I YEAR
I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MATRIX METHODS IN STRUCTURAL ANALYSIS

Course Code: GR25D5001 **L/T/P/C: 3/0/0/3**
I Year I Semester

Prerequisites: Engineering Mechanics, Strength of Materials, Structural Analysis

Course Outcomes:

1. Evaluate the static and kinematic indeterminacy and generate stiffness and flexibility matrices.
2. Analyse the skeleton structures using stiffness method under different coordinate system.
3. Use flexibility matrix method to analyse different structures.
4. Use stiffness matrix method to analyse different structures.
5. Analyse various types of structural members using special analysis procedures and shear walls in multi storied constructions.

UNIT I

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 - for truss element, beam element and tensional element. Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates

UNIT II

Stiffness Matrix Assembly of Structures and its Applications to Simple Problems: Direct Stiffness method, Matrix in Global Coordinates, Boundary Conditions, Solution of Stiffness Matrix Equations.

UNIT III

Analysis of Beams, Plane Trusses, Plane Rigid Jointed frames using flexibility method

UNIT IV

Analysis of plane truss - continuous beam - plane frame by stiffness matrix methods.

UNIT V

Special analysis procedures - Static condensation and sub structuring - initial and thermal stresses. Shear walls- Necessity - structural behaviour of large frames with and without shear walls - approximate methods of analysis of shear walls.

Text Books:

1. William Weaver J.R and James M.Geve, Matrix Analysis of Frames structures, CBS publications, Delhi 2004.
2. Ashok.K.Jain, Advanced Structural Analysis, New Chand & Brothers, Third edition,2015.
3. C.S.Reddy, Structural Analysis, 3rd edition, 2010.

Reference Books:

1. Kanchi, Matrix Structural Analysis, New Age International Pvt Limited, January 2016.
2. Ghali and Neville, Structural Analysis, 7th edition, September, 2017.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED SOLID MECHANICS

Course Code: GR25D5002 **L/T/P/C: 3/0/0/3**
I Year I Semester

Course Prerequisites: Mathematics and Strength of Materials

Course Outcomes:

1. Identify the theory, concepts, principles, and governing equations of Elasticity principles.
2. Examine equations of equilibrium and draw relations among stress, strain and displacement and utilize the equilibrium equations, compatibility equations and various boundary conditions to analyze elastic problems.
3. Simplify the understating of three-dimensional problems of elasticity in Cartesian coordinates system and able to determine principal stresses and planes of 3D problems.
4. Apply the principles of elasticity to solve torsional problems in prismatic bars and tubes.
5. Assess the concepts of stresses and strains for plastic deformation to comprehend the yield criteria of materials.

UNIT I

Introduction to Elasticity: Notation for forces and stresses - Components of stresses - Components of strain – Hooke's law, Strain and Stress Fields, Stress and strain at a Point, Stress Components on an Arbitrary Plane, Hydrostatic and Deviatoric Components, Saint- Venant's principle.

UNIT II

Equations of Elasticity in Two-dimensional problems in rectangular and polar coordinates: Equations of Equilibrium, Stress- Strain relations, Strain –Displacement and Compatibility Relations, Boundary conditions, Plane stress and plane strain analysis - stress function -Two dimensional problems in rectangular coordinates - solution by polynomials.

UNIT III

Analysis of stress and strain in three dimensions in rectangular and polar coordinates - principal stresses - stress ellipsoid-determination of principal stresses - max shear stresses- equations of equilibrium in terms of displacements.

UNIT IV

Torsion of Prismatic Bars: Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, use of soap films in solving torsion problems, Bending of Prismatic Bars: Stress function - bending of cantilever – circular cross section.

UNIT V

Concepts of plasticity, Plastic Deformation, Strain Hardening, Idealized Stress- Strain curve, Yield Criterions, Plastic Stress-Strain Relations.

Text Books:

1. Theory of Elasticity, S.P. Timoshenko and J.N. Goodier, Tata McGraw Hill, 3rd edition, 2017.
2. Advanced Mechanics of Solids, Srinath L.S., Tata McGraw Hill, 2nd edition, 2010.
3. Theory of Elasticity and Plasticity, H. Jane Helena, PHI Learning, 2017

Reference Books:

1. Theory of Elasticity, Sadhu Singh, Khanna Publishers, 2007.
2. Computational Elasticity, Ameen M., Narosa, 2005.
3. Solid Mechanics, Kazimi S. M. A., Tata McGraw Hill,2nd edition,2017.
4. Elasticity, Sadd M.H., Elsevier,3rd edition, 2014.
5. Engineering Solid Mechanics, Ragab A.R., Bayoumi S.E., CRC Press, first edition,1998.
6. Theory of Plasticity, J. Chakrabarty, Butterworth-Heinemann publications,3rd edition, 2006.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PRE-ENGINEERED BUILDINGS
(Professional Elective I)

Course Code: GR25D5003 **L/T/P/C: 3/0/0/3**
I Year I Semester
Pre-requisites: Design of Steel Structures & Structural Analysis

Course Outcomes:
1. Differentiate the functions of Primary system, Secondary system.
2. Classify Bracing system of PEB components.
3. Classify different design loads on pre-engineered buildings.
4. Classify the structural stability of PEB's.
5. Analyse and Design Methodology of 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, Staircases, 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, b_f/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.

Text Books:

1. Pre- Engineered Metal Buildings Systems, Labsori, McGraw-Hill Education; 3rd edition, September 2014
2. Hass, A.M., Precast Concrete, Design and Applications, Taylor & Francis, UK. Reprint 2023.
3. Pre-Engineered Steel Building, K.S. Vivek and P. Vyshnavi, LAP Lambert Academic Publishing, 1st edition, 2017.

Reference Books:

4. Metal building systems: Design and Specifications, Alexender Newman, McGraw-Hill education, 3rd edition, 2014.
5. Phillips, W.R. and Sheppard, D.A. Plant cast, Precast and Prestressed Concrete, McGraw Hill, New York,3rd edition 1989.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADVANCED CONCRETE TECHNOLOGY
(Professional Elective I)

Course Code: GR25D5004 **L/T/P/C: 3/0/0/3**
I Year I Semester

Prerequisite: Concrete Technology

Course Outcomes:
1. Describe the types of cement, admixture and decide the suitable cement and admixture for specific purpose.
2. Illustrate the properties of concrete ingredients i.e. cement, fine aggregate and coarse aggregate by conducting different tests such as work ability etc.,
3. Describe the mix proportion of ordinary, standard and high strength concrete by using different methods and how the strength of concrete can be modified by changing the proportions.
4. Identify the suitable concrete for different structures considering the prevailing weathering conditions and Design economic concrete mix proportion for different exposure conditions and intended purposes with special concrete.
5. Illustrate the forms for a specific work and decide the time of removal of forms for the different elements in different situations.

UNIT I
Concrete Making Materials: Early development and evolution of concrete- Cement- Bogues compounds – Hydration Process – Alkali silica reaction - Admixtures – Chemical and Mineral admixtures. The chemistry of Portland cement manufacture-Hydration of calcium silicate phases-Hydrated aluminates, ferrite and sulphate phases.

UNIT II

Fresh and Hardened Concrete: Fresh Concrete - workability tests on Concrete - Segregation and bleeding. Hardened Concrete: Abram's law- Gel space ratios, Maturity Concept–Stress Behavior–Creep and Shrinkage–Durability tests on concrete- Nondestructive testing of concrete. Microstructure and properties of hardened concrete-Microstructure of concrete- Strength

UNIT III
High Strength Concrete (HSC) –Use of Nano materials – Manufacturing and Properties- Design of HSC Using BIS Method- Ultra High Strength Concrete. High Performance Concrete - Requirements and properties of High-Performance Concrete.

UNIT IV
Special Concretes: Self Compacting concrete (SCC) – Mix design of SCC by Nansu and BIS methods – Polymer concrete – Fiber reinforced concrete– Reactive Powder concrete – Geopolymer Concrete - Requirements and Guidelines – Advantages and Applications. Light weight concrete, Bacterial concrete.
Concrete mix design: Mix Design method - BIS method, ACI method, DOE method.

UNIT V
Form work for Concrete – materials – structural requirements – form work systems – connections – specifications – slip forms, permanent form work, latest form work– design of form

work – shores – removal of forms – reshoring – failure of form work-case studies.

Text Books:

1. A.M.Neville, Properties of Concrete, Pearson publications, 5th edition,2011.
2. P Kumar Mehta, Paulo J M Monteiro, "Concrete: Microstructure, Properties, and Materials", 4th edition McGraw Hill Education; 2017
3. M.S.Shetty, Concrete Technology, S.Chand & Co publications,2006.

Reference Books:

1. A.R. Santhakumar, Concrete Technology, Oxford Press,2006.
2. Rafat Siddique, Special Structure concretes, Galgotia Publications, 3rd edition,2000.
3. N.KrishnaRaju, Design of Concrete Mixes, CBS Publications,5th edition,2017.
4. P.K.Mehta, Concrete: Micro Structure, properties and materials, ICI, Chennai,4th edition, 2014.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
THEORY OF STRUCTURAL STABILITY
(Professional Elective I)

Course Code: GR25D5005 **L/T/P/C: 3/0/0/3**
I Year I Semester

Prerequisites: Strength of Materials, Structural Analysis
Course Outcomes:
1. Comprehend the basics in the theory of structural stability of discrete and continuous Systems.
2. Analyze for stability of columns with axial, flexural, torsional and combined buckling and also investigate for stability of columns with lateral bracing.
3. Evaluate for stability of member buckling and global buckling in frames.
4. Analyze the lateral torsion buckling in beams and for the axial flexural buckling, shear flexural buckling, buckling under combined loads in plates.
5. Explain the concepts of inelastic buckling and dynamic stability.

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

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.
Text Books:
1. WIGGERS S L, Structural Stability And Vibration by , SPRINGER, 2018
2. A.I. Rusakov, Fundamentals of Structural Mechanics Dynamics and Stability, Taylor & Francis, 2020
3. Theory of elastic stability, Timoshenko and Gere, Dover publications,2nd edition,2009.

Reference Books:
1. Principles of Structural Stability Theory, Alexander Chajes,Prentice Hall, New Jersey, 4th edition 2016.
2. Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York, Reprint 2022.
3. Structural Stability of columns and plates, Iyengar, N. G. R., Ellis Horwood Ltd publisher, 1988.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING
(Professional Elective II)

Course Code: GR25D5006 **L/T/P/C: 3/0/0/3**
I Year I Semester

Prerequisites: Fundamentals of Matrices, Mathematics

Course Outcomes

1. Apply numerical methods to find the roots of a Nonlinear Algebraic and Transcendental equations and perform error analysis.
2. Solve linear algebraic system by direct and iteration methods and apply the knowledge of Eigen values and Eigen vectors to some contents in engineering.
3. Apply the knowledge of interpolation and extrapolation of uniform and non-uniform data to certain contents of Civil Engineering.
4. Apply the knowledge of numerical differentiation and integration to some contents of Civil Engineering.
5. Formulate simple problems into programming models.

UNIT I

Fundamentals of Numerical Methods: Error Analysis; Floating-Point Approximation of a Number; Loss of Significance and Error Propagation; Stability in Numerical Computation.

Solution of Nonlinear Algebraic and Transcendental Equations:

Bisection Method; Fixed-Point Iteration Method; Secant Method; Newton Method; Rate of Convergences; Solution of a System of Nonlinear Equations; Unconstrained Optimization.

UNIT II

Elements of Matrix Algebra: Solution of Systems of Linear Equations-Direct method – Cramer's rule, Gauss – Elimination Method-Gauss Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods -Jacobi – Iteration method – Gauss – Siedel iteration, Eigen Value Problems- Jacobi method for symmetric matrices- Power method

UNIT III

Curve Fitting: Linear Interpolation - Higher Order Interpolation - Lagrange Interpolation Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation. Fitting a straight-line, Second-degree curve, Exponential curve, power curve by method of least squares.

UNIT IV

Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations - Numerical Integration – Double integration using Trapezoidal and Simpson's method. Euler's method – Backward Euler method – Midpoint method – single step method-Taylor's series method-R-K Methods. Boundary value problems. Finite Difference Schemes.

UNIT V

Computer Algorithms: Algorithms – developing an algorithm for simple mathematical problems. Introduction to Fuzzy Logic and Neural Networks - applications in Civil and Structural Engineering. Application to simply supported beams and columns – calculation of slope and deflection – Application to find Eigen values and mode shape of columns.

Text Books:

1. Numerical Methods for Scientific and Engineering Computations, M.K. Jain and S.R.K.Iyengar, New Age International Pvt. Ltd., 2022.
2. Numerical Methods in Engineering & Science with Programs in C, C++ & MATLAB, B S Grewal, Khanna Book Publishers, New Delhi, 2013
3. Fuzzy Logic and Neural Networks Basic Concepts & Application, Chennakesava R Alavala, New Age International Pvt. Ltd., 2007.

Reference Books:

1. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 5th edition 2012.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), Reprint 2019.
3. Computer Based Numerical Analysis, Dr. M. Shanta Kumar, Khanna Book Publishers, New Delhi,1999.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
STRUCTURAL HEALTH MONITORING
(Professional Elective II)

Course Code: GR25D5007 **L/T/P/C: 3/0/0/3**
I Year I Semester

Prerequisites: Structural Vibrations, Advanced Solid Mechanics, Engineering physics, concrete technology.

Course Outcomes:
1. Assess the health of the structure.
2. Diagnose the distress due to various causes & Faults.
3. Identify the distress and document.
4. Assess the health of structure using static & dynamic field methods.
5. Suggest Repairs, Rehabilitation & Retrofitting of the structure.

UNIT I
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance. Structural Health Monitoring: Concepts, Various Measures.

UNIT II
Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Structural Health Monitoring techniques: RF/PSTN/GSM/Satellite Communications, Networking of sensor, Data compression technique, Case Studies.

UNIT III
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, Static Response Measurement.

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

UNIT V
Introduction to Repairs and Rehabilitations of Structures: Piezo–electric materials and other smart materials Electro–Mechanical Impedance (EMI) technique, adaptations of EMI technique.

Text Books:

1. Krishna Raju N., "Design of Bridges", Oxford and IBH Publishing Co., Ltd.,5th edition 2019.
2. Ponnu Swamy, "Bridge Engineering", McGraw-Hill Publication,3rd edition,2017.
3. Vazirani, Ratvani & Aswani, "Design of Concrete Bridges", Khanna Publishers, 5th Edition, 2006.

Reference Books:

1. M A. Jagadeesh and T R. Jayaram, "Design of Bridge Structures," Prentice-Hall of India, New Delhi, 2nd edition, 2009.

2. Johnson victor D, “Essentials of Bridge Engineering”, Oxford, IBH publishing Co., Ltd, 7th Edition, 2019.
3. Wai-Fah Chen LianDuan, "Bridge Engineering Handbook", CRC Press, USA, 2nd edition, 2014.
4. R.M. Barker and J.A. Puckett, “Design of Highway Bridges”, John Wiley& Sons, New York, 4th edition,2021.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF HIGHRISE BUILDINGS
(Professional elective II)

Course Code: GR25D5008 **L/T/P/C: 3/0/0/3**
I Year I Semester
Pre-requisites: Design of Reinforced Concrete Structures, Design of Steel Structures and Concrete Technology

Course Outcomes
1. Identify the different types of loading and approaches of design philosophies.
2. Acquire knowledge of behavior of various structural systems like Braced, In-filled frames and shear walls.
3. Analyse and design high-rise buildings with simplified 2D and 3D analysis.
4. Develop the analysis of high-rise buildings in various structural failures considerations.
5. Understand the Buckling and P-Delta analysis with different aspects of design.

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 3D analysis – Assumptions in 3D analysis – Simplified 2D analysis.

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

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

Text Books
1. Taranath B.S., "Structural Analysis and Design of Tall Buildings", McGraw Hill, 1988.
2. Gupta.Y.P.(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.

3. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.

Reference Books

1. Beedle.L.S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
2. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

STRUCTURAL DESIGN LAB

Course Code: GR25D5009 **L/T/P/C: 0/0/4/2**

I Year I Semester

Prerequisites: Design of Reinforced Concrete Structures, Structural Analysis, Foundation Engineering

Course Outcomes:

1. Identify the software usages and produce structural drawing for structural members.
2. Analyse and design the plane frame and truss subjected to different type of loading.
3. Design and detailing of RC structural members like beam, column, slab, and Footing
4. Analysis and design of RCC framed structures statically for different loading conditions.
5. Analysis and design of RCC framed structures dynamically for different loading conditions

List of Experiments

1. Develop a template for design of one-way slab.
2. Develop a template for design of two-way Slab.
3. Develop a template for design of columns.
4. Develop a template for design of combined footing.
5. Analysis and design of continuous beam.
6. Analysis and design of plane frame.
7. Analysis of multi-storeyed space frame.
8. Static analysis of multi-storeyed structure.
9. Dynamic analysis of multi-storeyed structure.
10. Analysis and design of Steel truss.

Software: Relevant Software

References:

1. IS 456: 2000-Plain and Reinforced Concrete- Code of Practice.
2. IS 1893:2002-Criteria for Earthquake Resistant Design of Structures.
3. IS 875 part 3: 1987- Code of Practice for Wind loads.
4. IS 875 part 4:1987- Code of Practice for design loads (other than Earthquake) for building structures.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADVANCED CONCRETE TECHNOLOGY LAB

Course Code: GR25D5010 **L/T/P/C: 0/0/4/2**
I Year I Semester

Prerequisites: Concrete Technology Theory and Practical.

Course Outcomes:

1. Design high grade concrete and identify, carry out laboratory tests related to the use of concrete on site.
2. Develop correlation between cube and cylinder of high strength concrete and analyze the stress-strain curve.
3. Interpret the mechanical properties of high strength concrete and examine the effect of cyclic loading on steel
4. Assess the quality of existing concrete members by Non-Destructive testing methods and study the behaviour of beams under flexure.
5. Analyze the behaviour of Self Compacting Concrete and understanding reinforcement details and corrosion levels in existing RC structures.

List of Experiments/Assignments:

1. Conduct basic tests on cement and aggregates.
2. Design the mix proportions for high strength concrete.
3. Study the correlation between cubes of dimensions 100mm and 150mm sizes.
4. Studythe correlation between cube and cylinder of high strength concrete.
5. Determine the split tensile strength of high strength concrete
6. Determine the modulus of rupture of high strength concrete.
7. Determine the compressive strength of existing concrete members by Non-Destructive testing method using Rebound Hammer.
8. Assess the quality of existing concrete members by Non-Destructive testing method using Ultrasonic Pulse Velocity.
9. Study the flow properties of self-compacting concrete (as per EFNARC guidelines).
10. Evaluation of air content in concrete.
11. Optimization of dosage of super plasticizer in cement (Marsh Cone test).
12. Demonstration on how to locate reinforcement details in any existing RC structures.
13. Demonstration on assessing the level of corrosion in the existing RC structures.

Reference Books:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co.,5th edition, 2006

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
RESEARCH METHODOLOGY AND IPR

Course Code: GR25D5011 L/T/P/C: 2/0/0/2
I Year I Semester
Course Outcomes:

1. Understand research problem formulation and analyze research related information and follow research ethics.
2. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
3. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering.
4. Understand the nature of Intellectual Property and IPR in International scenario.
5. Understand that IPR protection provides an incentive to inventors for further and design the administration of patent system and new Developments in IPR.

UNIT I

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 of Plagiarism, Research ethics, Citation

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

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

Text books and 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 Guidefor 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.

I YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

FEM IN STRUCTURAL ENGINEERING

Course Code: GR25D5012 **L/T/P/C: 3/0/0/3**

I Year II Semester

Prerequisites: Engineering Mechanics, Strength of Materials, Matrix methods in Structural Analysis

Course Outcomes:

1. Apply minimum potential energy principle and weighted residual methods in Finite Element Method.
2. Analyse one dimensional elements like beam and truss element using FEM approach.
3. Evaluation of stress and strains in 2D CST and axisymmetric elements.
4. Formulation of rectangular using Isoparametric formulation, Three dimensional element and estimate the error using numerical methods
5. Differentiate various types of non-linear analysis

UNIT I

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

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

UNIT II

Beam and Truss Elements: Flexure and axial Elements, Element Stiffness Matrix, Element Load Vector and Element stress Vector.

UNIT III

Types: Triangular Elements, Axi-Symmetric Elements.

UNIT IV

Isoparametric Formulation, Rectangular Elements, Three-Dimensional Elements, Numerical Integration, Gaussian Quadrature.

UNIT V

Introduction to non – linear analysis, various methods and their limitations.

Text Books:

1. G.S.Krishna Murthy, Finite Element Analysis, theory and programming, 3rd edition, MsGraw Hilll India publications, 2nd edition, 2013.
2. Finite Element Methods in Engineering, Belegundu A.D., Chandrupatla, T.R., PrenticeHall India, 3rd edition,2002.
3. Finite Element Analysis, Seshu P., Prentice-Hall of India, 2003.

Reference Books:

1. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 4th edition,2001.
2. Fundamentals of Finite Element Analysis, Hutton David, Mc- Graw Hill, 2017.
3. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 2005.
4. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier,7th edition,2013.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
STRUCTURAL DYNAMICS

Course Code: GR25D5013 **L/T/P/C: 3/0/0/3**
I Year II Semester

Course Prerequisites: Physics and Mathematics

Course Outcomes:
1. Comprehend and model the systems subjected to vibrations and dynamic loads
2. Analyse and obtain dynamics response of single degree freedom system using fundamental Theory and equations of motion.
3. Analyse and obtain dynamics response of Multi degree of freedom system idealized as lumped mass systems. Analyse and obtain dynamics response of Multi degree of freedom system idealized as distributed mass systems.
4. Obtain dynamics response of systems using numerical methods.
5. Describe the dynamic effects of Wind Loads, Moving Loads and Vibrations caused by Traffic, Blasting and Pile Driving.

UNIT I

Introduction: Objectives, Importance of Vibration Analysis, Nature of Exciting Forces, Mathematical Modeling of Dynamic Systems. Elements of vibratory system - Degrees of Freedom - Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. - Free and forced vibrations - undamped and damped vibrations - critical damping - Logarithmic decrement– Phase angle.

UNIT II

Single Degree of Freedom System: Formulation of equations of motion by different methods , Free and Forced Vibration with and without Damping, Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier Analysis for Periodic Loading

UNIT III

Multiple Degree of Freedom System (Lumped parameter): 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 determination of natural frequencies and mode shapes - Inverse Iteration Method for Determination of Natural Frequencies and Mode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration of Equation of Motion.

UNIT IV

Numerical Solution to Response using Stodola method, Holzer method, Newmark Method and Wilson Methods.

Continuous systems: 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.

UNIT V

Special Topics in Structural Dynamics (Concepts only): Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery, Excitation by rigid base translation.

Text Books:

1. Dynamics of Structures, Clough R. W. and Penzien J., McGraw-Hill Education / Asia; 2nd edition 2003.
2. Dynamics of Structures: Theory and Applications to Earthquake Engineering, Anil K. Chopra, Prentice Hall international series, Pearson, 2017.
3. Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication, 2nd Edition, 2006

Reference Books:

1. Basics of Structural Dynamics and Aseismic Design, Prentice Hall India Learning Private Limited; 5th Edition, 2009.
2. Vibration of Structures - Application in Civil Engineering Design, Smith J. W., Chapman and Hall, London,1988.
3. Dynamics of Structures, Humar J. L., CRC Press; 2nd edition, 2012.
4. Structural Dynamics for Structural Engineers, Gary C. Hart, John Wiley & Sons, 2000.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADVANCED STEEL DESIGN
(Professional Elective III)

Course Code: GR25D5014 **L/T/P/C: 3/0/0/3**
I Year II Semester

Prerequisites: Strength of materials, Structural Analysis and Design of steel Structures.

Course Outcomes:
1. Design Plate girders.
2. Design Gantry girders.
3. The design of steel truss girder, loads on trusses, analysis and design of purlins and truss members
4. The design of steel bridges.
5. Design of steel bunkers and silos

UNIT I
Design of Plate Girder: Introduction, Types of sections, elements of plate girder, general considerations, proportioning of web, proportioning of flanges, flexural strength, shear strength of web, shear buckling design methods, end panel design, stiffeners and curtailment of flanges.

UNIT II
Design of Gantry Girder: Introduction, Loads, fatigue effects, specifications and design procedure.

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

UNIT IV
Design of Steel Truss Girder Bridges: Types of truss bridges, component parts of a truss bridge, economic proportions of trusses, self-weight of truss girders, design of bridge compression members, tension members; wind load on truss girder bridges; wind effect on top lateral bracing; bottom lateral bracing; portal Bracing; sway bracing.

UNIT V
Design of Steel Bunkers and Silos: Introduction – Janseen's Theory – Airy's Theory – Designof Parameters – Design Criteria – Analysis of Bins – Hopper Bottom –Design of Bins.

Text Books:

1. S.K. Duggal, Limit State Design of Steel Structures, Mc Graw Hill Education Private Ltd. New Delhi, 3rd Edition, 2019.
2. N. Subramanian, Design of steel structures, Oxford University Press,2nd edition, 2016.
3. P. Dayaratnam, Design of Steel Structures, Publisher: S. Chand, first edition 2012.

Reference Books:

1. Dr. Ramachandra &Vivendra, Design Steel Structures Volume – II, Gehlot Scientific Publishes Journals Department, 19th edition, 2016.
2. Galyord & Gaylord, Design of Steel Structures, Publisher; Tata Mc Graw Hill, Education. Edition ,2012.
3. Indian Standard Code – IS: 800-2007.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF FORMWORK
(Professional Elective III)

Course Code: GR25D5015 **L/T/P/C: 3/0/0/3**
I Year II Semester

Prerequisites: Engineering Mechanics, Solid Mechanics, Structural Analysis.
Course Outcomes:
1. Identify the necessity and types of form work for various structures of civil Engineering and select proper type of form work, accessories and materials required.
2. Examine the form work for various structural elements like beam, slab, column, wall and foundation.
3. Distinguish the form work for special structures like shells, retaining walls, bridges, Sylos, bunkers & water tank.
4. Assess the working of flying form work like tunnel forms, slip forms and table forms.
5. Evaluate the form work failures from case studies.

UNIT I

Introduction to formwork: Requirements and Selection of Formwork, Formwork Materials-Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Form work selection

UNIT II

Formwork Design: Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

UNIT III

Formwork Design for Special Structures: Shells, Traditional Indian construction utilising formwork techniques in Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower and Bridges.

UNIT IV

Flying Formwork: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.

UNIT V

Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multistorey Building Construction.

Text Books:

1. Formwork for Concrete structures by Robert L Peurify and Gerold D Oberlender, Fourth edition,2010.
2. Formwork for Concrete Structures, Kumar Neerajha, Tata McGraw Hill Education,2017.
3. Formwork for Concrete Structures, Peurify, McGraw Hill India, 2015.

Reference Books:

1. IS 14687: 1999, False work for Concrete Structures – Guidelines; BIS, New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PRINCIPLES OF BRIDGE ENGINEERING
(Professional Elective III)

Course Code: GR25D5016 **L/T/P/C: 3/0/0/3**
I Year II Semester

Course Prerequisites: Design of Steel and Reinforced Concrete Structures

Course Outcomes:
1. Identify the load transfer mechanism of different types of bridge sand loads acting on the super and sub structure
2. Analyze and design of solid slab bridges and Box culvers
3. Analyze and design of T Beam bridges
4. Analyze and design of Plate girder bridges and understand the design concepts of various other types of bridges.
5. Analyse and design of piers, abutments and bearings. Also able to apply various types of inspections and maintenance techniques.

UNIT I
Road Bridges - History– Components – types of bridges and their load transfer mechanisms and suitability- Planning, Site selection, Soil Exploration investigations- Hydraulic factors in Bridge Design - IRC loadings - Economic span length –General Design requirements for super structures and sub structures.

UNIT II
Analysis and Design of Solid slab bridges: General design features, Effective width method. Simply supported and cantilever Slab Bridge, Design of Kerb; Analysis and Design of Box Culverts.

UNIT III
Analysis and design of T-Beam bridges (up to three girder only) Components – Design of interior slab panel. Pigeaud's method, Calculation of longitudinal moment using Courbon's theory, Design of Longitudinal girders and Cross girders beams.

UNIT IV
Plate Girder Bridges-Elements of plate girder and their design-web- flange- intermediate stiffener- vertical stiffeners- bearing stiffener- Splices, Design problem with detailing.
Introduction to Prestressed Concrete Bridges – Steel trussed bridges –Balanced Cantilever bridges – Continuous bridges- Cable stayed bridges (No detailed designs, only conceptual design principles)

UNIT V
Substructures: Analysis and design concepts of Abutments and pier-detailing; Bridge bearings: types, selection, forces on bearings and design concepts of elastomeric bearings; Bridge foundations (Only Design Concepts), Bridge Foundations- Types and design principles Inspection and Maintenance and Rehabilitation of Bridges: Procedures and methods for inspection – Testing

of bridges- Maintenance of Sub Structures and Superstructures- Maintenance of bearings- Repairs and Rehabilitation methods on any ancient bridges- Case studies.

Text Books:

1. Krishna Raju N., "Design of Bridges", Oxford and IBH Publishing Co., Ltd.,5th edition 2019.
2. Ponnu Swamy, "Bridge Engineering", McGraw-Hill Publication,3rd edition,2017.
3. Vazirani, Ratvani & Aswani, "Design of Concrete Bridges", Khanna Publishers, 5th Edition, 2006.

Reference Books:

1. M A. Jagadeesh and T R. Jayaram, "Design of Bridge Structures," Prentice-Hall of India, New Delhi, 2nd edition, 2009.
2. Johnson victor D, "Essentials of Bridge Engineering", Oxford, IBH publishing Co., Ltd, 7th Edition, 2019.
3. Wai-Fah Chen LianDuan, "Bridge Engineering Handbook", CRC Press, USA, 2nd edition, 2014.
4. R.M. Barker and J.A. Puckett, "Design of Highway Bridges", John Wiley& Sons, New York, 4th edition,2021.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF ADVANCED CONCRETE STRUCTURES

(Professional Elective IV)

Course Code: GR25D5017 **L/T/P/C: 3/0/0/3**

I Year II Semester

Prerequisites: Design of Reinforced concrete structures, Structural analysis, Bridge Engineering

Course Outcomes:

1. Structural design of flat slab including direct design method.
2. Design and detailing of pile foundations with pile caps and simply supported and continuous deep beams.
3. Design and detailing of plain concrete walls, shear walls.
4. Design and detailing of Intze type Over Head Tank, understand stability requirements of retaining walls.
5. Knowledge of IRC loading and design of Deck Slab Bridge.

UNIT I

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 strips moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears-Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip sketch showing reinforcement details.

UNIT II

Design of Deep Beams: Deep beam action, reinforcement requirements, design of simply supported and continuous deep beams and detailing. Reinforcement requirements of pile foundations, design of pile foundation and design of pile cap for a group of piles.

UNIT III

Design of Walls: Plain concrete walls – Braced and unbraced walls, slenderness ratio and design of plain concrete walls. Shear Walls – Classification of shear walls, loads in shear walls and design of shear walls. Retaining Walls – Types of retaining walls, stability requirements of retaining wall and design of counterfort retaining wall.

UNIT IV

Design of Intze Tank: Intze type overhead tank parts and approximation of dimensions of various parts, equation for tank capacity, design and detailing of Intze type OHT. Design of staging for Intze type overhead tank.

UNIT V

Design of Bridges: IRC loadings- class A, B, C and AA (70R), economic span, effective width, design of Deck Slab Bridge and T Beam bridge.

Text Books:

1. Illustrated Reinforced Concrete Design, Dr. V.L. Shah & Dr. S. R. Karve, Structures Publications, 6th edition,2010.
2. Reinforced Concrete Design, S. Unnikrishna Pillai and Devdas Menon D., Tata McGraw-Hill, 3rd Ed, 2017.
3. Reinforced Concrete Structures, Park R. and Paulay T., John Wiley & Sons, Reprint 2022.

Reference Books:

1. Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi,2nd edition, 2005.
2. Limit State design by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jai, Laxmi publication Pvt. Ltd., New Delhi, first edition,2007.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADVANCED DESIGN OF FOUNDATIONS
(Professional Elective IV)

Course Code: GR25D5018 **L/T/P/C: 3/0/0/3**

I Year II Semester

Prerequisites: Geotechnical Engineering, Foundation engineering, Ground Improvement Techniques

Course Outcomes:
1. Assess the suitability of soil strata for different projects.
2. Evaluate the bearing capacity and settlement of shallow foundations.
3. Analyze and design pile foundations and requirements of well foundation.
4. Distinguish about bracing and deep cuts and compute pressure around tunnels.
5. Analyze and design coffer dams and recognize soil structure interaction.

UNIT I
Planning of soil Exploration for Different Projects, Methods of Subsurface Exploration and Methods of Borings along with Various Penetration Tests.

UNIT II
Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics.

UNIT III
Deep Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Lateral and Uplift Capacity of Piles, Well Foundations, IS Code Provisions.

UNIT IV
Tunnels and Arching in Soils, Pressure Computations around Tunnels. Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.

UNIT V
Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil structure interaction

Text Books:

1. Braja M. Das, Principles of Foundation Engineering, Cengage Learning, New Delhi, 8th edition,2017.
2. Bowles, J.E., Foundation Analysis and Design, McGraw-Hill Publishing Company, New york, 5th edition, 2001.
3. Design of foundation system, N.P. Kurian, Narosa Publishing House,3rd edition,2005.

Reference Books:

1. Analysis and Design of Substructures, Swami Saran, Oxford and IBH Publishing Co. Pvt. Ltd,New Delhi,2nd edition,2018

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
EARTHQUAKE RESISTANT DESIGN OF BUILDINGS
(Professional Elective IV)

Course Code: GR25D5019 **L/T/P/C: 3/0/0/3**

I Year II Semester

Prerequisite: Engineering Mechanics, Engineering Geology, Strength of Materials, Structural Analysis, Design of Reinforced Concrete Structures and Design of Steel.

Course Outcome:

1. Acquire the fundamentals of earthquake engineering and seismicity conditions of the country and world.
2. Apply the Response Spectrum Analysis Method and static equivalent method for the determination of lateral loads on the buildings
3. Assess seismic performance of non-structural components and structural components and identify effective measures to mitigate potential damage.
4. Design the shear walls with an effect of earthquake forces.
5. Apply ductility requirements for the design of structural components.

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 of Functional planning, Continuous load path, overall form, simplicity and symmetry, elongated shapes, stiffness and strength. Seismic design requirements, regular and irregular configurations, basic assumptions.

UNIT II

Conceptual Design - Horizontal and Vertical Load Resisting Systems - System and Members for Lateral Loads and High Rise / Tall Structures. Twisting of Buildings – Flexible Building and Rigid Building Systems. Strength and Stiffness – Ductility – Definition – Ductility Relationships– Choice of construction Materials – Unconfined Concrete & Confined Concrete – Traditional Indian construction in Masonry Masonry, Steel Structures. Design Earthquake Loads – Basic Load Combinations – Permissible Stresses.

Seismic Methods of Analysis – Static Method – Equivalent Lateral Force Method. Dynamic Analysis – Response Spectrum Method – Modal Analysis Torsion.

UNIT III

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

UNIT IV

Design of Shear walls: Classification according to Behavior, Loads in Shear walls, Design of Rectangular and Flanged Shear walls, Derivation of Formula for Moment of Resistance of Rectangular Shear walls – Coupled Shear Walls. Introduction to non-linear static Push Over Analysis.

UNIT V

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

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

Text books:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press,2nd edition,2013.
2. Design of Reinforced Concrete Structures by N.Subramanian, Oxford University Press,2013.
3. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd, 2011.

Reference books:

1. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons, first edition,1992.
2. Masonry and Timber structures including earthquake Resistant Design –Anand S. Arya, Nemchand & Bros, first edition,1964.
3. Earthquake –Resistant Design of Masonry Building –Miha Tomazevic, Imperial college Press,1999.
4. C.V.R. Murty, Earthquake Tips – Learning Earthquake Design and Construction,2005.

Reference Codes:

1. IS: 1893 (Part-1) -2016 (Reaffirmed year 2021) “Criteria for Earthquake Resistant – Design of structures.” B.I.S., New Delhi.
2. IS:4326-1993, “Earthquake Resistant Design and Construction of Building”, Code of Practice B.I.S., New Delhi.
3. IS:13920-1993, “Ductile detailing of concrete structures subjected to seismic force” – Guidelines, B.I.S., New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADVANCED STRUCTURAL ENGINEERING LAB

Course Code: GR25D5020 **L/T/P/C: 0/0/4/2**

I Year II Semester

Prerequisites: Advanced Concrete Technology

Course Outcomes:

1. Assess the behavior of concrete in terms of strength and Permeability.
2. Interpret the mechanical properties of concrete and examine the effect of water absorption and sorpitivity.
3. Analyse the behaviour of concrete properties due to the effect of Thermal cycles.
4. Assess the quality of existing concrete members by Non-Destructive testing methods.
5. Analyze the behaviour and understanding reinforcement details and corrosion levels in existing RC structures.

List of Experiments:

1. Determination of water permeability of concrete
2. Determination of concrete compressive strength by accelerated curing test.
3. Assess the sorptivity of concrete.
4. Assessment of water absorption of concrete
5. Effect of elevated temperatures on properties of concrete.
6. Effect of thermal cycles on properties of concrete.
7. Assessment of location of rebar in existing RC structures.
8. Assessment of the level of corrosion in existing RC structures.
9. Assess the surface hardness of existing concrete members using rebound hammer test.
10. Assess the quality of existing concrete members using ultrasonic pulse velocity test.
11. Assessment of flexural behaviour of under reinforced RC Beam
12. Assessment of flexural behaviour of over reinforced RC Beam

References:

1. IS 3085-1965- Method of Test for Permeability of Cement mortar and Concrete.
2. IS 9013-1978- Accelerated Curing Test of concrete
3. IS 1124-1974- Method of Test for determination of Water Absorption, Apparent Specific gravity and Porosity of Natural Building stones.
4. IS 13311 -1992 part 1 & 2- Non-Destructive Testing of Concrete-Methods of Test

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

NUMERICAL ANALYSIS LAB

Course Code: GR25D5021 **L/T/P/C: 0/0/4/2**

I Year II Semester

Prerequisites: Numerical Methods, Mathematics, C programming

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

1. Find Roots of non-linear equations by Bisection method and Newton's method.
2. Do curve fitting by least square approximations.
3. Solve the system of Linear Equations using Gauss - Elimination/ Gauss - Seidal Iteration/Gauss - Jorden Method.
4. Integrate Numerically Using Trapezoidal and Simpson's Rules.
5. Find Numerical Solution of Ordinary Differential Equations by Euler's Method & Runge-Kutta Method.

List of Experiments (Tasks):

1. Find the Roots of Non-Linear Equation Using Bisection Method.
2. Find the Roots of Non-Linear Equation Using Newton's Method.
3. Curve Fitting by Least Square Approximations.
4. Solve the System of Linear Equations Using Gauss - Elimination Method.
5. Solve the System of Linear Equations Using Gauss - Seidal Iteration Method.
6. Solve the System of Linear Equations Using Gauss - Jorden Method.
7. Integrate numerically using Trapezoidal Rule.
8. Integrate numerically using Simpson's Rules.
9. Numerical Solution of Ordinary Differential Equations by Euler's Method.
10. Numerical Solution of Ordinary Differential Equations by Runge- Kutta Method.

Reference Books:

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 book company.
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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MINI PROJECT

Course Code: GR25D5048 **L/T/P/C: 0/0/4/2**

I Year II Semester

Course Outcomes:

1. Choose the problem domain in the specialized area under computer scienceand engineering.
2. Acquire and categorize the solution paradigms with help of case studies
3. Design and code using selected hardware, software and tools.
4. Execute, Implement and demonstrate the problem statement by using theselected hardware, software and tools.
5. Document the thesis and publish the final work in a peer reviewed journal.

Syllabus Contents:

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

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the Departmental committee.