MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.Tech in Computer Aided Structural Engineering
Scheme of Instruction and Examination
Effective from Academic Year 2022-23 Admitted Batch
(Choice Based Credit System)

I - SEMESTER

S.No	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P	CIE	SEE		
1	CE101PC	Theory of Elasticity and Plasticity	3	0	0	40	60	3	3
2	CE102PC	Advanced Structural Mechanics	3	0	0	40	60	3	3
3	CE11XPE	Professional Elective-I	3	0	0	40	60	3	3
4	CE11XPE	Professional Elective-II	3	0	0	40	60	3	3
5	CE101MC	Research Methodology & Intellectual Property Rights	2	0	0	40	60	3	2
6	AC10XHS	Audit Course - I	2	0	0	40	60	3	0
7	CE151PC	Computer Aided Design Laboratory	0	1	2	40	60	3	2
8	CE152PC	Numerical Analysis Laboratory	0	1	2	40	60	3	2
Total Hours/Marks/Credits			**16**	**2**	**4**	**320**	**480**		**18**

II - SEMESTER

S.No	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P	CIE	SEE		
1	CE201PC	Finite Element Analysis	3	0	0	40	60	3	3
2	CE202PC	Structural Dynamics	3	0	0	40	60	3	3
3	CE21XPE	Professional Elective-III	3	0	0	40	60	3	3
4	CE21XPE	Professional Elective-IV	3	0	0	40	60	3	3
5	AC20XHS	Audit Course – II	2	0	0	40	60	3	0
6	CE251PC	Structural Engineering Laboratory	0	1	2	40	60	3	2
7	CE252PC	FE Analysis and Design Studio	0	1	2	40	60	3	2
8	CE253PC	Mini Project with Seminar	0	0	4	100	--	-	2
Total Hours/Marks/Credits			**14**	**2**	**8**	**380**	**420**		**18**

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination.

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III - SEMESTER

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P	CIE	SEE		
1	CE31XPE	Professional Elective-V	3	0	0	40	60	3	3
2		Open Elective	3	0	0	40	60	3	3
3	CE351PC	Dissertation Work Review –II	0	0	12	100	--	-	6
		Total Hours/Marks/Credits	**6**	**0**	**12**	**180**	**120**		**12**

IV - SEMESTER

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P	CIE	SEE		
1	CE451PC	Dissertation Work Review -III	0	0	12	100	--	-	6
2	CE452PC	Dissertation Viva-Voce	0	0	28	-	100	-	14
		Total Hours/Marks/Credits	**0**	**0**	**40**	**100**	**100**		**20**

L: Lecture **T**: Tutorial **P**: Practical
CIE - Continuous Internal Evaluation **SEE** - Semester End Examination

List of Professional Electives

Professional Elective-I
CE111PE: Computer Aided Applications in Structural Engineering
CE112PE: Special Concretes
CE113PE: Design of High-Rise Buildings

Professional Elective-II
CE114PE: Advanced Reinforced Concrete Design
CE115PE: Computer Oriented Numerical Methods
CE116PE: Structural Reliability

Professional Elective-III
CE211PE: Advanced Structural Steel Design
CE212PE: Theory of Plates and Shells
CE213PE: Structural Stability

Professional Elective-IV
CE214PE: Programming for Structural Analysis and Design
CE215PE: Advanced Pre Stressed Concrete Design
CE216PE: Structural Health Monitoring

Audit Courses

Audit Course-I
AC101HS: English for Research Paper Writing
AC102HS: Sanskrit for Technical Knowledge
AC103HS: Stress Management by yoga
AC104HS: Constitution of India

Audit Course-II
AC201HS: Disaster Management
AC202HS: Value Education
AC203HS: Pedagogy Studies
AC204HS: Personality Development through Life Enlightenment Skills

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
CE101PC: THEORY OF ELASTICITY AND PLASTICITY

Prerequisites: Strength of Materials I & II

Course Objectives :

1. To define stresses, strains, equilibrium and compatibility
2. To derive the governing equilibrium equations in Two-dimensional & in three dimensionalproblems
3. To understand stress -strain relationships
4. To apply the concepts of elasticity & Plasticity to solve Structural Engineering problems

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

1. Understand the concepts and definitions of elasticity
2. Develop the analytical ability to analyse strain in engineering problems
3. Solve problems using strain relationship in 2D and 3D.
4. Understand the usage of Airy's stress function in 2D problems and are equipped with the knowledge of various theories of torsion of prismatic bars of various cross sections and can solve the problems of torsion
5. Solve plasticity problems in structural engineering

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

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

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

UNIT - IV
Solution of 2D and 3D elasticity problems: Problem solving using stress function approach: Beam bending problems – Symmetric stress distribution problems, Plane problems.
Torsion problems in Elasticity – Membrane analogy approach – Application to non- circular thin walledsections

UNIT - V

Plasticity: Introduction to plasticity – Yield criteria for pressure dependent and independent materials
– Tresca's criterion – Von mises criterion – Mohr-Coulomb criterion -Rankine criterion -Flow rule – Associative and Non-Associative-Hardening rules and consistency conditions -Introduction to iterative and return mapping.

REFERENCES:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
CE102PC: ADVANCED STRUCTURAL MECHANICS

Pre-requisites: Structural Analysis I & II

Course Objectives

1. To learn the unsymmetrical and symmetrical bending of the beams with deflections
2. To analyse the curved beams and beams on elastic foundations
3. To understand the deflection response of columns against compressive loads and inelastic buckling
4. To obtain the global stiffness matrix by assembling the element stiffness matrices.
5. To analyse the trusses, beams and frames by direct stiffness method

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

1. Calculate the deflections of symmetrical and unsymmetrical bending of the beams
2. Understand the behaviour of curved beams and beams on elastic foundations
3. Determine the capacity of a columns due to local buckling and inelastic buckling
4. Solve the Trusses, Continuous beams, Portal frames using element approach of stiffnessmethod
5. Solve the Trusses, Continuous beams and frames using direct stiffness method

UNIT - I
Unsymmetrical Bending:
Definition of Shear Center in Bending - Symmetrical and Nonsymmetrical Bending - Bending Stressesin Beams Subjected to Nonsymmetrical Bending - Deflections of Straight Beams Subjected to Nonsymmetrical Bending

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

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

UNIT - IV
Introduction to matrix methods of analysis: Static indeterminacy and kinematic indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement

equations-Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates - Assembly of stiffness matrix from element stiffness matrix – Analysis of trusses, beams and frames by stiffness matrix methods

UNIT - V

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

REFERENCES:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING

I – SEMESTER

CE111PE: COMPUTER AIDED APPLICATIONS IN STRUCTURAL ENGINEERING

(Professional Elective – I)

Pre-requisites: Structural Analysis I & II

Course Objectives

1. Understand computer hardware, software requirements, design process and graphics
2. Formulate stiffness matrix for beams and frames
3. Explain fundamentals of FEA.
4. Understand design optimization and expert systems

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

1. Explain design process
2. Formulate stiffness matrix for beams and frames
3. Apply fundamentals of FEA for solving structural analysis problems
4. Perform design optimization
5. Understand Knowledge based expert systems.

UNIT - I:

Introduction: Fundamentals of CAD - Hardware and software requirements - Design process - Applications and benefits - Graphic primitives - Transformations -Wire frame modeling and solid modeling -Graphic standards –Drafting packages.

UNIT - II:

Structural Analysis: Structural analysis – stiffness matrix method; Application to beams and frames

UNIT - III:

Finite Element Analysis: Fundamentals of finite element analysis – Discretization -Types of elements – shape function –plane stress and plane strain problems Analysis packages and applications.

UNIT - IV:

Design and Optimization: Principles of design of steel and RC Structures -Applications to simple design problems – Various Optimization techniques - Algorithms - Linear Programming – Evolutionary Algorithms

UNIT - V:

Expert Systems: Introduction to artificial intelligence - Knowledge based expert systems -Rules and decision tables –Inference mechanisms - Simple applications.

REFERENCES:

1. CAD/CAM, Computer Aided Design and Manufacturing by Groover M.P. and Zimmers E.W.Jr., Prentice Hall of India Ltd, New Delhi, 1993.
2. Computer Aided Design by Krishna moorthy C.S.Rajeev S., Narosa Publishing House, NewDelhi, 1993
3. Structural Analysis and Design by Harrison H.B., Part I and II Pergamon Press, Oxford, 1990.
4. Optimization Theory and Applications by Rao S.S., Wiley Eastern Limited, New Delhi, 1977.

5. Expert System Principles and Case Studies by Richard Forsyth (Ed), Chapman and Hall,London, 1989.
6. Computational structural mechanics by S. Rajasekaran, G. Sankara subramanian, PHILearning, 2001

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
CE112PE: SPECIAL CONCRETES (Professional Elective – I)

Course Objectives:

1. To recognize the effects of the rheology and early age properties of concrete on its longtermbehavior
2. To design economic concrete mix proportions for the given exposure conditions and with theavailable materials, for the desired strength and performance criteria
3. To design economic concrete mix proportions for special concretes
4. To use advanced techniques for Service Life assessment of Concrete Structures

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

1. Understand the rheology properties of cement on its long term behaviour
2. Design an appropriate economic cementitious composite based on the performancerequirements
3. Perform mix designs to develop special concretes and evaluate their properties
4. Understand the principles of concrete mix design
5. Assess the service life of an existing structure through determining the mechanical, durabilityand the current state of corrosion of reinforcement in concrete

UNIT - I

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-spaceratio - Maturity concept - Stress Strain behavior, Creep and Shrinkage.

UNIT - II

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

UNIT -III

Advanced Concrete Design: 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 -IV

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 - V

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.

REFERENCES :

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
3. Civil Engineering Materials by Shan Somayaji, Pearson Publishers, 2000
4. Corrosion of Steel in Concrete, P. Schiessl, Chapman & Hall
5. Concrete Making Materials, Sandor Popovics, Hemisphere Publishing Corporation
6. Aggregates in Concrete, Mark Alexander & Sydney Mindess, Taylor & Francis 4. CementBased Composites, Andrzej M. Brandt

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
CE113PE: DESIGN OF HIGH-RISE BUILDINGS (Professional Elective – I)

Pre-requisites: Structural analysis I and II

Course Objectives :

1. To understand the loading and design aspects of Tall structures
2. To understand the analysis and design of high rise frames with shear walls
3. To develop the modellig for approximate analysis and accurate analysis of Tall Buildings
4. To understand the resisting capacity of tall buildings against shear flow and prestressing
5. To understand the stability of a building for P-Delta analysis

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

1. Analyze and Design of Tall buildings with various types of loadings
2. Analyze and Design of high rise structures with shear walls
3. Understand the model analysis of tall buildings for approximate and accurate analysis
4. Calculate the resisting capacity of a tall building against shear flow and prestressing
5. Understand the torsional instability of tall buildings and effect of foundation rotation

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

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

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

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

UNIT - V

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

REFERENCES:

1. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.
2. Beedle.L.S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
3. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wileyand Sons, Inc., 2005.
4. Gupta.Y.P.(Editor), Proceedings of National Seminar on High Rise Structures - Design andConstruction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
5. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”,John Wiley, 1988.

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING

I – SEMESTER

CE114PE: ADVANCED REINFORCED CONCRETE DESIGN (Professional Elective – II)

Pre-requisites: Design of Reinforced Concrete Structures

Course Objectives :

1. To understand the concept of limit state design
2. To understand the various types of loads in current codes of practice for the design
3. To understand the Design concepts of structural elements
4. To analyze and Design advanced structural elements

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

1. Explain the concept of limit state design
2. Understand and explain the analysis of advanced structural elements
3. Apply the yield line method and various codal provisions of different limit states for the design of slabs
4. Design of members for shear, bond and torsion
5. Design of short and long columns

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

REFERENCES :

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

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3	0	0	3

M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
CE115PE: COMPUTER ORIENTED NUMERICAL METHODS (Professional Elective –II)

Pre-requisites: Mathematics I and II

Course Objectives:

1. To achieve fundamental understanding of stability criteria
2. To determine stability of columns and frames under different loading conditions
3. To determine stability of beams and plates under different loading conditions
4. To understand various theories of inelastic buckling

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

1. Apply numerical methods to find the roots of an equation
2. Identify mathematical model for solution of common engineering problems
3. Formulate simple problems using finite difference method
4. Apply numerical differentiation and numerical integration for engineering problems
5. Solve ordinary and partial differential equations

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

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

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

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

UNIT - V:

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

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE116PE: STRUCTURAL RELIABILITY (Professional Elective – II)

Course Objectives :

1. To acquire basic knowledge of Statistics and Probability Theory
2. To understand resistance distribution and parameters
3. To develop the ability to do computation of structural reliability
4. To understand reliability design criteria

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

1. Understand Basics of Statistics and explain Probability Theory
2. Characterize the dimensional variations of materials
3. Explain and apply Monte Carlo method
4. Explain and apply First-order second-momentmethods
5. Develop reliability-based designs

UNIT - I

Concepts of Structural Safety: General - Design methods- Basic Statistics: Introduction -Data reduction – Histograms - Sample correlation - Probability Theory: Introduction, Random events - Random variables - Functions of random variables - Moments and expectation - common probabilitydistribution - Extremal distribution.

UNIT - II

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

UNIT - III

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

UNIT - IV

Reliability Methods: Introduction - Basic variables and failure surface - First-order second-momentmethods (FOSM)

UNIT - V

Reliability Based Design: Introduction - Determination of partial safety factors - Safety checking formats - Development of reliability-based design criteria - Optimal safety factors -Summary of resultsof study for Indian standard – RCC Design.

REFERENCES:

1. R. Ranganathan, Structural Reliability Analysis and Design, Jaico Publishing House, 2006.
2. R.E. Melchers, Structural Reliability – Analysis & Prediction, 2/e, Wiley – Blackwell, 1999.
3. Maurice Lemaire, Structural Reliability,Wiley (2009).
4. Dan M. Frangopol, Mitsuo Kawatani & Chul-Woo Kim, Reliability and Optimization of Structural Systems, Taylor & Francis (2006)

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING

I – SEMESTER

CE101MC: RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS

Course Objectives :

1. To understand the research problem
2. To know the literature studies, plagiarism and ethics
3. To get the knowledge about technical writing
4. To analyze the nature of intellectual property rights and new developments
5. To know the patent rights

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

1. Understand research problem formulation.
2. Analyze research related information
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrowworld will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. Understand that IPR protection provides an incentive to inventors for further research work andinvestment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT- I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation,Necessary instrumentations

UNIT- II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT- III:

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

UNIT- IV:

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

UNIT- V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent

System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES :

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New TechnologicalAge”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING

I – SEMESTER

AC101HS: ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I)

Prerequisite: None

Course Objectives :

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

UNIT-I:

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

UNIT-II:

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

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

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

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
AC102HS: SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I)

Prerequisite: None

Course Objectives :

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

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

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

UNIT-I:
Alphabets in Sanskrit,

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

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

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

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
AC103HS: STRESS MANAGEMENT BY YOGA (Audit Course - I)

Prerequisite: None

Course Objectives :

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

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

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

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

UNIT-II:
Yam and Niyam.

UNIT-III:
Do`s and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:
Asan and Pranayam

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

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
AC104HS: CONSTITUTION OF INDIA (Audit Course - I)

Prerequisite: None

Course Objectives :

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

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

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

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

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

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

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

UNIT-V:

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

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING

I – SEMESTER

CE151PC: COMPUTER AIDED DESIGN LABORATORY

Pre-Requisites:

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

Course Objectives :

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

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

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

List of Experiments:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
I – SEMESTER
CE152PC: NUMERICAL ANALYSIS LABORATORY

Course Objectives:

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

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

1. Analyze the beams by solving a system of equations
2. Apply the concepts of FDM and FEM to solve Structural Engineering Problems
3. Generate the best fit curves, Sketch the basic 2D, 3D plots

List of Experiments:

1. Overview of MATLAB, Matrix operations (Addition, Subtraction, Multiplication, Transpose)
2. Solution of simultaneous equations using matrix inversion
3. Solution of system of linear equations using Gauss Elimination method
4. Solution of System of linear equations using Gauss Seidal iteration Method
5. Finding the Roots of non-linear equations using Newton – Raphson Method
6. Finding the Solution of an Eigen Value problem
7. Numerical Integration using Trapezoidal & Simpson's Rule
8. Numerical solution of ordinary differential equations by Runge- Kutta method
9. Numerical solution of second and higher order differential equations
10. Plotting Simple Graphs, Basic 2D Plots, 3D Plots

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE201PC: FINITE ELEMENT ANALYSIS

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

1. About the fundamentals of domain discretization, interpolation, application of boundary conditions, assembly of global matrices, and solution of the resulting algebraic systems.
2. Understand the core concepts of variational and weighted residual methods in FEM.
3. Derive the element stiffness matrix for 1-D, 2-D and 3-D problems.
4. Formulate the simple structural problems in to finite elements.

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

1. Build and analyse the FEA models for various engineering problems.
2. Identify the requirements and sources for analysis, design and evaluation.
3. Formulation of shape functions for isoparametric elements
4. Use the standard finite element software to solve the structural engineering problems.
5. Interpret the results obtained from FEA software, and arrive at the conclusions

UNIT – I

Introduction to FEM: Types of Problems – Types of Materials – Elastic / Inelastic situations – Types of forces: Body forces / Surface Traction / Point loads – Deformable bodies – Types of Deformations –Homogeneous / Non homogeneous Problems – Equations of equilibrium for elastic 2-D / 3-D continua

- Equilibrium equations for 2-D / 3-D boundary elements – Boundary conditions – Strain-displacement relation for 2-D / 3-D – Stress-strain relation for 2-D / 3-D – Plane stress / Plane strain problems.

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

UNIT – II

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

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

-Numerical Examples

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

-Numerical Examples

UNIT – III

Iso-parametric elements:

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

UNIT – IV

Finite element formulation for 3 -D elements:

FE Formulation for Tetrahedral and Hexahedral elements**:** Volume coordinates, Strain-displacement matrix, stiffness matrix, load matrices due to body force and surface traction/ introduction to Hexahedron(brick) elements,Galerkin's Method of Weighted Residuals – Application to problems of mathematics / structural engineering, number of trial functions not exceeding two.

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

UNIT – V

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

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE202PC: STRUCTURAL DYNAMICS

Prerequisites: Structural Analysis I & II, Mathematics

Course Objectives :

1. To know the fundamental concepts of dynamic analysis
2. To understand SDOF systems under dynamic load.
3. To identify degrees of freedom of MDOF systems and their responses
4. To learn the methods of practical vibrational analysis and generate responses.

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

1. Apply the fundamental concepts and definitions used in structural dynamics
2. Determine the natural frequency of SDOF systems under dynamic loads using Duhamel's integral
3. Determine the natural frequency and mode shapes of MDOF
4. Apply practical vibrational analysis methods and obtain the dynamic parameters
5. Determine the response of continuous system

UNIT - I:

Theory of Vibrations: Introduction - Elements of vibratory system - Degrees of Freedom - Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. – Fundamental objectives of dynamic analysis -Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.

UNIT - II

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

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

UNIT - III

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

UNIT - IV

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

UNIT - V

Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions.

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE211PE: ADVANCED STRUCTURAL STEEL DESIGN (Professional Elective – III)

Pre-requisites: Design of Steel Structures & Structural Analysis

Course Objectives :

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

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

1. Understand and design of simple connections
2. Determine the collapse loads for continuous beams and portal frames
3. Design the eccentric and moment connections
4. Analyse and Design of industrial buildings
5. Design of steel truss bridges

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

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

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

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

UNIT - V

Design of Steel Truss Girder Bridges:

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

REFERENCES:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE212PE: THEORY OF PLATES AND SHELLS (Professional Elective – III)

Pre-requisites: Theory of Elasticity, Structural Analysis

Course Objectives :

1. To understand the behaviour of Rectangular and circular Plates subjected to various loading
2. To understand the behaviour of various types of Shells subjected to various loading
3. To study the analysis procedures for plates and shells
4. To study the analysis of folded plates

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

1. Understand the basic concepts of shells and plates
2. Use analytical and numerical techniques for the solution of thin rectangular plates
3. Use analytical and numerical techniques for the solution of circular plates
4. Apply the numerical techniques for the complex problems in shells
5. Apply and design axi symmetrical shells and shells of double curvature

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation.
Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugges simulations equations.

UNIT - V

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

REFERENCES:

1. Theory of Plates & Shells –Stephen, P. Timoshenko, S. Woinowsky-Krieger – Tata MC GrawHill Edition

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE213PE: STRUCTURAL STABILITY (Professional Elective –III)

Pre-requisites: RCC Design and Analysis

Course Objectives :

1. To derive the differential equations for beam-columns
2. To understand the elastic buckling of bars and frames
3. To understand the Torsional Buckling
4. To analyze lateral buckling of beams and plate

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

1. Apply the approximate methods based on energy to determine the stability of simple systems
2. Analyze the columns for its stability
3. Analyze frames for its stability
4. Analyze the beams and plates for its stability
5. Differentiate how the tangent modulus and double modulus theories of inelastic buckling led tothe column paradox, thereby preventing further difficulties for a general theory of structures

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

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

UNIT – III
Stability of Frames: Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.

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

UNIT – V
Introduction to Inelastic Buckling and Dynamic Stability.

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING

II – SEMESTER

CE214PE: PROGRAMMING FOR STRUCTURAL ANALYSIS AND DESIGN

(Professional Elective –IV)

Course Objectives :

1. To understand the fundamentals of programming
2. To differentiate and apply different programming techniques
3. To develop program for analysing the structural elements
4. To Appreciate the programming techniques in structural design

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

1. Understand the Programming basics
2. Understand the data structures
3. To learn the programming techniques in 'C', PYTHON and JAVA
4. Apply the programming concepts to structural analysis
5. Develop programs for Structural components design

UNIT - I

Basics of Programming: List Basics - Conditionals - Iterative Loops – while and for loops - Handlingexceptions - Modules Variables – Arrays – loops – functions

UNIT - II

Advanced Programming: Data structures - Functions and Recursions - List Comprehensions - Sets -Tuples and Dictionaries - Glimpses of Algorithms - OOP Basics

UNIT - III

Programming using Python: Basics of Python programming - Using the Python interpreter - Modularization and Classes -Python Data Science Library - C.Numpy / Scipy - Pandas / Flask

Programming using Java: OOPS Concepts And Java Programming – Inheritance - Exception Handling And Multithreading - Interfaces And Packages - Files And Connecting To Database

UNIT - IV

Applications in Structural Analysis: Development of algorithms and programs for Matrix methods ofanalysis using 'C' programming and Python

UNIT - V

Applications in Structural Design: Development of programs for the structural design of primitive structural components – Beams – slabs - columns -footings

REFERENCES:

1. Schum's Outline of Programming with C by Byron Gottfried, McGraw-Hill
2. Computer Basics and C Programming by V. Rajaraman , PHI Learning Pvt. Limited, 2015.
3. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing House
4. Lutz, M. (2001). Programming python, O'Reilly Media, Inc. 5
5. Chun, W. (2001). Core python programming (Vol. 1). Prentice Hall Professional.
6. Zelle, J. M. (2004). Python programming: an introduction to computer science. Franklin, Beedle & Associates, Inc.
7. Herbert Schildt and Dale Skrien, "Java Fundamentals – A comprehensive Introduction",McGraw Hill, 1st Edition, 2013.

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE215PE: ADVANCED PRESTRESSED CONCRETE DESIGN
(Professional Elective – IV)

Pre requisites : Reinforced Concrete Design & Structural Analysis

Course Objectives :

1. To critically review the techniques of pre-stressing both Pre-tensioning and Post-tensioning
2. To design the pre-stressed concrete members for ultimate limit state and limit state of serviceability
3. To realize the importance of the Statically Indeterminate structures and Load Balancing •
4. 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

1. Realize the importance of pre-stressing the long span structures and heavily loaded
2. members
3. Acquire the knowledge of various pre-stressing techniques; their merits and demerits
4. Develop skills in planning, analysis and design of pre-stressed concrete beams, and slabs
5. Develop skills to satisfy the serviceability and strength provisions of the Indian Standards (IS:1343-2012)

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

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

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

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

UNIT V:

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

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

REFERENCES:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE216PE: STRUCTURAL HEALTH MONITORING (Professional Elective – IV)

Pre-requisites: Concrete Technology.

Course Objectives :

1. To understand the concepts of health monitoring
2. To assess the structural health of the structures using static and dynamic field methods
3. To suggest the possible repair and rehabilitation methods

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

1. Diagnosis the distress in the structure understanding the causes and factors.
2. Understand the various concepts of structural health monitoring
3. Assess the health of structure using static field methods.
4. Assess the health of structure using dynamic field tests.
5. 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.
Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

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

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

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

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
AC201HS: DISASTER MANAGEMENT (Audit Course - II)

Prerequisite: None

Course Objectives :

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

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

1. Understanding disasters, manmade hazards & vulnerabilities
2. Understanding disaster management mechanism
3. Understanding capacity building
4. Understanding concepts
5. Understanding planning of disaster management

UNIT-I:
Introduction:
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

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

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

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

UNIT-V:

Disaster Mitigation:

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

REFERENCES:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
AC202HS: VALUE EDUCATION (Audit Course - II)

Prerequisite: None

Course Objectives :

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

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

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

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

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

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

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

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

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
AC203HS: PEDAGOGY STUDIES (Audit Course - II)

Prerequisite: None

Course Objectives:

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

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

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

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

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

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

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

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

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher educationresearch project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING

II – SEMESTER

AC204HS: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Audit Course - II)

Prerequisite: None

Course Objectives:

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

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

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

UNIT-I:

Neetisatakam-Holistic development of personality

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

UNIT-II:

Neetisatakam-Holistic development of personality

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

UNIT-III:

Approach to day to day work and duties.

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

UNIT-IV:

Statements of basic knowledge.

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

UNIT-V:

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

REFERENCES:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department),Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.
3.

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE251PC: STRUCTURAL ENGINEERING LABORATORY

Pre-requisites: Concrete Technology.

Course Objectives :

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

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

1. Design normal and special concretes and evaluate the parameters affecting its performance
2. Apply engineering principles to understand mechanical and durability characteristics of structural elements
3. Conduct Non-Destructive Tests on existing concrete structures

List of Experiments/Assignments:

A. Tests on following fresh concretes
Self- Compacting Concrete, High Strength Concrete, Normal Strength Concrete
The tests shall include

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

B. Tests on Hardened Concrete:

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

C. Durability Tests:

1. Water Permeability
2. Rapid Chloride Permeability Test

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

REFERENCES :

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
II – SEMESTER
CE252PC: FE ANALYSIS AND DESIGN STUDIO

Pre-requisites: RCC and Steel design

Course Objectives:

1. To model the beams, frames and trusses
2. To analyze the beams, frames and trusses
3. To interpret the results from post processing

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

1. Analyze the Beams, Portal Frames and Trusses
2. Analyze and Design of Multistory RC Buildings
3. Analyze and Design of PEB components

List of Experiments:

1. Analysis and design of a multi-storeyed building subjected to DL, LL and EQ using equivalent static method
2. Analysis and design of a multi-storeyed building subjected to DL, LL and EQ using Response spectrum method
3. Analysis and design of a multi-storeyed building subjected to DL, LL and EQ using Time history analysis
4. Analyse of a structure using pushover anlaysis
5. Analysis and design of a Highrise Multi storey Building with shear wall
6. Analysis and design of a Highrise Multi storey Building with Flat Slab System
7. Analysis and Design of a PEB Structure
8. Analysis and design of raft foundation

List of Professional Electives

Professional Elective-V

CE311PE: Earthquake Resistant Design of Structures
CE312PE: Pre Engineered Buildings
CE313PE: Rehabilitation and Retrofitting of Structures

List of Open Electives offered by Civil Department to other Departments

CE321OE: Green Buildings
CE322OE: Construction Project Management
CE323OE: Safety and Construction Project Regulations

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
III – SEMESTER
CE311PE: EARTHQUAKE RESISTANT DESIGN OF STRUCTURES
(Professional Elective-V)

Course Objectives

1. To impart knowledge on the seismology and
2. To impart knowledge behavior of buildings during earthquakes
3. To impart knowledge on design of shear wall
4. To impart knowledge on structural walls
5. To impart knowledge Ductility Considerations in Earthquake Resistant design of RC Buildings

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

1. The learner will be able to analyse seismic forces
2. The learner will be able to design buildings to resist seismic forces
3. The learner will be able to design the shear wall
4. The learner will be able to design the structural walls
5. The learner will be able to design ductility Considerations in Earthquake Resistant Design of RC buildings

Unit-I: Engineering Seismology

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

Unit-II: Conceptual Design of Buildings

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

Unit-III: Earthquake Resistant Design

Seismic Design Requirements and Methods.RC Buildings – IS Code based Method.- Vertical Irregularities – Mass Irregularity TorsionalIrregularity-Plan Configuration Problem - Design Lateral Force, Base Shear Evaluation – Lateral Distribution of Base Shear – Structural Walls Strategies and the Location of Structural Walls – Sectional Shapes – Behaviourof Unreinforced and Reinforced Masonry Walls – Behaviourof Walls Box Action andBands-Behaviour of infill Walls-NonStructuralElements–Failure Mechanism of NonstructuralElements-Effects of Nonstructural Elements on Structural System – Analysis – Prevention of Damage to Nonstructural Elements – Isolation ofNon-Structures.

Unit-IV: Design of Shear walls

Classification according to Behaviour, Design of Shear walls- Shear Wall Functions & Loads Transfer Mechanism .Loads in Shear walls, Design of Rectangular and Flanged Shear walls, Derivation of Formula for Moment of Resistance of Rectangular Shear walls – Behaviour of Coupled Shear Walls.

Unit-V: Ductility Considerations in Earthquake Resistant Design of RC Buildings

Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920.Behavior of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquake- Seismic Evaluation and Retrofitting. Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns- Case studies.

REFERENCES:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
III – SEMESTER
CE312PE: PRE-ENGINEERED BUILDINGS (Professional Elective-V)

Pre-requisites: Design of Steel Structures & Structural Analysis

Course Objectives

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

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

1. Understand the functions of Primary system, Secondary system and Bracing system of PEBcomponents.
2. Calculate the Dead, Live, Wind and Seismic loads acting on PEB's
3. Check the structural stability of PEB's
4. Analyse and design of Mezzanine floor system
5. 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, Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads. Serviceability Limits as per code., Design Parameters of PEB Frames - Depth of the section, Depth to Flange width ratios, Thickness of Flange to thickness of Web ratio. d/t_w, bf/t_f ratios of sections as per IS code. Section Sizes as per Manufacturing Limitations, Analysis and Design of Rigid Frames.

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

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

UNIT - V:

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

REFERENCES:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
III – SEMESTER
CE313PE: REHABILITATION AND RETROFITTING OF STRUCTURES
(Professional Elective-V)

Prerequisites: Reinforced Concrete Design, Steel Design, Concrete Technology

Course Objectives

1. To impart knowledge about different types of distress in structures
2. Testing the structures for the deterioration of structures
3. Testing the structures for the diagnosis of defects and different types of repairing methods.

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

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

Materials for Repair and Retrofitting: Artificial fibre reinforced polymer like CFRP, GFRP, AFRP and natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete,

Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning-HealthMonitoring of Structures – Use of Sensors – Building Instrumentation.

REFERENCES:

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
III – SEMESTER
CE321OE: GREEN BUILDINGS (Open Elective)

Course Objectives

1. To impart knowledge of the principles behind the green building technologies.
2. To know the importance of sustainable use of natural resources and energy.
3. To understand the principles of effective energy and resources management in buildings.
4. To bring awareness of the basic criteria in the green building rating systems.
5. To understand the methodologies to reduce, recycle and reuse towards sustainability.

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

1. Define a green building, along with its features, benefits and rating systems.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc. Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to green

buildings: NBC, ECBC, ASHRAE, UPC etc.

REFERENCES:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. Alternative building materials and technologies by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. Non-Conventional Energy Resources by G. D. Rai, Khanna Publishers.
5. Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, Green Building Fundamentals, Pearson, USA, 2010.
7. Charles J. Kibert, Sustainable Construction - Green Building Design and Delivery, John Wiley & Sons, New York, 2008.
8. Regina Leffers, Sustainable Construction and Design, Pearson / Prentice Hall, USA, 2009

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
III – SEMESTER
CE322OE: CONSTRUCTION PROJECT MANAGEMENT (Open Elective)

Course Objectives

1. To know about the various Construction Management Techniques available for execution of project.
2. To understand Resource planning, different types of contract.
3. To learn the occupational and safety Hazard Assessment.

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

1. Plan, coordinate and control of project from beginning to completion.
2. Able to understand the different techniques in project management
3. Adopt the most effect method for meeting the requirement in order to produce a functionally and financially viable project.
4. Distinguish different types of contracts that can be used for a project
5. Understand various labour laws and legal aspect of accidents in constructions

Unit-I: Management process

Management Roles, Management theories. Social responsibilities. Planning and strategic management. Strategy implementation. Decision making: tools and techniques – Organizational structure. Human resource management- motivation performance- leadership.

Unit--II: Classification of Construction projects

Construction stages, Resources- Functions of Construction Management and its Applications. Preliminary Planning-Collection of Data-Contract Planning – Scientific Methods of Management: Network Techniques in construction management - Bar chart, Gant chart, CPM, PERT- Cost & Time optimization.

Unit--III: Resource planning

Planning for manpower, materials, costs, equipment. Labour-Scheduling. Forms of scheduling – Resource allocation. Budget and budgetary control methods

Unit--IV: Contract

Types of contract, contract document, and specification, important conditions of contract – tender and tender document - Deposits by the contractor - Arbitration. Negotiation - M.Book - Muster roll -stores.

Unit--V: Management Information System

Labour Regulations: Social Security - welfare Legislation - Laws relating to Wages, Bonus and Industrial disputes, Labour Administration - Insurance and Safety Regulations - Workmen's Compensation Act -other labour Laws - Safety in construction: legal and financial aspects of accidents in construction. occupational and safety hazard assessment. Human factors in safety. Legal and financial aspects of accidents in construction. Occupational and safety hazard assessment

REFERENCES:

1. Ghalot, P.S., Dhir, D.M., Construction Planning and Management, Wiley Eastern Limited 1992.
2. Chitkara, K.K., Construction Project Management¸ Tata McGraw Hill Publishing Co, Ltd., New Delhi 998.
3. Punmia, B, C., Project Planning and Control with PERT and CPM, Laxmi Publications, New Delhi, 1987.
4. Sengupta, B. & Guha, H, Construction Management And Planning by: Tata McGraw-hill publications.
5. Gaurav Kumar Sagar., Arvind Kumar Sagar, Construction Technology and Management, S.K Kataria & Sons,2016

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
III – SEMESTER
CE323OE: SAFETY AND CONSTRUCTION PROJECT REGULATIONS
(Open Elective)

Course Objectives

1. To provide basic knowledge on accidents and their impacts on construction;
2. To understand safety requirements in various construction operations.
3. To know importance of safety measures in material handling and stacking
4. To gain knowledge of safety of vehicles in construction industry
5. To provide knowledge of safety legislations and rules to be followed in construction.

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

1. Develop knowledge on accidents and their causes
2. Develop knowledge about safety programs and job-site safety assessments in various construction operations.
3. Develop the knowledge in handling, storing and stacking of construction of materials
4. Adopt safety procedures and methods in handling construction equipments
5. Understand and apply safety regulations wherever is applicable

UNIT-I :
Introduction to Construction Industry :- Safety issues in construction- Human factors in construction safety management. Roles of various groups in ensuring safety in construction industry. Framing Contract conditions on safety, and related matters. Relevance of ergonomics in construction safety.

UNIT-II:
Safety in various construction operations : Excavation- under- water works- under- pinning & shoring Ladders & Scaffolds- Tunneling- Blasting- Demolition- Pneumatic caissons- confined Space Temporary Structures. Indian Standards on construction safety- National Building Code Provisions on construction safety.

UNIT-III :
Safety measures: Safety in material handling and equipments-Safety in storage & stacking of construction materials.

UNIT-IV:
Safety in these of construction equipments- Vehicles, Cranes, Tower Cranes, Lifting gears, Hoists & Lifts, Wire Ropes, Pulley blocks, Mixers, Conveyors, Pneumatic and hydraulic tools in construction. Temporary power supply.

UNIT-V :
Contract Labor (R&A) Act and Central Rules: Definitions, Registration of Establishments, Licensing of Contractors, Welfare and Health provisions in the Act and the Rules, Penalties, Rules regarding wages. Building & Other Construction Workers (RE&CS) Act,1996 and Central Rules, 1998: Applicability, Administration, Registration, Welfare Board & Welfare Fund, Training of Building workers, General Safety, Health & Well fare provisions, Penalties.

REFERENCES:
1. Construction Safety Management, K.N.Vaid,
2. Construction Safety Handbook ,V.J. Davies and K.Tomasin, 1996
3. Construction Safety, Security & Loss Prevention, James B.Fullman,
4. Modern Methods of Material Handling, LingerL
5. National Building Code of India,2016, Bureau Of Indian Standards, New Delhi
6. SP 70 :2001 : Handbook On Construction Safety Practices, Bureau Of Indian Standards, New Delhi

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING
III – SEMESTER
DISSERTATION PHASE – I

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

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

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

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

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

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

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M.Tech in COMPUTER AIDED STRUCTURAL ENGINEERING

IV – SEMESTER

DISSERTATION PHASE – II

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

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

Syllabus Contents:

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

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