to solve continuum problems
CO-3: Solve engineering problems such as thick cylinders, rotating discs, shafts and complex loading on structural members
CO-4: Solve problems of theory of plasticity

UNIT–I:
Introduction to Elasticity: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity, Generalized Hook's law.

UNIT–II:
Strain and Stress Field: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Compatibility Conditions, Plane Stress and Plane Strain Problems, Airy's stress Function, Hydrostatic and Deviatoric Components.

UNIT–III:
Two-Dimensional Problems in rectangular Coordinates: Stress- Strain relations, Strain Displacement and Compatibility Relations, Boundary Value Problems: Solution by polynomials, Saint Venant's principle, determination of displacements, bending of simple beams.

UNIT–IV:
Two-Dimensional Problems in Polar Coordinates: Differential Equations of Equilibrium, Compatibility Conditions - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions - simple symmetric and asymmetric problems - general solution of two-dimensional problem in polar coordinates.

UNIT–V:
Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.

UNIT–VI:
Plastic Deformation: Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening

TEXT BOOKS:
1. Theory of Elasticity, S. Timoshenko & J. N. Goodier, McGraw-Hill
2. Theory of Elasticity, Sadhu Singh, Khanna Publishers

REFERENCES:

1. Mechanics of Solids, Srinath L. S., Tata McGraw Hill
2. Theory of Plasticity, J. Chakarbarthy, McGraw-Hill Ryerson
3. Applied Elasticity, C. T. Wang, McGraw Hill
4. Elasticity - Theory, Applications and Numerics, Martin and H. Sadd, Elsevier
5. Theory of Plasticity, Sadhu Singh, Dhanpat Rai sons Private Limited

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M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1ST03) ADVANCED CONCRETE TECHNOLOGY

COURSE OBJECTIVES:

- To determine the properties of concrete ingredients i.e., cement, sand, coarse aggregate by conducting different tests and decide the suitability
- To recognize the effects of the rheology and early age properties of concrete on its long-term behavior
- To design economic concrete mix proportions for the given exposure conditions and with the available materials, for the desired strength and performance criteria
- To use advanced techniques for Service Life assessment of Concrete Structures

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

CO-1: Design an appropriate economic cementitious composite based on the performance requirements

CO-2: Determine the characteristics of concrete making materials and decide it's suitability

CO-3: Judge and Resolve any controversy that arises regarding material suitability through required field and laboratory investigations

CO-4: Assess the service life of an existing structure through determining the mechanical, durability and the current state of corrosion of reinforcement in concrete

UNIT–I:

Concrete Making Materials: Cement - Bogue's compounds - Hydration process - Types of cement - Aggregates Mineral and Chemical Characterization of aggregates - Gradation curves - Fullers Curve - Grading Evaluation & Specifications - Alkali silica reaction - Admixtures: mineral and chemical admixtures - Secondary Pozzolanic Reaction due to mineral admixtures – Efficiency Concept.

UNIT–II:

Fresh and Hardened Concrete: Fresh concrete - Workability tests on concrete- Workability tests on Self Compacting Concretes - segregation and bleeding.

Hardened Concrete - Abram's law - Gel- space ratio - Maturity concept - Stress Strain behavior, Creep and Shrinkage.

UNIT–III:

High Performance and High Strength Concretes: High performance concrete - Requirements and properties of high-performance concrete - Design considerations – High strength concrete – Design considerations.

UNIT–IV:

Special Concretes: Light weight concrete - Self Compacting concrete - Polymer concrete - Fiber reinforced concrete – Reactive powder concrete - Bacterial concrete-Geo-polymer concrete – Requirements and guidelines- Advantages and Applications – Porous pavement – White Topping – Roller compacted concrete.

UNIT–V:

Concrete Mix Design: Quality control - Quality assurance - Quality audit - Mix design by various methods - BIS method - DOE method - ACI method - Erntroy & Shacklock's method.

UNIT–VI:

Performance Evaluation of Reinforced Concrete Structures: Durability of concrete & Corrosion tests - Resistivity of concrete - Half Cell Potential - Rapid Chloride Penetration Test - Macro cell Corrosion - Effects of concrete exposed to acidic environment - Durability Factor -

Accelerated Corrosion Cracking Test - Non-destructive evaluation of concrete structures - Ultrasonic Pulse Velocity - Evaluation of Dynamic Shear & Young's Modulus - Introduction to XRD & SEM Analysis.

TEXT BOOKS:

1. Properties of Concrete, A. M. Neville, Pearson Education
2. Concrete Microstructure, Properties and Materials, P. K. Mehta and Paulo J. M. Monteiro, McGraw Hill

REFERENCES:

1. Corrosion of Steel in Concrete, P. Schiessl, Chapman & Hall
2. Concrete Making Materials, Sandor Popovics, Hemisphere Publishing Corporation
3. Aggregates in Concrete, Mark Alexander & Sydney Mindess, Taylor & Francis
4. Cement Based Composites, Andrzej M. Brandt

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M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST01) THEORY OF THIN PLATES AND SHELLS

COURSE OBJECTIVES:
- To understand the behaviour of Rectangular and circular Plates subjected to various loading
- To understand the behaviour of various types of Shells subjected to various loading
- To study the analysis procedures for plates and shells
- To study the analysis of folded plates

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Use analytical methods for the solution of thin plates and shells
CO-2: Use analytical methods for the solution of shells and folded plates
CO-3: Apply the numerical techniques and tools for the complex problems in thin plates
CO-4: Apply the numerical techniques and tools for the complex problems in shells

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:
Static Analysis of Plates: Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

UNIT–III:
Circular Plates: Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

UNIT–IV:
Static Analysis of Shells: Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells

UNIT–V:
Shells of Revolution: with Bending Resistance - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels.

UNIT–VI:
Folded Plates: Introduction of folded plate structures – Structural behavior – Various types.

TEXT BOOKS:
1. Theory of Plates, Chandrashekhara K., Universities Press
2. Theory of Plates and Shells, Bhavikatti S. S., New Age International

REFERENCES
1. Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill
2. Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill
3. Thin Elastic Shells, Kraush, John Wiley and Sons
4. Design and Construction of Concrete Shells, Ramaswamy G. S.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST02) FRACTURE MECHANICS OF CONCRETE STRUCTURES

COURSE OBJECTIVES:

- To understand the reasons for failure of an existing structure
- To apply the concepts of basic fracture mechanics to evaluate the residual strength in the cracked structural element
- To apply numerical methods and evaluate the service life through fracture characterization
- To evaluate the performance of structural elements constructed using composite materials

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify and classify cracking of concrete structures based on fracture mechanics
CO-2: Implement stress intensity factor for notched members
CO-3: Apply fracture mechanics models to high strength concrete and FRC structures
CO-4: Compute J-integral for various sections understanding the concepts of LEFM

UNIT–I:
Introduction to Fracture Mechanics: Kinds of Failure - Historical Aspects - Brittle and Ductile Fracture - Modes of Fracture Failure - How Potent is a Crack - Point of View - Damage Tolerance

UNIT–II:
Energy Release Rate: Griffith Dilemma - Energy Release Rate - Mathematical Formulation - Change in Compliance Approach - Change in the Strain Energy Approach – Energy Release Rate of DCB Specimen - Anelastic Deformation at Crack-tip - Crack Resistance - Stable and Unstable Crack Growth - R-curve for Brittle Cracks - Thin Plate vs Thick Plate - Critical Energy Release Rate

UNIT–III:
Stress Intensity Factor: Introduction - Why Should Investigations be Closer to the Crack Tip? - Linear Elastic Fracture Mechanics (LEFM) - Stress and Displacement Fields in Isotropic Elastic Materials - Stress Intensity Factor - Background for Mathematical Analysis - Field Equations - Elementary Properties of Complex Variables - Westergaard's Approach for Models with Opening Mode, Sliding Mode & Tearing Mode.

UNIT–IV:
Inelastic Deformation at the Crack Tip: Further Investigation at the Crack Tip - Approximate Shape and Size of the Plastic Zone - Plastic Zone Shape for Plane Stress - Plastic Zone Shape for Plane Strain - Effective Crack Length - Approximate Approach - The Irwin Plastic Zone Correction - Plastic Zone Size through the Dugdale Approach - Effect of Plate Thickness - Closure

UNIT–V:
J Integral & Crack Tip Opening Displacement: J-Integral: Relevance and Scope - Definition - Path Independence - Stress-Strain Relation
Crack Tip Opening Displacement: Introduction - Relationship between CTOD, Kr and Gr for Small Scale Yielding - Equivalence between CTOD and J.

UNIT–VI:

Application to Cementitious Composites: Material models - General concepts – crack models – band models - Models based on continuum damage mechanics– applications to high strength concrete – fibre reinforced concrete - crack concepts and numerical modelling.

TEXT BOOKS:

1. Introduction to Fracture Mechanics, Prasant Kumar, McGraw Hill Publications
2. Fracture Mechanics, Suri C. T. and Jin Z. H., Elsevier Academic Press

REFERENCES:

1. Elementary Engineering Fracture Mechanics, Broek David, Springer
2. Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEM Report, Chapman and Hall

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST03) THEORY OF STRUCTURAL STABILITY

COURSE OBJECTIVES:
- To derive the differential equations for beam-columns
- To understand the elastic buckling of bars and frames
- To understand the Torsional Buckling
- To analyze lateral buckling of beams and plate

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the approximate methods based on energy to determine the stability of simple systems
CO-2: Differentiate how the tangent modulus and double modulus theories of inelastic buckling led to the column paradox, thereby preventing further difficulties for a general theory of structures
CO-3: Analyze elastic and in-elastic buckling of bars and frames
CO-4: Analyze the beams for lateral torsional buckling

UNIT–I:
Buckling of Columns: Introduction; Method of Neutral Equilibrium; The Critical Load of the Euler Column; Linear Column Theory – An Eigen Value problem; Boundary Conditions – Both ends fixed, One end fixed and one end free, One end fixed and one end hinged, Elastically restrained end; Effecting-Length Concept and Design concept, Higher Order Differential Equation for Columns – hinged-hinged, free-free.

UNIT–II:
Buckling of Columns: Large Deformation Theory for Columns; Initially Bent Columns; Eccentrically Loaded Columns.
Inelastic Buckling of Columns: Introduction; Double Modulus Theory; Tangent Modulus Theory; Shanley's Theory of Inelastic Column Behaviour; Eccentrically Loaded Inelastic Columns; Buckling of Short Columns.

UNIT–III:
Beam Columns: Introduction; Beam Column with Concentrated Lateral Load; Beam Column with Distributed Lateral Load; Effect of Axial Load on Bending Stiffness – Slope-Deflection Equation; Failure of Beam Columns.

UNIT–IV:
Buckling of Frames: Introduction; Modes of Buckling; Critical Load of a Frame using Neutral Equilibrium; Calculation of Critical Loading using Slope-Deflection Equation; Stability of a Frame by Matrix Analysis; Effect of Primary Bending and Plasticity on Frame Behaviour.

UNIT–V:
Torsional Buckling: Introduction; Torsional Load-Deformation Characteristics of Structural Members; Strain Energy of Torsion; Torsional and Torsional-Flexural Buckling of Columns; Lateral Buckling of Beams; Lateral Buckling of Rectangular Beams in Pure Bending; Buckling of I Beams by Energy Method; Lateral Buckling of Cantilever Beam by Finite Differences.

UNIT–VI:
Buckling of Plates: Introduction; Differential Equation of Plate Buckling – Linear Theory; Critical Load of a Plate Uniformly Compressed in One Direction; Strain Energy of Bending in a plate; Critical Load of Uniaxially Compressed Plate, Fixed along all edges by the Energy method; Critical Load of a Plate in Shear by Galerkin Method; Inelastic Buckling of plates.

TEXT BOOKS:

1. Principles of Structural Stability, Alexander Chajes A. Prentice-Hall Inc
2. Theory of Elastic Stability, Timoshenko S. P., and Gere J. M., Tata McGraw Hill

REFERENCES:

1. Stability of Metallic Structures, Blunch, McGraw Hill
2. Theory of Beam-Columns, Vol-I, Chem. & Atste, McGraw Hill

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
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(A18PE1ST04) DESIGN OF ADVANCED CONCRETE STRUCTURES

COURSE OBJECTIVES:
- To analyze and design of slabs by using yield line theory
- To understand the various types of loads in current codes of practice for the design of tall buildings
- To understand the Design concepts of flat slabs
- To analyze and Design of Concrete Deep beams and retaining walls

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Determine moment of resistance for square and circular slabs
CO-2: Analyze and design of flat slabs
CO-3: Design of Concrete Deep beams and Retaining walls
CO-4: Understand the various types of loads to consider in the design of tall buildings

UNIT–I:
Limit State Analysis of R.C. Structures: Review of Limit state design concepts, Rotation of a plastic hinge, Redistribution of moments, moment-rotation characteristics of RC member, I.S. code provisions and 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.

UNIT–II:
Design of Ribbed Slabs: Analysis of the Slabs for Moment and Shears, Ultimate moment of resistance, Design for shear, Deflection, Arrangement of Reinforcement.

UNIT–III:
Design of 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 shear - 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: steps of Designing Deep Beams, Design by IS 456, Checking for Local Failures, Detailing of Deep Beams.

UNIT–V:
Introduction to Tall Buildings: Tall Building in the Urban Context - Tall Building and its Support Structure - Development of High Rise-Building Structures - General Planning Considerations. Dead Loads - Live Loads - Construction Loads - Snow, and Wind Loads -Seismic Loading.

UNIT–VI:
Retaining Walls: Analysis and Design of Cantilever Retaining wall, Counterfort Retaining wall.

TEXT BOOKS:
1. Reinforced Concrete Design, S. Unnikrishnan Pillai and Devdas Menon, TMH
2. Advanced Reinforced Concrete Design, P. C. Varghese, Practice Hall

REFERENCES:
1. Limit State Theory and Design of Reinforced Concrete, Dr. S. R. Karve and Dr. V. L. Shah, Standard Publishers

2. Reinforced Concrete Structures, Vol-I, B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST05) STRUCTURAL OPTIMIZATION

COURSE OBJECTIVES:
- To understand the concepts calculus of variation for optimization
- To perform linear, non-linear and geometric programing methods
- To understand the applications of mathematical optimization methods to steel and RCC
- To perform the designs based on frequency constraint

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Use Variational principle for optimization
CO-2: Perform linear, non-linear, dynamic and geometric programing methods
CO-3: Apply optimization techniques to structural steel and concrete members
CO-4: Design using frequency constraint

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

UNIT–II:
Calculus of Variation: Variational 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.

UNIT-VI:
Design: Frequency Constraint, Design of Layouts.

TEXT BOOKS:
1. Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer
2. Variational Methods for Structural Optimization, Cherkaev Andrej, Springer

REFERENCES:
1. Introduction to Structural Optimization (Solid Mechanics and Its Applications), Peter W. Christensen, A. Klarbring, Springer
2. Engineering Optimization: Theory and Practice, Singiresu S. Rao, New Age International

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1MT01) ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

COURSE OBJECTIVES:
- To apply the basic knowledge of Mathematics in Engineering
- To provide a formidable base for analysis and programming using computer applications
- To develop the ability in programming and solutions based on the various analysis tools
- To check the consistency of system of linear equations

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply numerical methods to find the roots of an equation
CO-2: Identify mathematical model for solution of common engineering problems
CO-3: Formulate simple problems into programming models
CO-4: Solve ordinary and partial differential equations

UNIT–I:
Solution of Nonlinear Algebraic and Transcendental Equations: Introduction, errors and approximations, binary and decimal systems, computing roots using direct methods (bisection, Regula- falsi) and Iterative Methods (fixed point iterative and Newton- Raphson Methods) and applications.

UNIT–II:
Elements of Matrix Algebra: Introduction, Methods of solution direct (Matrix inversion and Gauss elimination methods) and iterative methods (Gauss Jacobi and Gauss seidel methods), Eigen values, computing largest Eigen value by power method and applications.

UNIT–III:
Fundamentals of Numerical Methods: Interpolation: Introduction, Interpolation for equally spaced data and unequally space data by Newton's methods, Lagrange's method and cubic spline, Error Analysis, Polynomial Approximations.
Curve Fitting: Fitting a straight line, Second degree curve, Exponential curve, power curve by method of least squares.

UNIT–IV:
Numerical Differentiation & Integration: Numerical differentiation formulae using finite differences and interpolation. Newton-Cotes integration formulae (Trapezoidal and Simpsons rules) and Gauss quadrature formulae.
Numerical Solution of ordinary Differential Equations: Introduction, Solution of ODE of IVP type by Euler's methods, Runge-Kutta methods (single step) and Multistep methods.

UNIT–V:
Finite Difference Scheme: Numerical solution of PDE using finite difference schemes approaches: Bender Schmidt and Crank-Nicolson Methods (Parabolic, Elliptic type) and applications.

UNIT–VI:
Computer Algorithms:
Introduction to Matlab, Matlab Algorithms (Gauss Jacobi and Gauss seidel methods, power method, Euler's methods, Runge-Kutta methods).

TEXT BOOKS:
1. Numerical Methods, Dr. B. S. Grewal
2. Numerical Analysis, R. L. Burden and J. D. Faires

REFERENCES:

1. An Introduction to Numerical Analysis, Atkinson K. E., J. Wiley and Sons
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, Schaum Series
3. Introductory Methods of Numerical Analysis, Sastry S. S., Prentice Hall of India

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2ST01) ADVANCED CONCRETE TECHNOLOGY LABORATORY

COURSE OBJECTIVES:

- To understand the behaviour of cementitious composite systems inclusive of the effects of particulate and fibrous ingredients
- To analyze and evaluate the performance of structural elements in the laboratory an field
- To decide upon the type of material to be used for a particular exposure condition
- To evaluate parameters required to determine the service life of structures

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

CO-1: Design normal and special concretes and evaluate the parameters affecting its performance

CO-2: Conduct Non-Destructive Tests on existing concrete structures

CO-3: Apply engineering principles to understand mechanical and durability characteristics of structural elements

CO-4: Evaluate the corrosion characteristics through RCPT and ACC tests

LIST OF EXPERIMENTS:

1. Characterization of concrete making materials:
   a) Specific gravity of cement, fine aggregate and coarse aggregate
   b) Consistency and Setting times of cement
   c) Zone classification and Fineness modulus of fine aggregates
2. Mix design of concrete as per IS-10262: 2009 (inclusive of casting and testing for 28 days compressive strength and split tensile strength)
3. Mix design of Self Compacting Concrete as per EFNARC guidelines and evaluation of workability and mechanical characteristics
   a) J-Ring Test
   b) Slump flow Test
   c) L-Box test
   d) U-Box test
   e) V-Funnel test
   f) Compressive strength and Split tensile strength
4. Evaluation of flexural strength of concrete beam
5. Determination of bond strength of concrete with mild steel bar
6. Non Destructive evaluation of structural elements using Rebound hammer
7. Permeability characteristics of concrete
8. Rapid Chloride Penetration Test
9. Accelerated Corrosion Cracking Test
10. Abrasion test on concrete

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2MT01) NUMERICAL ANALYSIS LABORATORY

COURSE OBJECTIVES:

- To solve a system of linear and non-linear equations
- To draw best fit curve for the given data set
- To find numerical solutions by FDM and FEM
- To solve ordinary and partial differential equations numerically

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Analyze the beams by solving a system of equations
CO-2: Generate the best fit curves, Sketch the basic 2D, 3D plots
CO-3: Apply the concepts of FDM and FEM to solve Structural Engineering Problems
CO-4: Solve the ODE and PDE and apply to the Structural Engineering Problems

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. To check whether the system has Unique solution / Many solutions / No solution using the Rank of a matrix.
4. Solution of system of linear equations using Gauss Elimination method - Application to the analysis of indeterminate beams
5. Solution of System of linear equations using Gauss Seidal iteration Method – Application to the analysis of portal frames
6. Finding the Roots of non-linear equations using Newton – Raphson Method - Application for finding the slopes and deflections in determinate beams
7. Finding the Solution of an Eigen Value problem – Application to a multistory RC building for determining the Time periods and Mode shapes.
8. Curve Fitting by Method of Least Squares – Application for finding the Modulus of elasticity of steel from stress - strain curve obtained by conducting Tension test.
9. Numerical Integration using Trapezoidal & Simpson's Rule – Application for finding the Areas and Volumes of a given plot.
10. Numerical solution of ordinary differential equations by Runge- Kutta method
11. Numerical solution of partial differential equations – Application to the analysis of plate problems - Finite Difference Method
12. Numerical solution of partial differential equations – Application to the analysis of solids - Finite Element Method
13. Numerical solution of second and higher order differential equations
14. Plotting Simple Graphs, Basic 2D Plots, 3D Plots

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	0	**4**	**2**

(A18PW4ST01) TECHNICAL SEMINAR

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify a research topic related to advanced/state-of-the-art technologies
CO-2: Collect the literature and comprehend/analyze critically the technological advancements
CO-3: Engage in effective oral communication through presentation of seminar
CO-4: Engage in effective written communication through report

COURSE OUTLINE:

- A student shall present a seminar on a technical topic during I semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on a technical topic of his / her choice, critically review the literature and submit it to the Seminar Review Committee (SRC) in a prescribed report form.
- The SRC shall consist of Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- Student shall make an oral presentation before the SRC after clearing the plagiarism check.
- Prior to the submission of seminar report to the SRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The report shall be accepted for submission to the SRC only upon meeting the prescribed similarity index.

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M.Tech. I Semester (STRE)	**L**	**T/P**	**C**
	2	**0**	**0**

(A18AU5CS01) RESEARCH METHODOLOGY AND IPR

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To introduce the characteristics of a good research problem
- To choose appropriate approaches of investigation of solutions for research problem
- To familiarize with basic Intellectual Property Rights
- To understand different Patent Rights

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand research problem formulation, analyze research related information and follow research ethics
CO-2: Realize the importance of ideas, concept, and creativity in the present-day context
CO-3: Recognize that when IPR would take such important place in growth of individuals and nation, it is needless to emphasize the need of information about IPR to be promoted among students in general and engineering in particular
CO-4: Appreciate IPR protection which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

UNIT-I:
Introduction: 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:
Literature Survey: 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.

UNIT-VI:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR.

TEXT BOOKS:
1. Research Methodology: An Introduction for Science & Engineering Students, Stuart Melville and Wayne Goddard

2. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville
3. Resisting Intellectual Property, Halbert, Taylor & Francis Ltd ,2007

REFERENCES:

1. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, 2nd Edition
2. Research Methodology: Methods and Techniques, C. R. Kothari and Gaurav Garg, New Age International
3. Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016
4. Intellectual Property Rights Under WTO, T. Ramappa, S. Chand, 2008

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1ST04) FEM IN STRUCTURAL ENGINEERING

COURSE OBJECTIVES:
- To provide the fundamental concepts of the theory of the finite element method
- To enable the students to formulate the problems into FEA
- To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems
- To use professional-level finite element software to solve engineering problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Use Finite Element Method for solving structural Engineering problems
CO-2: Execute the Finite Element Program/ Software
CO-3: Solve continuum problems using finite element analysis
CO-4: Understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements

UNIT-I:
Introduction: History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.

UNIT-II:
Beam Elements: Flexure Element, Element Stiffness Matrix, Element Load Vector.

UNIT-III:
Method of Weighted Residuals: Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.

UNIT-IV:
Element Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.

UNIT-V:
Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.

UNIT-VI:
Computer Implementation of FEM procedure, Pre-Processing, Solution, Post- Processing, Use of Commercial FEA Software.

TEXT BOOKS:
1. Finite Element Analysis, Seshu P., Prentice-Hall of India
2. Concepts and Applications of Finite Element Analysis, Cook R. D., John Wiley

REFERENCES:
1. Fundamentals of Finite Element Analysis, Hutton David, McGraw Hill
2. Finite Element Analysis, Buchanan G. R., McGraw Hill
3. Finite Element Method - Vol. I, II, Zienkiewicz O. C. and Taylor R. L., Elsevier

4. Finite Element Methods in Engineering, Belegundu A. D., Chandrupatla, T. R., Prentice Hall India

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1ST05) STRUCTURAL DYNAMICS

COURSE OBJECTIVES:
- To know the fundamental concepts and theory of dynamic analysis
- To understand the free vibrations concepts and the problem of determining the natural frequency of a system
- To understand the free vibrations concepts of harmonically excited vibrations
- To understand the free Vibrations of Multi -degree of freedom

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the fundamental concepts and definitions used in structural dynamics
CO-2: Calculate the natural frequency of a system using equilibrium or energy methods
CO-3: Determine the effect of viscous damping on the response of a freely vibrating system
CO-4: Determine the response of a system to a harmonic excitation

UNIT-I:
Theory of Vibrations: Introduction - Elements of vibratory system - Degrees of Freedom – Continuous and Lumped mass idealization - Oscillatory motion - Simple Harmonic motion – Vectorial representation of S.H.M.

UNIT-II:
Single Degree of Freedom Systems – Free Vibrations: Fundamental objectives of dynamic analysis -Types of prescribed loading – Method of discretization - Formulation of equations of motion by different methods - Direct equilibration using Newton's law of motion, D' Alembert's
principle of virtual work and Hamilton Principle, Single Degree of Freedom systems – Free Vibrations : Formulation and solution of the equation of motion – Free vibration response - Formulation of single degree of freedom system - Undamped and Damped motions - Critical damping - Logarithmic decrement.

UNIT-III:
Single Degree of Freedom Systems – Forced Vibrations: Response to Harmonic, Periodic, Impulsive and General dynamic loadings - Duhamel integral - Dynamic magnification factor- Phase angle – Bandwidth

UNIT-IV:
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 super position procedure

UNIT-V:
Practical Vibration Analysis: Introduction - Stodola method - Fundamental mode analysis – Analysis of second and higher modes - Holzer method.

UNIT-VI:
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.

TEXT BOOKS:

1. Dynamics of Structures, Clough and Penzien, McGraw Hill
2. Structural Dynamics, Mario Paz, CBS Publishers
3. Structural Dynamics and Earthquake Engineering, Er. Srinivas Vasam

REFERENCES:

1. Dynamics of Structures, Anil K. Chopra, Pearson Education

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M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1ST06) DESIGN OF PRESTRESSED CONCRETE STRUCTURES

COURSE OBJECTIVES:

- To critically review the techniques of pre-stressing both Pre-tensioning and Post-tensioning
- To design the pre-stressed concrete members for ultimate limit state and limit state of serviceability
- To realize the importance of the Statically Indeterminate structures and Load Balancing
- To analyze and design continuous pre-stressed concrete beams with bent cables having straight and parabolic profiles

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

CO-1: Realize the importance of pre-stressing the long span structures and heavily loaded members

CO-2: Acquire the knowledge of various pre-stressing techniques; their merits and demerits

CO-3: Develop skills in planning, analysis and design of pre-stressed concrete beams, and slabs

CO-4: Develop skills to satisfy the serviceability and strength provisions of the Indian Standards (IS:1343-2012)

UNIT-I:

General Principles and Systems of Pre-stressing: Basic concepts of prestresing, Need for High strength steel and concrete, Advantages and Applications of PSC, Different methods and systems of pre-stressing like Hoyer system, Freyssinet system.

Analysis of pre-stressed beams : Basic concepts, Analysis of sections for flexure, stresses at transfer and service loads, Pre-stressing by straight, concentric, eccentric, bent and parabolic tendons, Pressure line, concept of load balancing, cracking moment.

UNIT-II:

Losses of Pre-stress: Loss of pre-stress in pre-tensioned and post-tensioned members due to various causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, slip in anchorage, frictional loss.

Deflections of Pre-stressed Concrete Beams: Short term deflections of un-cracked members, Prediction of long-time deflections, IS code requirements for maximum deflections.

UNIT-III:

Design of Sections for Flexure: Allowable stresses, Elastic design of simple beams having rectangular and I-sections, kern lines, cable profile and cable layout.

Design of Sections for Shear : Shear and Principal Stresses, Improving shear resistance by different pre-stressing techniques - horizontal, inclined and vertical pre-stressing, Design of beams having rectangular and I-sections, Design of shear reinforcement, IS code provisions.

UNIT-IV:

Transfer of Pre-stress in Pre-tensioned Members: Transmission of pre-stressing force by bond, Transmission length, Bond stresses, IS code provisions.

Anchorage zone stresses in Post-tensioned Members: Stress distribution in End block - Analysis by Guyon and Magnel methods, Anchorage zone reinforcement.

UNIT-V:

Statically Indeterminate Structures: Advantages & Disadvantages of continuous beams - Primary and Secondary moments - P and C lines - Linear transformation, Concordant and Non-concordant cable profiles - Analysis of continuous beams.

UNIT-VI:

Composite Construction: Advantages, Types, Analysis of stresses in Propped and Unpropped construction with precast PSC beams and cast in-situ RC slab, Differential shrinkage.

TEXT BOOKS:

1. Pre-stressed Concrete, Krishna Raju, Tata McGraw-Hill
2. Pre-stressed Concrete, Muthu K. U., Ibrahim Azmi, Janardhana Maganti, Vijayanand M., PHI Learning Pvt. Ltd.

REFERENCES:

1. Pre-stressed Concrete, Ramamrutham, Dhanpat Rai & Sons
2. Pre-stressed Concrete, N. Rajagopalan, Narosa
3. Pre-stressed Concrete Structures, P. Dayaratnam, Oxford & IBH
4. Design of Pre-stressed Concrete Structures, T. Y. Lin and N. H. Burns, John Wiley

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M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST06) EARTHQUAKE RESISTANT DESIGN OF BUILDINGS

COURSE OBJECTIVES:
- To explain the possible causes for earthquakes understanding seismology
- To understand the principles of earthquake resistant design of RC and masonry buildings
- To learn to evaluate base shears using IS methods
- To detail the structural members for ductile requirements

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Predict the sources of earthquakes understanding seismology and conceptually design the buildings
CO-2: Apply the Response Spectrum Analysis Method and static equivalent method for the determination of lateral loads on the buildings
CO-3: Apply ductility requirements for the design of structural components
CO-4: Assess seismic performance of non-structural components and structural components and identify effective measures to mitigate potential damage

UNIT-I:
Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- plate seismic tectonics- waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales- Energy released-Earthquake measuring instruments-seismoscope, accelerograph, Characteristics of strong ground motions - Seismic zones of India.

UNIT-II:
Conceptual Design: Introduction-Functional planning-continuous load path-overall form-simplicity and symmetry-elongated shapes-stiffness and strength-Horizontal and Vertical members-Twisting of buildings-Ductility- definition-ductility relationships, flexible buildings-framing systems-choice of construction materials-unconfined concrete-confined concrete, masonry-reinforcing steel. Introduction to earthquake resistant design: seismic design requirements-regular and irregular configurations - basic assumptions - design earthquake loads - basic load combinations- permissible stresses-seismic methods of analysis-factors in seismic analysis-equivalent lateral force method – response spectrum method -Time history method.

UNIT-III:
Reinforced Concrete Buildings and Design Methods: Principles of earthquake resistant deign of RC members-structural models for frame buildings- seismic methods of analysis- seismic design methods- IS code-based methods for seismic design-Seismic Coefficient and Response Spectrum Method- Determination of design lateral forces- Equivalent lateral force procedure- Lateral distribution of base shear.

UNIT-IV:
Masonry Buildings: Introduction-Elastic properties of masonry assemblage- Categories of masonry buildings- Behaviour of unreinforced and reinforced masonry walls- Behaviour of walls- Box action and bands- Behaviour of infill walls- Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses- seismic design requirements- Lateral load analysis of masonry buildings.

UNIT-V:
Structural Walls and Non-structural Elements: Strategies in the location of structural walls-sectional shape & variations in elevation- cantilever walls without openings- Failure mechanism of non-structures- Effects of non-structural elements on structural system- Analysis

of non-structural elements- prevention of non-structural damage- Isolation of non- structures.

UNIT-VI:

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. Behaviour of beam, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquakes.

TEXT BOOKS:

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.

REFERENCES:

1. Seismic Design of Reinforced Concrete and Masonry Building, T. Paulay and M. J. N. Priestly, John Wiley
2. Earthquake Resistant Design and Risk Reduction, D. J. Dowrick, Wiley India
3. Earthquake Resistant Design of Masonry Building, Miha Tomazevic, Imperial College Press
4. Earthquake Tips - Learning Earthquake Design and Construction, C. V. R. Murthy

CODE BOOKS:

1. IS: 1893 (Part 1)- 2016, Criteria for Earthquake Resistant Design of Structures, B.I.S., New Delhi
2. IS: 13920-2016, Ductile Detailing of Concrete Structures Subjected to Seismic Force-Guidelines, B.I.S., New Delhi

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M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST07) DESIGN OF HIGH RISE STRUCTURES

COURSE OBJECTIVES:
- To understand the design aspects of Transmission Towers and Masts
- To understand the analysis and design of Steel and RC Chimneys
- To develop through understanding of the loading and structural forms of Tall Buildings
- To understand the modelling for analysis of Tall Buildings

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Analyze and Design Transmission Line Towers and Masts
CO-2: Analyze and Design Steel Chimney
CO-3: Analyze and Design RC Chimney
CO-4: Understand various loadings and structural forms of Tall Buildings and perform modal analysis

UNIT-I:
Design of Towers and Masts: Introduction, Lattice Tower Configuration and Bracings, Load acting on Lattice Towers, Analysis and Design of Lattice Towers.

UNIT-II:
Masts Transmission Line Towers, Loads on Transmission Line Towers, Effect of Temperature Variation on Conductors and Earth Wires, Analysis and Design of Transmission Line Towers, Foundations for Towers.

UNIT-III:
Design of Steel Chimney: Introduction, Dimensions of Steel Stacks, Chimney Lining, Breech Openings and Access Ladder, Loading and Load Combinations, Design Considerations, Stability Considerations, Design of Base Plate, Design of Foundation Bolts, Design of Foundation.

UNIT-IV:
Design of RC Chimney: 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, Design of RC Chimney.

UNIT-V:
Loading:
Gravity Loading: Methods of Live Load Reduction, Impact Gravity Loading, Construction Loads; Wind Loading: Simple Static Approach, Dynamic Method; Earthquake Loading: Equivalent Lateral Force Procedure, Modal Analysis Procedure.
Structural Form: Braced-Frame, Rigid-Frame, Infilled-Frame, Flat-Plate and Flat- slab, Shear Wall, Wall-Frame, Framed Tube, Outrigger-Braced, Suspended, Core, Space and Hybrid Structures; Floor Systems (Reinforced Concrete): One-Way Slabs on Beams or Walls, One-Way Pan Joists and Beams, One-Way Slab on Beams and Girders, Two-Way Flat Plate, Two-Way Flat Slab, Waffle Flat Slab, Two- Way Slab and Beam; Floor Systems (Steel Framing): One-Way, Two-Way and Three-Way Beam Systems, Composite Steel-Concrete Floor Systems.

UNIT-VI:

Modelling for Analysis: Approaches to Analysis: Preliminary Analyses, Intermediate and Final Analysis, Hybrid Approach to Preliminary and Final Analyses; Assumptions; High-Rise Behaviour; Modelling for Approximate Analyses: Approximate Representation of Bents, Approximate Modelling of Slabs, Modelling for Continuum Analyses; Modelling for Accurate Analysis: Plane Frames, Plane Shear Walls, Three- Dimensional Frame and Wall Structures, P-Delta Effects, The Assembled Model;

Reduction Techniques: Symmetry and Antisymmetry, Two-Dimensional Models of Nontwisting Structures, Two-Dimensional Models of Structures that Translate and Twist, Lumping, Wide-Column Deep-Beam Analogies.

TEXT BOOKS:

1. Comprehensive Design of Steel Structures, Punmia B. C., Jain A. K., and Jain A. K., Laxmi Publications
2. RCC Designs, Punmia B. C., Jain A. K., and Jain A. K., Laxmi Publications

REFERENCES:

1. Tall Building Structures: Analysis and Design, Stafford Smith B. and Coull A., Wiley – Inder Science

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M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST08) STRUCTURAL HEALTH MONITORING

COURSE OBJECTIVES:
- To understand the concepts of health monitoring
- To assess the structural health of the structures using static and dynamic field methods
- To suggest the possible repair and rehabilitation methods
- To perform the Structural Auditing after the investigation

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Diagnosis the distress in the structure understanding the causes and factors
CO-2: Assess the health of structure using static field methods
CO-3: Assess the health of structure using dynamic field tests
CO-4: Suggest repairs and rehabilitation measures of the structure

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.

UNIT-III:
Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

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

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

TEXT BOOKS:
1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons
2. Health Monitoring of Structural Materials and Components - Methods with Applications, Douglas E. Adams, John Wiley and Sons

REFERENCES:
1. Structural Health Monitoring and Intelligent Infrastructure, Vol-1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis
2. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST09) DESIGN OF ADVANCED STEEL STRUCTURES

COURSE OBJECTIVES:
- To analyze bolted and welded eccentric connections
- To sketch the Influence line diagrams for truss members
- To estimate the various types of loads such as Dead, Live and Wind loads on roof trusses
- To determine the shape factor and define the theorems of plastic analysis

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Design the eccentric and moment connections
CO-2: Design the truss members subjected to tension, compression
CO-3: Determine the collapse loads for continuous beams and portal frames
CO-4: Estimate the various types of loads such as Dead, Live and Wind loads on PEB's

UNIT-I:
Eccentric and Moment Connections: Beam-Column connections, Connections subjected to eccentric shear, Bolted framed connections, Bolted seat connections, Bolted bracket connections, Welded framed connections, Welded seat connections, Welded bracket connections, Moment resistant connections

UNIT-II:
Influence Line Diagrams: Introduction, Influence line diagrams for top chord member, bottom chord member, vertical member, diagonal member, Influence line diagrams for stresses in members of a Pratt truss with parallel chords, Warren truss with parallel chords, K-Truss.

UNIT-III:
Roof Trusses: Introduction, Types of roof trusses, Components of a roof truss, Economical spacing of roof trusses, Loads on the roof trusses – Dead load, Live load, Wind load, Analysis of Angular Roof Truss, Tubular Roof Truss, Design of truss members subjected to tension, compression, Design of Purlins.

UNIT-IV:
Introduction to Plastic Theory: Stress-Strain curve for Mild steel, Plastic bending of beams, Stages of bending of rectangular sections, Fully Plastic Moment of a Section, Shape Factor – Rectangular, Triangular, Circular, Hollow circular sections, Moment-Curvature relationships, Plastic Hinge, Load Factor, Theorems of plastic analysis – Static / Lower bound theorem, Kinematic / Upper bound theorem, Uniqueness / Combined theorem

UNIT-V:
Plastic Analysis and Design: Beam mechanism, Sway mechanism, Combined mechanism, Collapse load for standard cases of loadings over beams, Collapse load for continuous beams, Collapse load for portal frames, Design of continuous beams.

UNIT-VI:

Pre Engineered Buildings: Concept of Pre Engineered Buildings, Components of PEB – Primary framing system, Secondary framing system, Roof sheeting, Advantages of PEBs over Conventional Steel buildings, Thumb rules for selection of column, rafter, Loads acting on PEB frames – Dead, Live and Wind loads.

TEXT BOOKS:

1. Limit State Design of Steel Structures, S. K. Duggal, TMH
2. Design of Steel Structures, N. Subramanian, Oxford University Press

REFERENCES:

1. Design of Steel Structures, S. S. Bhavikatti, I. K. International Publishing House Pvt. Ltd.
2. Limit State Design of Steel Structures, V. L. Shaw, Structures Publications
3. Comprehensive Design of Steel Structures, B. C. Punmia, Laxmi Publications
4. Design of Steel Structures – Vol. II, Ram Chandra, Scientific Publishers

CODE BOOKS:

1. IS : 800-2007
2. IS 875
3. Steel Tables

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST10) DESIGN OF MASONRY STRUCTURES

COURSE OBJECTIVES:
- To understand the masonry design approaches
- To understand the principles of design and construction of masonry structures
- To evaluate the strength and stability of the masonry structures
- To summarize the masonry characteristics

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the physical & mechanical properties of masonry and its failure theories
CO-2: Analyze Reinforced Masonry Members
CO-3: Determine interactions between members, shear strength and ductility of Reinforced Masonry members
CO-4: Check the stability of walls and Perform elastic and Inelastic analysis of masonry walls

UNIT-I:
Introduction: Masonry units, materials and types: History of masonry Characteristics of Brick, stone, clay block, concrete block, stabilized mud block masonry units – strength, modulus of elasticity and water absorption. Masonry materials – Classification and properties of mortars, selection of mortars

UNIT-II:
Strength of Masonry in Compression: Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, Failure theories of masonry under compression. Effects of slenderness and eccentricity, effect of rate of absorption, effect of curing, effect of ageing, workmanship on compressive strength.

UNIT-III:
Flexural and Shear Bond: Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength.

UNIT-IV:
Masonry under Lateral Loads: In-plane and out-of-plane loads, Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms. Behaviour of Masonry - Combined bending and axial loads - Reinforced and unreinforced masonry - Cyclic loading and ductility of shear walls for seismic design - Infill masonry.

UNIT-V:
Prestressed Masonry: Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams. Structural design of Masonry - Working and Ultimate strength design - In-plane and out-of-plane design criteria for load-bearing and infills, connecting elements and ties - Consideration of seismic loads - Code provisions.

UNIT-VI:
Earthquake Resistant Masonry Buildings: Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions. Masonry arches, domes and vaults: Components and classification of masonry arches, domes and vaults, historical buildings, construction procedure, Modeling Techniques, Static Push Over

Analysis and use of Capacity Design Spectra.

TEXT BOOKS:

1. Brick and Reinforced Brick Structures, Dayaratnam P., Oxford & IBH Publishing
2. Masonry Structures: Behaviour & Design, Drysdale R. G. Hamid, A. H. and Baker, L.R, Prentice Hall
3. Design of Masonry Structures, A.W. Hendry, B. P. Sinha and Davis S. R., E & F. N. Spon, UK

REFERENCES:

1. Design of Reinforced and Prestressed Masonry, Curtin, Thomas Telford
2. Structural Masonry, Sahlin S., Prentice Hall
3. Reinforced Masonry Design, R. S. Schneider and W.L. Dickey, Prentice Hall
4. Seismic Design of Reinforced Concrete and Masonry Buildings, Paulay, T. and Priestley, M. J. N., John Wiley
5. Design of Reinforced Masonry Structures, Narendra Taly, ICC

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST11) PRE-ENGINEERED BUILDINGS

COURSE OBJECTIVES:
- To distinguish between conventional steel buildings and PEB's
- To identify the Pre-Engineered Building components
- To estimate the loads on Pre-Engineered Buildings
- To identify the various design parameters of PEB frames

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the functions of Primary system, Secondary system and Bracing system of PEB components.
CO-2: Calculate the Dead, Live, Wind and Seismic loads acting on PEB's
CO-3: Check the structural stability of PEB's
CO-4: Analyze and Design the PEB's

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.

UNIT – III:
Design Loads on Pre-Engineered Buildings: Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads. Serviceability Limits as per code.

UNIT – IV:
PEB Design Methodology: 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. Rigid Frame Moment Connection, Shear Connection- Anchor bolt and base plate design (Pinned and Fixed)

UNIT – V:
Structural Stability System of PEB: Shear buckling effect (d/t ratio exceeding 67ε), Effective Cross-sectional area concept for Compression Members d/t ratio exceeding 42ε; Effect of d/t ratio for flexural members according to section classifications, Lateral Torsional Restraint system: Flange Bracing and design considerations. Global and Local behavior of Frame system depending on Slenderness ratio, d/t and b/t ratio, Bracing system: Rod Bracing, Angle Bracing, Portal Bracing,

UNIT – VI:
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, Erection Procedures.

TEXT BOOKS:

1. Pre-Engineered Steel Building, K. S. Vivek and P. Vyshnav, LAMBERT Academic Publishing
2. Metal Building Systems: Design and Specification, Alexander Newman, McGraw Hill

REFERENCES:

1. Pre-engineered Metal Building Iron Worker, Red-Hot Careers, Create Space Independent Publishing Platform
2. Pre-engineered Metal Building Systems, Labsori

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M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2ST02) MODEL TESTING LABORATORY

COURSE OBJECTIVES:

- To distinguish between under reinforced and over reinforced failure
- To retrofit the structural members by external strengthening
- To estimate the load carrying capacity of columns
- To understand the shear and bond characteristics in RC elements

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the failure behavior of under reinforced and over reinforced beams
CO-2: Study the confinement effects in concrete beams and columns
CO-3: Understand the behaviour of columns under compression
CO-4: Estimate the shear capacity and pull-out strength in RC elements

LIST OF EXPERIMENTS:

1. Determination of Pull-out strength of HYSD bar embedded in concrete
2. Flexure test on under reinforced RC beam
3. Flexure test on over reinforced RC beam
4. Evaluation of shear capacity of beams with and without shear reinforcement
5. Determination of flexural characteristics of concrete beam retrofitted with GFRP wrap
6. Evaluation of flexural strength of deteriorated concrete beam with corroded reinforcement
7. Evaluation of compressive strength of concrete cylinders with and without GFRP wraps
8. Estimation of load carrying capacity of an axially loaded RC column
9. Evaluation of tensile strength of GFRP laminates
10. Vibration characteristics of steel flat using PZT sensor

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M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2ST03) STRUCTURAL DESIGN LABORATORY

COURSE OBJECTIVES:
- To understand the importance of writing templates in Excel
- To model the beams, frames and trusses
- To analyze the beams, frames and trusses
- To interpret the results from post processing

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Prepare Excel templates for the design of structural elements
CO-2: Analyze the Beams, Portal Frames and Trusses using Staad Pro
CO-3: Analyze and Design the Multistory RC Buildings for various loads using Staad Pro
CO-4: Determine the stresses in plane stress and plane strain problems using ANSYS

LIST OF EXPERIMENTS:

1. Excel Template for the design of a Two-way Slab
2. Excel Template for the design of an Isolated Square Footing
3. Analysis of Continuous Beams
4. Analysis of Portal Frames
5. Analysis and Design of Steel Truss
6. Analysis of Multistory RC Building for gravity loads
7. Design of Beams and Columns of a Multistory RC Building
8. Analysis of Multistory RC Building for Wind loads
9. Analysis of Multistory RC Building for Seismic loads
10. Stress Analysis of Plane stress problems
11. Stress Analysis of Plane strain problems
12. Stress Analysis of Axi-symmetric problems

Note: Staad Pro / Any other equivalent analysis software may be used

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M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	0	**4**	**2**

(A18PW4ST02) MINI-PROJECT

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the formulated industry / technical / societal problems
CO-2: Analyze and / or develop models for providing solution to industry / technical / societal problems
CO-3: Interpret and arrive at conclusions from the project carried out
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- A student shall undergo a mini-project during II semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on an allotted project topic of his / her choice, critically review the literature, carry out the mini-project, submit it to the department in a prescribed report form.
- Evaluation of the mini-project shall be done by a Project Review Committee (PRC) consisting of the Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- Prior to the submission of mini-project report to the PRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The mini-project report shall be accepted for submission to the PRC only upon meeting the prescribed similarity index.

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M.Tech. II Semester (STRE)	**L**	**T/P**	**C**
	2	**0**	**0**

(A18AU5EN01) ENGLISH FOR ACADEMIC AND RESEARCH WRITING

COURSE OBJECTIVES:

- To understand the usage of appropriate vocabulary (Formal, Informal, Gender Insensitive etc.)
- To understand the features and processes of academic writing
- To identify the resources
- To understand standard documentation styles

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

CO-1: Use appropriate vocabulary (Formal, Informal, Slang, Gender Insensitive etc.)

CO-2: Employ processes of academic writing

CO-3: Identify the resources

CO-4: Understand standard documentation styles

UNIT- I:

Introduction to Research:

i. Identifying the topic
ii. Identifying Sources; Finding Sources
iii. Defining the broad area; Defining the specific area; Difference between a broad area and specific area
iv. Choosing a topic
v. Mechanics of Writing – Language, Tone, Style, Ethics

UNIT-II:

Referencing & Library Skills:

i. Literature Survey
ii. Writing Objectives
iii. Hypothesis
iv. Methodology
v. Prospects for Future Research

UNIT-III:

Academic Writing Skills:

i. Paraphrasing
ii. Summarizing
iii. Quoting
iv. Rewriting
v. Expansion

UNIT-IV:

Kinds of Academic Writing:

i. Essays
ii. Reports
iii. Reviews
iv. SOPs
v. Abstracts
vi. Proposals

UNIT-V:

Research Process:

i. Selection of Topic
ii. Formulation of Hypothesis
iii. Collection of Data
iv. Analysis of Data
v. Interpretation of Data
vi. Presentation of Data

UNIT-VI:

i. Title
ii. Abstract
iii. Introduction
iv. Literature Survey
v. Methodology
vi. Discussion
vii. Findings/Results
viii. Conclusion
ix. Documenting Sources

TEXT BOOKS:

1. Writing for Science, Goldbort R., Yale University Press, 2006
2. Handbook of Writing for the Mathematical Sciences, Highman N., SIAM. Highman's Book, 1998

REFERENCES:

1. How to Write and Publish a Scientific Paper, Day R., Cambridge University Press, 2006
2. English for Writing Research Papers, Adrian Wall Work, Springer New York Dordrecht Heidelberg London, 2011
3. MLA Handbook for Research

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M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST12) REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES

COURSE OBJECTIVES:
- To understand the causes of deterioration of structures
- To understand various non-destructive evaluation tests for assessment of health of a structure
- To know various repair materials and their properties
- To understand various repair strategies for rehabilitation and retrofitting of structures

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify the causes of deterioration of structures
CO-2: Perform various non-destructive evaluation tests and asses the health of a structure
CO-3: Suggest suitable repair material for concrete
CO-4: Suggest suitable repair technique for the rehabilitation of a structure

UNIT-I:
Causes of Deterioration and Durability Aspects: Holistic Model for Deterioration of RCC; Permeability of Concrete: Capillary Porosity, Air Void, Micro and Macro Cracks;
Aggressive Deteriorating Chemical Agents: Corrosion of reinforcing bars, Sulphate Attack, Alkali Silica Reaction, Intrinsic and Extrinsic Causes and Stages of Distress.

UNIT-II:
Condition Survey & Non-Destructive Evaluation: Definition, Objective, Stages, Consideration for Repair Strategy.
Non-Destructive Evaluation Tests: Concrete Strength Assessment: Rebound Hammer Test, Ultrasonic Pulse Velocity (UPV) Test, Penetration Resistance (Windsor Probe & PNR Test), Pull-out (LOK) Test, Core Sampling and Testing; Chemical Tests: Carbonation Test, Chloride Content; Corrosion Potential Assessment: Cover meter survey, Half-cell potential survey, Resistivity Measurement; Fire Damage Assessment: Differential Thermal Analysis (DTA), X-ray Diffraction (XRD); Structural Integrity/Soundness Assessment: Radiography, Impact-echo Test, Dynamic Testing of Structures; Interpretation & Evaluation of test result data.

UNIT-III:
Selection of Repair Materials for Concrete: Essential Parameters for Repair Materials; Materials for Repair: Premixed Cement Concrete/Mortars: Cements, Mineral and Chemical Admixtures, Water Cement Ratio; Epoxies and Epoxy Systems including Epoxy Mortars/Concretes: Epoxies, Modifies Epoxy Systems, Precautions to be taken, Field of Applications; Polyester Resins; Surface Coatings: Essential Parameters for coatings, Types of surface coatings.

UNIT-IV:
Polymer Modified Mortars and Concrete (PMM/PMC): Materials, Process of Polymer Modification in Cement Concrete/Mortar, Composition of Polymers, General Requirements, Classification and Properties of Polymer Latexes, Physical and Mechanical Properties of Polymer Modified Mortars/Concretes, Mix Proportioning, General Guidelines & Precautions for use of Polymer Modified Cement Mortar/Concrete, Field of Applications.

UNIT-V:
Rehabilitation and Retrofitting Methods: Repair options; Performance Requirements of Repair Systems; Important factors to be considered for Selection of Repair Methods; Repair Stages; Repair Methods: Repairs using Mortars, Dry Pack and Epoxy Bonded Dry Pack, Pre-placed Aggregate Concrete (PAC), Shotcrete, Concrete Replacement, Epoxy Bonded Concrete,

Silica Fume Concrete, Polymer Concrete System, Strengthening Concrete by Surface Impregnation using Vacuum Methods, Thin Polymer Overlays, Thin Epoxy Overlays, Resin/Polymer Modified Cement Slurry Injection, Protective Seal Coats on the Entire Surface.

UNIT-VI:

Repair Methods: Ferro-cement, Plate Bonding, RCC Jacketing, Propping and Supporting, Fibre Wrap Technique, Foundation Rehabilitation Methods, Chemical and Electro-chemical Methods of Repair; Repair/Rehabilitation Strategies – Stress Reduction, Repair/Strengthening of Columns, Beams and Slabs, Compressive Strength of Concrete, Cracks/Joints, Masonry, Protection, Foundation, Base Isolation.

TEXT BOOKS:

1. Handbook on Repair and Rehabilitation of RCC Buildings, Director General (Works), Central Public Works Department (CPWD), Government of India Press, New Delhi
2. Concrete – Microstructure, Properties and Materials, Mehta P. K. and Monteiro P. J. McGraw-Hill

REFERENCES:

1. Concrete Structures – Protection, Repair and Rehabilitation, Woodson R. D., Butterworth-Heinemann, Elsevier

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M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST13) BRIDGE ENGINEERING

COURSE OBJECTIVES:
- To understand the bridge hydrology
- To list the components of bridge substructure, superstructure and types of bearings
- To understand the codal provisions for loading and design standards of bridges
- To design RC and PSC bridges

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Determine flood discharge, waterway, economic span
CO-2: Select type of super structure, sub structure and the bearings
CO-3: Calculate the various types of loads acting on the bridges
CO-4: Design the Slab bridges, Girder bridges and Prestressed Concrete bridges

UNIT-I:
Introduction: Components of a bridge, Classification of bridges, Requirements of an ideal bridge, Selection of bridge site, Choice of bridge type, Investigation for bridges
Bridge Hydrology: Determination of flood discharge, Waterway, Economic span, Scour depth, Depth of foundation, Afflux, Clearance, Freeboard

UNIT-II:
Bridge substructure and Super Structure: Bridge Piers, Abutments, Wing walls, Approaches, Types of bridge superstructures, Bridge flooring, Choice of superstructure type

UNIT-III:
Standards of Loadings for Bridge Design: Types of loading for Road bridges – Dead load, Live load, Impact load, Wind loads, Lateral loads, Longitudinal forces, Centrifugal forces, Seismic loads, Forces due to water currents, Earth pressure, Buoyancy, Temperature stresses, Deformation stresses, Erection stresses, Requirements of traffic in the design of highway bridges

UNIT-IV:
Reinforced Concrete Bridges: Design of Slab bridge, Design of Girder bridge, Courbon's theory.

UNIT-V:
Prestressed Concrete Bridges: Types of prestressing – Pre tensioning, Post tensioning, Pretensioned PSC bridges, Post tensioned PSC bridges

UNIT – VI:
Bridge Bearings and Expansion Joints: Functions, types and selection of bearings - Bearing materials - Design of elastomeric bearings for different conditions - Expansion joints – types of expansion joints.

TEXT BOOKS:
1. Principles and Practice of Bridge Engineering, S. P. Bindra, Dhanpat Rai Publications
2. Design of Concrete Bridges, M. G. Aswani, V. N. Vazirani, M. M. Ratwani, Khanna Publishers

REFERENCES:
1. Essentials of Bridge Engineering, D. J. Victor, Oxford & IBH Publishing Co.
2. Design of Bridge Structures, T. R. Jagdeesh and M. A. Jayaram, PHI

3. Bridge Engineering, S. Ponnuswamy, TMH
4. Analysis and Design of Substructures, Swami Saran, Oxford & IBH Publishing Co.

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M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1ST14) CONSTRUCTION TECHNOLOGY AND PROJECT MANAGEMENT

COURSE OBJECTIVES:
- To understand role of project management
- To learn preparation of project schedules and life cycle cost
- To learn about critical construction management
- To understand about on BOT, BOOT & PP projects

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Develop organization structure of construction company
CO-2: Estimate project cost and develop cost Models
CO-3: Prepare contract documents
CO-4: Interpret the contract in case of inconsistency and solve post contract problems

UNIT-I:
Introduction to Project Management: Construction as industry and its challenges, Role of Project management, systems approach, systems theory and Concepts, Organisation, Management Functions, Overview of Management Objectives, Tools and Techniques, Life cycle of construction projects, time estimates and construction schedules, CPM and PERT, Linear programming, queuing concept, simulation, bidding models, game theory

UNIT-II:
Project Cost Estimation: Approximate cost, detailed cost estimates, administrative approval and expenditure sanctions, rate analysis by client and contractor, bidding processes and strategies, Pre-qualification of bidders

UNIT-III:
Construction Equipment: Equipment economics, Excavators, Rollers, Dozers, Scrapers, Handling equipment, Concrete equipment, Cranes, Draglines and Clamshells. various items of construction : Earthwork, Excavation, Earth- moving, Drilling, Blasting, dewatering, foundation, Finishing items

UNIT-IV:
Contract Management: Why law is critical to construction management, contract, its definition, Indian contract Act, documents forming a contract, Tendering and contractual procedures, stages of awarding contract, general conditions of Indian (domestic) contracts, General conditions of International contracts (FIDIC), contract administration; Duties and responsibilities of parties; important site documents, importance of standards and codes in contract documents.

UNIT-V:
Quality Management and Safety in Construction Industry: Quality control by statistical methods, sampling plan, control charts, ISO standards, Safety Measures, Personnel, Fire and Electrical safety, Safety Programmes, Safety Awareness and Implementation of Safety Plan - Compensation

UNIT-VI:
Interpretation of Contract: Interpretation of contract in case of inconsistency, post contract problems, contract interpretation, concealed conditions, termination of contract, claims and disputes, dispute resolution techniques, negotiations, arbitration and settlement of disputes, arbitration and conciliation Act, alternate dispute resolutions, delay, liquidated damages, actual damages.

TEXT BOOKS:

1. A Guide to Quantity Surveyors, Engineers Architects and Builders (Vol. I: Taking Off Quantities, Abstracting & Billing; Vol II: Analysis of Prices), Kharb K. S.
2. Construction Project Management, K. K. Chitkara, Tata McGraw Hill Education

REFERENCES:

1 Construction Technology, Subir K. Sarkar, Subhajit Saraswati, Oxford University Press
2 Construction Project Management – Theory and Practice, Kumar Neeraj Jha, Pearson Education
3 Project Planning and Control with PERT and CPM, B. C. Punmia, K. K. Khandelwala, Laxmi Publications
4 Construction Planning & Management, U. K. Srivastava, Galgotia Publications

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M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1CN01) BUSINESS ANALYTICS

COURSE OBJECTIVES:

- To understand the role of business analytics within an organization and to analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making and to become familiar with processes needed to develop, report, and analyze business data
- To use decision-making tools/Operations research techniques and to manage business process using analytical and management tools
- To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply knowledge of data analytics
CO-2: Think critically in making decisions based on data and deep analytics
CO-3: Use technical skills in predicative and prescriptive modeling to support business decision-making
CO-4: Translate data into clear, actionable insights

UNIT-I:
Business Analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data Business Analytics Technology.

UNIT-III:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT-VI:

Recent trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. Business Analytics-Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics, James Evans, Pearson Education
3. Business Analytics, Purba Halady Rao, PHI, 2013

REFERENCES:

1. Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, Gert H. N. Laursen, Jesper Thorlund, 2nd Edition, Wiley Publications
2. Business Analytics: Data Analysis & Decision Making, S. Christian Albright, Wayne L. Winston 5th Edition, 2015
3. Business Intelligence Guidebook: From Data Integration to Analytics, Rick Sherman Elsevier, 2014

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM01) INDUSTRIAL SAFETY

COURSE PRE-REQUISITES: Elements of Mechanical, Civil, Electrical and Industrial Engineering

COURSE OBJECTIVES:

- To achieve an understanding of principles, various functions and activities of safety management
- To communicate effectively information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities
- To anticipate, recognize, and evaluate hazardous conditions and practices affecting people, property and the environment, develop and evaluate appropriate strategies designed to mitigate risk
- To develop professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries

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

CO-1: Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards

CO-2: Communicate effectively on health and safety matters among the employees and with society at large

CO-3: Demonstrate the use of state-of-the-art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations

CO-4: Interpret and apply legislative / Legal requirements, industry standards, and best practices in accident prevention programmes in a variety of workplaces

UNIT-I:

Safety Management: Evaluation of modern safety concepts – Safety management functions – safety organization, safety department – safety committee, safety audit - performance measurements and motivation – employee participation in safety and productivity.

UNIT-II:

Operational Safety: Hot metal Operation – Boiler, pressure vessels – heat treatment shop - gas furnace operation-electroplating-hot bending pipes – Safety in welding and cutting. Cold-metal Operation- Safety in Machine shop-Cold bending and chamfering of pipes – metal cutting – shot blasting, grinding, painting – power press and other machines

UNIT-III:

Safety Measures: Layout design and material handling - Use of electricity – Management of toxic gases and chemicals – Industrial fires and prevention – Road safety– Safety of sewage disposal and cleaning – Control of environmental pollution – Managing emergencies in industrial hazards.

UNIT-IV:

Accident Prevention: Human side of safety – personal protective equipment – Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP – Training and development of employees – First Aid – Firefighting devices – Accident reporting investigation.

UNIT-V:

Safety, Health, Welfare & Laws: Safety and health standards – Industrial hygiene – occupational diseases prevention - Welfare facilities – History of legislations related to safety–

pressure vessel act- Indian boiler act- The environmental protection act – Electricity act - Explosive act.

UNIT-VI:

Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers

TEXT BOOKS:

1. Safety Management, John V. Grimaldi and Rollin H. Simonds, All India Travellers Bookseller, New Delhi, 1989
2. Safety Management in Industry, Krishnan N. V., Jaico Publishing House, 1996

REFERENCES:

1. Occupational Safety Manual, BHEL
2. Industrial Safety and The Law, P. M. C. Nair Publisher's, Trivandrum
3. Managing Emergencies in Industries, Loss Prevention of India Ltd., Proceedings, 1999
4. Safety Security and Risk Management, U. K. Singh & J. M. Dewan, A. P. H. Publishing Company, New Delhi, 1996
5. Industrial Safety Management: Hazard Identification and Risk Control, L. M. Deshmukh, McGraw-Hill Education (India) Private Limited, 2005

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M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM02) OPERATIONS RESEARCH

COURSE PRE-REQUISITES: Mathematics, Industrial Engineering

COURSE OBJECTIVES:
- To analyze linear programming models in practical and their practical use
- To apply the transportation, assignment and sequencing models and their solution methodology for solving problems
- To apply the theory of games, replacement, inventory and queuing models and their solution methodology for solving problems
- To evaluate the dynamic programming and simulation models

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply and solve the dynamic programming problems
CO-2: Apply the concept of non-linear programming
CO-3: Carry out sensitivity analysis
CO-4: Model the real-world problem and simulate it

UNIT-I:
Introduction to Operations Research-Definitions of OR, Characteristics of OR, Scope of OR, Classification of Optimization Techniques, models in OR, General L.P Formulation, Graphical solution, Simplex Techniques.

UNIT-II:
Revised simplex method - duality theory - dual simplex method – sensitivity or post optimality analysis - parametric programming

UNIT-III:
Nonlinear programming problem - Kuhn-Tucker condition, min cost flow problem - max flow problem - CPM/PERT

UNIT-IV:
Scheduling and sequencing, Inventory models, deterministic inventory, models - Probabilistic inventory control models - Geometric Programming.

UNIT-V:
Waiting line Models, Single and Multi-channel Problems, Dynamic Programming, Game Theory, Simulation.

UNIT-VI:
Introduction to Genetic Algorithms, Operators, applications to engineering optimization, Problems.

TEXT BOOKS:
1. Operations Research, S. D. Sharma, Kedarnath Ramnath, Meerut, New Delhi
2. Engineering Optimization, S. S. Rao, New Age International Publications, 2014
3. Introduction to Genetic Algorithms, S. N. Sivanandam, Springer

REFERENCES:
1. Operations Research-An Introduction, H. A. Taha, PHI, 2008
2. Principles of Operations Research, H. M. Wagner, PHI, Delhi, 1982
3. Introduction to Optimization: Operations Research, J. C. Pant, Jain Brothers, Delhi, 2008

4. Operations Research, Hitler Liebermann McGraw-Hill Pub., 2009
5. Operations Research, Pannerselvam, Prentice Hall of India, 2010

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M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM03) COMPOSITE MATERIALS

COURSE PRE-REQUISITES: Maths, Physics, Chemistry, Engineering Mechanics, Mechanics of Solids

COURSE OBJECTIVES:
- To understand composite materials and their properties, relationship between them and manufacturing methods
- To understand the principles of material science applied to composite materials
- To study the equations to analyze problems by making good assumptions and learn systematic engineering methods to solve practical composite mechanics problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply fundamental knowledge of mathematics to modeling and analysis of composite materials
CO-2: Understand the manufacturing methods of various composite materials
CO-3: Analyze the failure modes of composites

UNIT-I:
Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT-II:
Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements.
Mechanical Behavior of Composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT-III:
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications.
Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT-IV:
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications, Introduction to Machining of Composites.

UNIT-V:
Elastic Behavior of Laminate: Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates

UNIT-VI:
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight

strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology, Vol. 13–Composites, R. W. Cahn – VCH, West Germany
2. Analysis and Performance of Fiber Composites, Third Edition, B. D. Agarwal, Wiley Publishers

REFERENCES:

1. Mechanics of Composite Materials, Second Edition. Robert M. Jones, Scripta Book Company
2. Materials Science and Engineering-An Introduction, W. D. Callister Jr., Adapted by R. Bala Subramaniam, John Wiley & Sons, NY, Indian Edition, 2007
3. Composite Materials, K. K. Chawla
4. Composite Materials Science and Applications, Deborah D. L. Chung
5. Composite Materials Design and Applications, Danial Gay, Suong V. Hoa and Stephen W. Tasi

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M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1PS01) WASTE TO ENERGY

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To create awareness in students of energy conservation
- To identify the use of different types of Bio waste energy resources
- To understand different types of bio waste energy conservations
- To detect different waste conversion into different forms of energy

COURSE OUTCOMES: After completion of the course, students should be able to
CO1: Find different types of energy from waste to produce electrical power
CO2: Estimate the use of bio waste to produce electrical energy
CO3: Understand different types of bio waste and its energy conversions
CO4: Analyze the bio waste utilization to avoid the environmental pollution

UNIT-I:
Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW (Municipal solid waste) – Conversion devices – Incinerators, Gasifiers, Digestors

UNIT-II:
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III:
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV:
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V:
BiogaS: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion.

UNIT-VI:
Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS:
1. Biogas Technology-Transfer and Diffusion, M. M. EL-Halwagi, Elsevier Applied Science Publisher, New York, 1984
2. Introduction to Biomass Energy Conversions, Sergio Capareda

REFERENCES:

1. Non-Conventional Energy, Desai Ashok V., Wiley Eastern Ltd., 1990
2. Biogas Technology - A Practical Handbook, Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw-Hill Publishing Co. Ltd., 1983
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

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M.Tech. III Semester (STRE)	**L**	**T/P**	**C**
	0	**16**	**8**

(A18PW4ST03) PROJECT PART-I

M.Tech. IV Semester (STRE)	**L**	**T/P**	**C**
	0	**28**	**14**

(A18PW4ST04) PROJECT PART-II

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify and formulate the problem (Industry/technical/societal)
CO-2: Analyze, design and develop a solution to industry/technical/societal problems
CO-3: Implement and execute the solution
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- M.Tech. project work shall be for a minimum duration of 40 weeks spread over two semesters i.e., Project Part-I in III semester and Project Part-II in IV semester.
- A student shall be permitted to register for the major project after satisfying the attendance requirement in all the courses, i.e., theory and practical courses.
- Project reviews namely Project Review I and Project Review II in III semester and Project Review III and Project Pre-submission Seminar in IV semester shall be conducted during the course of Project work.
- A Project Review Committee (PRC) consisting of the Head of the Department as Chairperson and PG Coordinator, Project Supervisor and one senior faculty member of the Department offering the M. Tech. programme as members shall evaluate the progress of project work.
- In Project Review I, a student, in consultation with his Project Supervisor, shall present the title, objective and plan of action of his/her project work to the PRC for approval within four weeks from the commencement of III semester.
- A student can initiate the project work only after obtaining the approval of the PRC.
- The work on the project shall be initiated at the beginning of the III semester.
- Project Review II shall be conducted and evaluated at the end of the III semester.
- Project Review III shall be conducted during IV semester to examine the overall progress of the project work.
- A project pre-submission seminar shall be conducted to decide whether or not the project is eligible for final submission.
- After approval from the PRC, a soft copy of the thesis shall be submitted for PLAGIARISM check to the Examination Branch.
- At the end of IV semester upon fulfilling the above conditions, project viva-voce shall be conducted.
- A student shall submit project progress in prescribed report format during each of the project reviews.