**GOVERNMENT COLLEGE OF ENGINEERING, SALEM – 636 011**
*(An Autonomous Institution affiliated to Anna University, Chennai)*
**CURRICULUM FOR 2022 REGULATIONS**
**M.E. DEGREE IN STRUCTURAL ENGINEERING – FULL TIME**

**FIRST SEMESTER**

| Sl. No. | Subject Code | Course Title | CAT | CA Marks | End Sem. Marks | Total Marks | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| | | **THEORY** | | | | | | | | |
| 1 | 22STC11 | Advanced Structural Analysis | PC | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 2 | 22STC12 | Theory of Elasticity and Plasticity | PC | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| | | **ELECTIVE** | | | | | | | | |
| 3 | 22STE1X | Elective –I | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 4 | 22STE2X | Elective – II | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| | | **PRACTICAL** | | | | | | | | |
| 5 | 22STC13 | Structural Design Lab | EEC | 40 | 60 | 100 | 0 | 0 | 2 | 2 |
| 6 | 22STC14 | Concrete and Experimental Stress Analysis Lab | PC | 40 | 60 | 100 | 0 | 0 | 2 | 2 |
| | | **MANDATORY COURSE** | | | | | | | | |
| 7 | 22MLC01 | Research Methodology and IPR | MLC | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| | | **AUDIT COURSE** | | | | | | | | |
| 8 | 22ACX | Audit Course 1 | AC | | | | 2 | 0 | 0 | 0 |
| | | **TOTAL** | | 280 | 420 | **700** | 17 | 0 | 4 | **19** |

**SECOND SEMESTER**

| Sl. No. | Subject Code | Course Title | CAT | CA Marks | End Sem. Marks | Total Marks | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| | | **THEORY** | | | | | | | | |
| 1 | 22STC21 | Finite Element Method in Structural Engineering | PC | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 2 | 22STC22 | Structural Dynamics | PC | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| | | **ELECTIVE** | | | | | | | | |
| 3 | 22STE3X | Elective – III | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 4 | 22STE4X | Elective – IV | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| | | **PRACTICAL** | | | | | | | | |
| 5 | 22ST**C**23 | Model Testing Lab | PC | 40 | 60 | 100 | 0 | 0 | 2 | 2 |
| 6 | 22ST**C**24 | Numerical Analysis Lab | EEC | 40 | 60 | 100 | 0 | 0 | 2 | 2 |
| 7 | 22ST**C**25 | Mini Project | EEC | 40 | 60 | 100 | 0 | 0 | 4 | 2 |
| | | **AUDIT COURSE** | | | | | | | | |
| 8 | 22ACX | Audit Course 2 | AC | | | | 2 | 0 | 0 | 0 |
| | | **TOTAL** | | 280 | 420 | **700** | 14 | 0 | 8 | **18** |

**THIRD SEMESTER**

| Sl. No. | Subject Code | Course Title | CAT | CA Marks | End Sem. Marks | Total Marks | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| | | **ELECTIVE** | | | | | | | | |
| 1 | 22STE5X | Elective – V | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 2 | 22STE6X | Elective – VI | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| | | **DISSERTATION** | | | | | | | | |
| 3 | 22STC31 | Dissertation Phase – I | EEC | 80 | 120 | 200 | 0 | 0 | 20 | 10 |
| | | **TOTAL** | | 160 | 240 | **400** | 6 | 0 | 20 | **16** |

**FOURTH SEMESTER**

| Sl. No. | Subject Code | Course Title | CAT | CA Marks | End Sem. Marks | Total Marks | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| | | **DISSERTATION** | | | | | | | | |
| 1 | 22STC41 | Dissertation Phase – II | EEC | 160 | 240 | 400 | 0 | 0 | 32 | 16 |
| | | **TOTAL** | | 160 | 240 | **400** | 0 | 0 | 32 | **16** |

**Total number of credits to be earned for the award of degree = 69 (19+18+16+16)**

**List of Programme Electives (PE):**

| Sl. No. | Subject Code | Course Title | CAT | CA Marks | End Sem. Marks | Total Marks | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| **Elective 1** | | | | | | | | | | |
| 1 | 22STE11 | Theory of Thin Plates and Shells | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 2 | 22STE12 | Theory and Applications of Cement Composites | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 3 | 22STE13 | Theory of Structural Stability | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 4 | 22STE14 | Corrosion and its Prevention | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| **Elective II** | | | | | | | | | | |
| 5 | 22STE21 | Analytical and Numerical Methods for Structural Engineering | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 6 | 22STE22 | Structural Health Monitoring | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 7 | 22STE23 | Structural Optimization | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 8 | 22STE24 | Experimental Techniques and Instrumentation | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| **Elective III** | | | | | | | | | | |
| 9 | 22STE31 | Advanced Steel Design | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 10 | 22STE32 | Design of Formwork | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 11 | 22STE33 | Design of High Rise Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 12 | 22STE34 | Design of Masonry Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 13 | 22STE35 | Design of Prefabricated Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 14 | 22STE36 | Design of Steel - Concrete Composite Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| **Elective – IV** | | | | | | | | | | |
| 15 | 22STE41 | Design of Advanced Concrete Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 16 | 22STE42 | Advanced Design of Foundations | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 17 | 22STE43 | Design of Industrial Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 18 | 22STE44 | SubStructure Design | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 19 | 22STE45 | Design and Construction of Ferrocement Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Elective –V** | | | | | | | | | | |
| 20 | 22STE51 | Design of Prestressed Concrete Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 21 | 22STE52 | Analysis of Laminated Composite Plates | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 22 | 22STE53 | Fracture Mechanics of Concrete Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 23 | 22STE54 | Design of Plates and Shells | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 24 | 22STE55 | Design of Bridges | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 25 | 22STE56 | Modern Construction Materials | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| **Elective –VI** | | | | | | | | | | |
| 26 | 22STE61 | Advanced Concrete Technology | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 27 | 22STE62 | Disaster Resistant Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 28 | 22STE63 | Soil Structure Interaction | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 29 | 22STE64 | Environmental Engineering and Offshore Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 30 | 22STE65 | Wind and Cyclone Effects on Structures | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |

**Audit Courses (AC):**

| **Sl. No.** | **Subject Code** | **Course Title** | **CAT** | **CA Marks** | **End Sem. Marks** | **Total Marks** | **Credits** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | **L** | **T** | **P** | **C** |
| 1 | 22AC01 | English for Research Paper Writing | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 2 | 22AC02 | Disaster Management | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 3 | 22AC03 | Sanskrit for Technical Knowledge | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 4 | 22AC04 | Value Addition | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 5 | 22AC05 | Constitution of India | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 6 | 22AC06 | Pedagogy Studies | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 7 | 22AC07 | Stress Management by Yoga | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 8 | 22AC08 | Personality Development through Life Enlightenment Skills | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |

| 22STC11 | ADVANCED STRUCTURAL ANALYSIS | Semester | | | I |
|---|---|---|---|---|---|
| PREREQUISITES | Category | PC | Credit | | 3 |
| | Hours/Week | L | T | P | TH |
| | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students with fundamental concepts |
| 2 | Energy concepts in structures |
| 3 | Statically determinate and indeterminate structures |
| 4 | Modern methods like flexibility method and stiffness method |

| Unit I | STRUCTURES- FUNDAMENTAL CONCEPTS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Introduction – Force and displacement measurement – Generalized or Independent measurement – Constrained or Dependent measurements- Principle of superposition-Methods of Structural analysis.

**Characteristics of structures – stiffness and flexibility**

Introduction- Structure with single coordinate- Two coordinates- Flexibility and stiffness matrices in n coordinates- Examples-symmetric nature of matrices- Stiffness and Flexibility matrices in constrained measurements- Stiffness and flexibility of systems and elements-Computing displacements and forces from virtual work- Computing stiffness and flexibility coefficients.

| Unit II | ENERGY CONCEPTS IN STRUCTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Strain energy in terms of stiffness and flexibility matrices – properties of stiffness and flexibility matrices – interpretation of co-efficient – Betti's law (forces not at the coordinates) – other energy theorems using matrix notations

**Transformation of information in structures**

Determinate – indeterminate structures – transformation of system forces to element forces – element flexibility to system flexibility – system displacement to element displacement – element stiffness to system stiffness – transformation of forces and displacement in general – stiffness and flexibility in general – normal coordinates and orthogonal transformation – principle of contragradience

| Unit III | THE FLEXIBILITY METHOD | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Statically determinate structures-Indeterminate structures-Choice of redundant leading to ill and well conditioned matrices-Transformation to one set of redundant to another- Internal forces due to Thermal expansion and lack of fit-Reducing the size of flexibility matrix- Application to pin-jointed plane truss-Continuous beams-Frames-Grids

| Unit IV | THE STIFFNESS METHOD | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Introduction-Development of stiffness method-Stiffness matrix for structures with zero force at some coordinates- Analogy between flexibility and stiffness- lack of fit-Stiffness matrix with rigid motions-Application of Stiffness approach to pin jointed plane trusses-Continuous beams-Frames-Grids-Space trusses and frames-introduction only-Static condensation technique-choice of method-Stiffness or Flexibility.

| Unit V | ANALYSIS BY SUBSTRUCTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Analysis by substructures using the stiffness and the flexibility method with tridiagonalization ANALYSIS BY ITERATION Iteration method for frames with non-prismatic members – iteration methods applied to rigidly connected members – computer program for the analysis of rigidly connected beams – efficiency of iteration method.

**Total 45 Periods**

**Text Books:**

| | |
|---|---|
| 1 | Rubinstein F.M., Matrix computer methods of Structural Analysis, Prentice Hall, 2016 |
| 2 | William Weaver J.R. and James M.Gere, Matrix Analysis of Framed Structures, CBS Publishers & Distributors, 2012 |
| **Reference Books:** | |
| 1 | Devadas Menon, Advanced Structural Analysis, Narosa Publishing House, New Delhi, 2009 |
| 2 | Pandit G.S. and Gupta S.P., Structural Analysis-A Matrix Approach, TataMcGraw-Hill Publishing company Limited, New Delhi 2008 second edition |
| 3 | Reddy C.S., Basic Structural Analysis, Tata McGraw-Hill Publishing Company Limited, New Delhi third edition July 2017 |
| 4 | Rajasekaran S and Sankarasubramanian G., Computational Structural Mechanics, Prentice-Hall of India Private limited, New Delhi, 2015. |

| | | | | | |
|---|---|---|---|---|---|
| **22STC12** | **THEORY OF ELASTICITY AND PLASTICITY** | | **Semester** | | **I** |
| **PREREQUISITES** | | **Category** | **PC** | **Credit** | **3** |

| | | L | T | P | TH |
|---|---|---|---|---|---|
| | Hours/Week | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about the behaviour and stresses in elastic bodies subjected to various loadings and to obtain general solution, torsion of non-circular section and energy methods. Also behavior of materials in elasto-plastic and plastic stages of loadings will be discussed |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **ANALYSIS OF STRESS AND STRAIN** | **9** | **0** | **0** | **9** |

Elasticity approach – definition and notation of stress - components of stress and strain – Generalized Hooke's law- Principal stresses and strains for three dimensional element - equations of equilibrium and compatibility conditions for 3-D problems in Cartesian coordinates – Transformation of stresses and strains – Boundary conditions.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **TWO DIMENSIONAL PROBLEMS IN CARTESIAN CO-ORDINATES** | **9** | **0** | **0** | **9** |

Plane stress and plane strain problems with practical examples – Equations of equilibrium and compatibility conditions in Cartesian coordinates – Airy's stress function.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **TWO DIMENSIONAL PROBLEMS IN POLAR CO-ORDINATES** | **9** | **0** | **0** | **9** |

Equations of equilibrium and compatibility conditions in polar co-ordinates – axisymmetrical problems; thick cylinder under uniform pressure, shrink and force fits, circular arc beams subjected to pure bending – stress concentration due to circular hole in plate – effect of concentrated and uniformly distributed load on straight boundary of semi infinite plates, stresses in circular disc subjected to diametrically opposite concentrated loads.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **TORSION** | **9** | **0** | **0** | **9** |

Torsion of various shaped bars, pure torsion of prismatic bars, Prandtl's membrane analogy, torsion of thin walled tubes and hollow shafts, Plastic torsion – elastic-plastic torsion analysis – circular section – sand heap analogy.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **THEORY OF PLASTICITY** | **9** | **0** | **0** | **9** |

Theory of Plasticity – Stress-strain diagram – Ideal plastic body – illustration of plastic analysis – yield criteria – Rankine's theory – St. Venant's theory – Tresca Criterion – Beltrami's theory – Von mises criterion – Mohr's theory of yielding – yield surface – Flow rule (stress-strain relationship for perfectly plastic flow) – PrandtlReuss equality – Plastic work – stress-strain relation based on Tresca – Plastic potential – uniqueness of a stress distribution – strain hardening.

**Total 45 Periods**

**Text Books:**


| | |
|---|---|
| 1 | Timoshenko S.P and Goodier J.N, *Theory of Elasticity*, McGraw Hill Book Co., New York, 2010 3rd edition |
| 2 | Sadhu Singh, *Theory of Plasticity*,Khanna Publishers, New Delhi. 2005 |


**Reference Books:**


| | |
|---|---|
| 1 | Prasantkumar, Elements of Fracture Mechanics,A.H.Wheeler&Co,New Delhi 1989 |
| 2 | Popov E, Mechanics of Materials, Prentice Hall reprinted Pearson education, 2003 |
| 3 | Hill R, Mathematical theory of plasticity, Oxford Publishers 1967 |
| 4 | Chakrabarthy, Theory of Plasticity, McGraw Hill Co., 1988 |
| 5 | Mendelson, Plasticity: Theory and Application, A McMillan and Co., New York 1968 |

| Course Outcomes: Upon completion of this course, the students will be able to: | | Bloom's Taxonomy Level |
|---|---|---|
| **CO1** | Have Knowledge about stress distribution in engineering structures | |
| **CO2** | to understand of the essential facts, concepts, theories and principles underlying elasticity and plasticity theory | |
| **CO3** | Complex methods to understand stress distribution which is not possible using elementary methods. | |
| **CO4** | learn applications of both elasticity and plasticity to Engineering design and analysis. | |

| **22STC13** | **STRUCTURAL DESIGN LAB** | | **Semester** | | | **I** |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **EEC** | **Credit** | | **2** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |

| | | | | | |
|---|---|---|---|---|---|
| | | **0** | **0** | **2** | **2** |

| **EXPERIMENTS** | |
|---|---|
| 1 | Analysis of continuous beam |
| 2 | Analysis of Single Storey frame |
| 3 | Analysis of multi-storey frame |
| 4 | Design of multi-storey frame |
| 5 | Analysis and Design of Multistorey Building |
| 6 | Analysis and Design of Steel Truss |
| 7 | Analysis and Design of Foundation |
| 8 | Analysis of Prefabricated/Preengineered Structures |
| | **Total (45+15) = 60 Periods** |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | All the Structural Components of Frame Buildings. |
| **CO2** | Multi-Storey Frame Buildings. |
| **CO3** | Foundation |
| **CO4** | Steel Structures. |

| **22STC14** | **CONCRETE AND EXPERIMENTAL STRESS ANALYSIS LAB** | | **Semester** | | | **I** |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **PC** | **Credit** | | **2** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **0** | **0** | **2** | **2** |

| Course Learning Objectives | |
|---|---|
| 1 | To impart practical knowledge to the students about the tests on properties of concrete, design of concrete mix and also about the measuring devices. |
| **EXPERIMENTS** | |
| 1. | Determination of Modulus of Elasticity of concrete using Compress meter |
| 2. | Mix Design |
| 3. | Experimental stress analysis using photoelastic apparatus |
| 4. | Study of Begg'sDeformator |
| 5. | Study of mechanical strain gauges |
| 6. | Study of optical and electrical strain gauges |
| 7. | Load vs deflection characteristics of simply supported beam using load cell, LVDT and Data acquisition system |
| 8. | Permeability test for concrete |
| 9. | Experimental study on fresh properties of self compacting concrete |
| 10. | Accelerated curing of concrete |
| | |
| | |
| **Total (45+15) = 60 Periods** | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Able to design concrete mixes |
| **CO2** | Measure the permeability of concrete, crack width etc |
| **CO3** | Study the applications of various strain gauges |
| **CO4** | Perform non-destructive tests |

| **22MLC01** | **RESEARCH METHODOLOGY AND IPR** | | **Semester** | | | |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **MLC** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |

| | | | | | |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To develop the subject of the research, encourage the formation of higher level of trained intellectual ability, critical analysis, rigor and independence of thought, foster individual judgment and skill in the application of research theory and methods and develop skills required in writing research proposals, reports and dissertation. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **INTRODUCTION TO RESEARCH** | **9** | **0** | **0** | **9** |

Meaning of research problem, sources of research problem, criteria characteristics of a good research problem, errors in selecting the research problem, scope and objectives of research problem, approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentation.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **EFFECTIVE LITERATURE STUDIES APPROACHES, ANALYSIS** | **9** | **0** | **0** | **9** |

Developing the theoretical frame work of research- developing operational statements of the problem-criteria for evaluating research approach-hypothesis: parametric and non-parametric testing- establishing the reliability and validity of findings with literature review and experiments- documentation, plagiarism, research ethics

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **EFFECTIVE TECHNICAL WRITING, HOW TO WRITE REPORT, PAPER** | **9** | **0** | **0** | **9** |

Developing a research proposal, format of research proposal, a presentation and assessment by a review committee

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **NATURE OF INTELLECTUAL PROPERTY** | **9** | **0** | **0** | **9** |

Patents, designs, trade and copyright, process of patenting and development: technological research, innovation, patenting, development. International scenario: international cooperation on intellectual property. Procedure grants of patents, patenting under PCT

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **PATENT RIGHTS AND IPR** | **9** | **3** | **0** | **12** |

Scope of patent rights. Licensing and transfer of technology. Patent information and databases. Geographical indications. Administration of patents system. New developments in IPR; IPR of biological system, computer software etc., traditional knowledge case studies , IPR and IITs.

**Total 45 Periods**

**Text Books:**


| | |
|---|---|
| 1 | Stuart melvile and waynegoddard “Rearch methodology an introduction for science & engineering students” |
| 2 | Wayne Goddard and stuart Melville, “research methododlogy: An introduction” |
| 3 | Ranjitkumar, second edition, “Rearch methodology : A step by step guide for beginners” |
| 4 | Halbert, “ Resisting intellectual property”, Taylor and Francis Ltd, 2007 |


**Reference Books:**


| | |
|---|---|
| 1 | Mayall, “Industrial design” McGraw Hill, 1992 |
| 2 | Niebel, “ Product design” McGraw Hill, 1974 |
| 3 | Asimov, “Introduction to Design”, Prentice Hall, 1962. |
| 4 | Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age,” 2016. |
| 5 | T. Ramappa, “Intellectual Property Rights Under WTO”. S. Chand 2008. |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Understand research problem formulation |
| **CO2** | Analysis research related information |
| **CO3** | Follow research ethics. |
| **CO4** | Understand that today's world controlled by Computer, Information technology, but tomorrow world ruled by ideas, concept and creativity. |
| **CO5** | Understand that IPR production provides an incentive to inventors for further research work and investment in R&D, which leads to creation of new and better products, and in turnbrings about, economic growth and social benefits. |

| **22STC21** | **FINITE ELEMENT METHOD IN STRUCTURAL ENGINEERING** | | **Semester** | | | **II** |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **PC** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |

| | |
|---|---|
| 1 | To have a detailed knowledge and understanding of the fundamental concept of finite element methods |
| 2 | To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems |
| 3 | To develop proficiency in the application of the finite element methods (modeling, analysis, and interpretation of results) to realistic engineering problems |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **INTRODUCTION** | **9** | **0** | **0** | **9** |

Historical background – mathematical modeling of field problems in engineering – governing equation – discrete and continuous models – boundary, initial and eigen value problems – weighted residual methods – variational formulation of boundary value problems – Ritz technique – basic concepts of finite element method – advantage, disadvantage of finite element analysis and its applications.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **ONE DIMENSIONAL PROBLEMS** | **9** | **0** | **0** | **9** |

One dimensional second order equation – discretization – element types – linear and higher order elements – derivation of shape functions and stiffness matrices and force vectors – assembly of matrices.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **TWO-DIMENSIONAL SCALAR VARIABLE PROBLEMS** | **9** | **0** | **0** | **9** |

Second order 2D equations involving scalar variable functions – variational formulation – finite element formulation – triangular elements – shape function and element matrices and vectors. Application to field problems.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **TWO-DIMENSIONAL VECTOR VARIABLE PROBLEMS** | **9** | **0** | **0** | **9** |

Equations of elasticity – plane stress, plane strain, and axisymmetric problems – body forces and temperature effects – stress calculations – plate and shell elements

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **ISOPARAMETRIC FORMULATION** | **9** | **0** | **0** | **9** |

Natural coordinate system – iso parametric elements – shape function for iso parametric elements – one and two dimensions – serendipity elements – numerical integration and application to plane stress problem – matrix solution techniques – solution techniques to dynamic problems – introduction of analysis software

**Total 45 Periods**

**Text Books:**


| | |
|---|---|
| 1 | Rao S.S., The Finite Elements Method in Engineering, EL Service, New Delhi, 2005 |
| 2 | Rajasekaran S., Finite Element Analysis in Engineering Design, Wheeler Publishing 2020 |


**Reference Books:**


| | |
|---|---|
| 1 | Desai C.S., Elementary Finite Element Method, Prentice Hall, INC, 2011 |
| 2 | Chandrapatla Tirupati R and Belegundu Ashok D, Introduction to Finite Elements in Engineering 4th edition, Prentice Hall of India, 2015 |
| 3 | Krishnamoorthy C.S., Finite Element Analysis – Theory and programming, Second edition, Tata McGraw Hill Publishing Co.,2017 |
| 4 | Segerlind Larry J., Applied Finite element Analysis, John Wiley and Sons Inc., 2010 |
| 5 | Seshu T.N, Finite Element Analysis – Theory and Programming, Second Edition, Tata McGraw Hill Publishing Co., 2003 |


**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | discretize the structure and also to formulate boundary value problems of finite element method |
| **CO2** | develop shape function and element stiffness matrices for 1D elements and solve structures made up of 1D elements using FEM |
| **CO3** | solve 2D scalar variable problems |
| **CO4** | formulate 2D FEM elements for plane stress and plane strain problems |
| **CO5** | built iso parametric elements, serendipity, Lagrangian elements and axisymmetry elements for 2D stress analysis |

| | | | | | | |
|---|---|---|---|---|---|---|
| **22STC22** | **STRUCTURAL DYNAMICS** | | **Semester** | | | **II** |
| **PREREQUISITES** | | **Category** | **PC** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | To impart the knowledge to the students about vibrations theory on stable structural systems, the response of a structure to a dynamic load. | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **PRINCIPLES OF DYNAMICS** | **9** | **0** | **0** | **9** |
| Vibration and its importance to structural engineering problems - Elements of vibratory systems and simple harmonic motion - generalized mass - D'Alembert's principle - Mathematical modeling of dynamics systems - Degree of Freedom - equation of motion for SDOF - damped and undamped free vibrations - Undamped forced vibration - Critical damping - response to harmonic excitation - damped or undamped - evaluation of damping - resonance - force transmitted to foundation - Vibration Isolation - | | | | | |
| **Unit II** | **MULTIPLE DEGREE OF FREEDOM SYSTEM** | **9** | **0** | **0** | **9** |
| Mathematical modeling of MDOF systems - Two degree of freedom systems - Damped and Undamped free vibration - Undamped forced vibration - Normal modes of vibration - Free and forced vibrations of MDOF systems - Orthogonality of normal modes - Approximate methods - Holzer, Rayleigh and Mode superposition techniques. | | | | | |
| **Unit III** | **DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE** | **9** | **0** | **0** | **9** |
| Mathematical modeling of MDOF systems - Two degree of freedom systems - Damped and Undamped free vibration - Undamped forced vibration - Normal modes of vibration - Free and forced vibrations of MDOF systems - Orthogonality of normal modes - Approximate methods - Holzer, Rayleigh and Mode superposition techniques. | | | | | |
| **Unit IV** | **CONTINUOUS SYSTEMS** | **9** | **0** | **0** | **9** |
| Mathematical modeling of continuous systems - Free and forced vibration of continuous systems - axial vibration of a beam - flexural vibration of a beam - Rayleigh- Ritz method - Formulation using Conservation of Energy - Formulation using Virtual Work. | | | | | |
| **Unit V** | **SPECIAL TOPICS IN STRUCTURAL DYNAMICS(CONCEPTS ONLY)** | **9** | **0** | **0** | **9** |
| Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery - Base Isolation. | | | | | |
| **Total 45 Periods** | | | | | |

**Text Books:**

| | |
|---|---|
| 1 | Dynamics of Structures, Clough R. W. and Penzien J., McGraw Hill. |
| 2 | Structural Dynamics and Introduction to Earthquake Engineering, Chopra A. K.,Pearson, 2014. |

**Reference Books:**

| | |
|---|---|
| 1 | Structural Dynamics - Vibrations and Systems, Madhujit Mukhopadhyay, Ane Books India.2008. |
| 2 | Dynamics of Structures, Humar J. L., Prentice Hall. |
| 3 | Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication. |
| 4 | Dynamics of Structures with MATLAB Applications, Ashok K.Jain,Pearson, 2016. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Evaluate the dynamics response of SDOF and MDOF systems using fundamental theory and equation of motion. |
| **CO2** | Analyze the continuous system subjected to dynamic loading. |

| | |
|---|---|
| **CO3** | Solve the dynamic response by using various numerical methods. |
| **CO4** | Study the effect of Wind, Moving loads,Vibration etc on structures. |

| | | | | | | |
|---|---|---|---|---|---|---|
| **22STC23** | **MODEL TESTING LAB** | | **Semester** | | | **II** |
| **PREREQUISITES** | | **Category** | **PC** | **Credit** | | **2** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **0** | **0** | **2** | **2** |
| **Course Learning Objectives** | | | | | | |
| 1 | To impart practical knowledge to the students to understand the behavior of concrete structures and about the Non destructive tests, their field applications by applying engineering principles. | | | | | |
| **EXPERIMENTS** | | | | | | |
| 1. | Determination of stress-strain curve of high strength concrete | | | | | |

| | |
|---|---|
| 2. | Determination of Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture of concrete. |
| 3. | Cyclic loading test |
| 4. | Non-Destructive testing on existing concrete members through<br>i) Rebound hammer and<br>ii) Ultrasonic pulse velocity test<br>iii) Measurement of cracks |
| 5. | Experimental study on the behavior of beam under flexure |
| 6. | Experimental study on the behavior of beam under shear |
| 7. | Corrosion study on reinforced concrete |
| 8. | Rapid chloride penetration test (RCPT) on concrete |
| 9. | Determination of density of hardened concrete using automated buoyancy balance |
| 10. | Perform the dynamic test on beam to determine the damping co-efficients for free vibration. |
| | **Total (45)Periods** |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | After completing all the experiments prescribed, students will be able to design high grade concrete and study the parameters affecting its performance |
| **CO2** | Students will be able to conduct Non Destructive tests, corrosion test and RCPT on concrete |
| **CO3** | On completion of this laboratory course students will be able to cast and test RC beams for flexure and shear behavior |
| **CO4** | They will be able to test cyclic load testing on beams |

| **22STC24** | **NUMERICAL ANALYSIS LAB** | | **Semester** | | | **II** |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **EEC** | **Credit** | | **2** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **0** | **0** | **2** | **2** |
| **Course Learning Objectives** | | | | | | |
| 1 | To obtain the numerical solution of non- linear system of equations by using Bisection and Newton's methods and To acquire the knowledge with Curve fitting by Least Square approximations. To find the solution of system of linear equations using Gauss Elimination, Gauss Seidal, Gauss Jordan methods. To familiarize with numerical integration using Trapezoidal and Simpson's rules. To familiarize with numerical solution of ordinary differential equations using Euler's and Runge-Kutta methods. | | | | | |

| SYLLABUS CONTENTS | |
|---|---|
| 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 equation using Gauss Elimination Method |
| 5 | Solve the System of Linear equation using Gauss Seidal Iteration Method |
| 6 | Solve the System of Linear equation using Gauss Jordan Method |
| 7 | Integrate numerically using Trapezoidal rule |
| 8 | Integrate numerically using Simpson's rule |
| 9 | Numerical Solution of Ordinary Differential equations by Euler's Method |
| 10 | Numerical Solution of Ordinary Differential equations by Runge- Kutta Method |
| | **Total (45+15) = 60 Periods** |

| **Text Books:** | |
|---|---|
| 1 | Fausett. L.V., "Applied Numerical Analysis Using MATLAB" , Pearson Education Pvt. Ltd., 2nd edition, 2007 |
| **Reference Books:** | |
| 1 | Chapra. S.C. and Canale. R.P, Numerical Methods for Engineers, Tata Mcgraw Hill Publications, 5th edition, 2006 |
| 2 | Structural Dynamics by using MATLab |
| 3 | Introduction to MATLab |
| **RELATED VIDEO COURSES** | |
| 1 | Computational Techniques: http://nptel.ac.in/courses/103106074/ |
| 2 | Numerical Methods and Programming: http://nptel.ac.in/courses/122106033 |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Obtain the numerical solutions of non-linear equations using Bisection and Newton's method |
| **CO2** | Do curve fitting by least square approximations |
| **CO3** | Solve the system of linear equations using Gauss -Elimination / Gauss -Seidal iteration / Gauss Jordan Method |
| **CO4** | Integrate numerically using Trapezoidal and Simpson's rules |
| **CO5** | Obtain the numerical solution of ordinary differential equations by Euler's and Runge-Kutta methods |

| 22STC25 | MINI PROJECT | | Semester | | | II |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **EEC** | **Credit** | | **2** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **0** | **0** | **4** | **4** |
| **Course Learning Objectives** | | | | | | |
| 1 | Identify structural engineering problems reviewing available literature | | | | | |
| 2 | Study different techniques used to analyze complex structural systems | | | | | |
| 3 | work on the solutions given and present solution by using his/her technique applying engineering principles | | | | | |
| **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.

| 22STC31 | DISSERTATION I | | | | |
|---|---|---|---|---|---|
| | Category | EEC | Credit | | 10 |
| | Hours/Week | L | T | P | TH |
| | | 0 | 0 | 20 | 20 |

**Course Outcomes:**

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

**Syllabus Contents**

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

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

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

| 22STC41 | DISSERTATION II | | | | |
|---|---|---|---|---|---|
| | **Category** | **EEC** | **Credit** | | **16** |
| | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | **0** | **0** | **32** | **32** |

**Course Outcomes:**

| | |
|---|---|
| 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 an extension of the to 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 a pre submission seminar at the end of the academic term. After the approval the student has to submit the detailed report and an external examiner is called for the viva-voce to assess along with the guide.

| 22STE11 | THEORY OF THIN PLATES AND SHELL | Semester | | | I |
|---|---|---|---|---|---|
| PREREQUISITES | Category | PE | Credit | | 3 |
| | Hours/Week | L | T | P | TH |
| | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about theory of plates, special and approximate methods of analysis of plates. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **INTRODUCTION** | **9** | **3** | **0** | **12** |

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

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **STATIC ANALYSIS OF PLATES** | **9** | **3** | **0** | **12** |

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

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **CIRCULAR PLATES** | **9** | **3** | **0** | **12** |

Analysis under Axi- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in RectangularPlates.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **STATIC ANALYSIS OF SHELLS** | **9** | **3** | **0** | **12** |

Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **SHELLS OF REVOLUTION** | **9** | **3** | **0** | **12** |

Shells of Revolution: with Bending Resistance - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels. Thermal Stresses in Plate and Shell.

**Total -45Periods**

**Text Books:**

| | |
|---|---|
| 1 | Theory of Plates and Shells, Timoshenko S. and KriegerW., McGraw Hill.2nd edition 1987. |
| 2 | Stresses in Plates and Shells, UguralAnsel C., McGraw Hill. illustrated edition 1981 |

**Reference Books:**

| | |
|---|---|
| 1 | Thin Elastic Shells, Kraus H., John Wiley and Sons.1st edition1967. |
| 2 | Theory of Plates, ChandrashekharaK., Universities Press. 2001,Illustrated edition |
| 3 | Design and Construction of Concrete Shells, Ramaswamy G.S., R.E.Krieger 1984, 2nd edition |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | At the end of the course, students will be able to Use analytical methods for the solution of thin plates and shells. |
| **CO2** | Use analytical methods for the solution of shells. |
| **CO3** | Apply the numerical techniques and tools for the complex problems in thin plates. |
| **CO4** | Apply the numerical techniques and tools for the complex problems in shells. |

| | | | | |
|---|---|---|---|---|
| **22STE12** | **THEORY AND APPLICATIONS OF CEMENT COMPOSITES** | **Semester** | | **I** |
| **PREREQUISITES** | **Category** | **PE** | **Credit** | **3** |

| | | L | T | P | TH |
|---|---|---|---|---|---|
| | Hours/Week | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge on the material properties of ferrocement, analysis, design and construction of ferrocement structures. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **INTRODUCTION** | **9** | **0** | **0** | **9** |

Composites and Multi-phase materials – Components of Composite materials – Classifications – Structure of Composite materials – Models and Theories.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **MECHANICAL BEHAVIOUR** | **9** | **0** | **0** | **9** |

Concrete like Composites – Kinds – Ordinary Concrete – Fiber Reinforced Cement Matrices – Ferrocement and Textile Reinforcement – Components and Applications – Interfaces in Cement Composites – Kinds of Interfaces – Aggregate Cement paste interface – Fiber Cement paste interface – Interface between old and new composites.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **CEMENT COMPOSITES** | **9** | **0** | **0** | **9** |

Types of Cement Composites, Terminology, Constituent Materials and their Properties, Reinforcement of Cement based Composites – Glass fiber – Steel fiber – Synthetic Polymeric fiber – Carbon fiber – Vegetable fiber – Textile fiber, Construction Techniques for Fibre Reinforced Concrete - Ferrocement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting and Curing.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **MECHANICAL PROPERTIES OF CEMENT COMPOSITES** | **9** | **0** | **0** | **9** |

Behavior of Ferrocement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability and Corrosion.

**Application of Cement Composites:** FRC and Ferrocement- Housing, Water Storage, Boats and Miscellaneous Structures.
Composite Materials- Orthotropic and Anisotropic behaviour, Constitutive relationship, Elastic Constants.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **ANALYSIS AND DESIGN OF CEMENT COMPOSITE STRUCTURAL ELEMENTS** | **9** | **0** | **0** | **9** |

Ferrocement, SIFCON and Fibre Reinforced Concrete.

**Total -45Periods**

**Reference Books:**


| | |
|---|---|
| 1 | Cement – Based Composites Materials, Mechanical Properties and Performance, Andrzej M Brandt, 2nd Ed., Taylor and Francis, CRC Press, 2017. |
| 2 | Mechanics of Composite Materials, Jones R. M,, 2nd Ed.,Taylor and Francis, BSP Books, 2015. |
| 3 | Ferrocement – Theory and Applications, Pama R. P., IFIC, 1987. |
| 4 | New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983. |


**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behaviour |
| **CO2** | Classify the materials as per orthotropic and anisotropic behavior. |
| **CO3** | Estimate strain constants using theories applicable to composite materials. |
| **CO4** | Analyse and design structural elements made of cement composites. |

| | | | | | |
|---|---|---|---|---|---|
| **22STE13** | **THEORY OF STRUCTURAL STABILITY** | | **Semester** | | **I** |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |

| | | | | | |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students on the behaviour of structural elements under compression, the stability of columns and plates, lateral buckling of beam and column design formula. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **STABILITY OF COLUMNS** | **9** | **0** | **0** | **9** |

Concepts of Elastic Structural stability- Analytical approaches to stability - characteristics of stability analysis- Elastic Buckling of columns- Equilibrium; Energy and Imperfection approaches – Non-prismatic columns- Built up columns- Buckling modes- Effect of shear on buckling load - Large deflection theory.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **METHODS OF ANALYSIS AND IN ELASTIC BUCKLING** | **9** | **0** | **0** | **9** |

Approximate methods – Rayleigh and Galerkin methods – numerical methods – Finite difference and finite Element - analysis of columns – Experimental study of column behaviour – South well plot - Column curves - Derivation of Column design formula - Effective length of Columns - Inelastic behaviour- Tangent modulus and Double modulus theory.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **BEAM COLUMNS AND FRAMES** | **9** | **0** | **0** | **9** |

Beam column behaviour- standard cases- Continuous columns and beam columns – Columns on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Use of Wood's charts.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **BUCKLING OF BEAMS** | **9** | **0** | **0** | **9** |

Lateral buckling of beams – Energy method- Application to Symmetric and single symmetric I beams – simply supported and Cantilever beams - Narrow rectangular cross sections- – Numerical solutions – Torsional buckling – Uniform and non-uniform Torsion on open cross section - Flexural torsional buckling – Equilibrium and energy approach.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **BUCKLING OF THIN PLATES** | **9** | **0** | **0** | **9** |

Isotropic rectangular plates - Governing Differential equations - Simply Supported on all edges – Use of Energy methods – Numerical Techniques.

**Total -45Periods**

**Text Books:**

| | |
|---|---|
| 1 | **Chajes A, Principles of Structural Stability Theory, Prentice Hall, Inc., New Jersey 1974** |
| 2 | Ashwinikumar, Stability of Structures, Allied Publishers Ltd, 1998 |

**Reference Books:**

| | |
|---|---|
| 1 | Iyengar N.G.R, Structural Stability of Columns and Plates, Affiliated East- West Press Pvt. Ltd., 1988 |
| 2 | Stephen P. Timoshenko and Gere, Theory of Elastic Stability, McGraw-Hill Company 2012 |
| 3 | Allen H.G and Bulson P.S., Background to Buckling, McGraw-Hill Book Company, 1980 |
| 4 | Smitses, Elastic Stability of Structures, Prentice Hall, 1998 |
| 5 | Brush and Almorth, Buckling of Bars, Plates and Shells, McGraw-Hill Book Company, 1975 |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Will have knowledge about the concepts of structural stability and analytical approaches |
| **CO2** | Will have an understanding of the methods of analysis and inelastic behaviour of columns, lateral and torsional buckling of beams and buckling of thin plates. |
| **CO3** | Will also be able to perform advanced experiments on beam columns and frames. |
| **CO4** | Publish papers in conferences and journals. |

| **22STE14** | **CORROSION AND ITS PREVENTION** | | **Semester** | | | **I** |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |

| | |
|---|---|
| 1 | To study the environmental effects on structures, corrosion, tests and prevention of corrosion. |
| 2 | To understand the mechanism of corrosion. |
| 3 | To recognize the importance of corrosion prevention and control planning. |
| 4 | To know about the various methods of protective measures against corrosion. |
| 5 | To get know about the chemicals and materials used as inhibitors for corrosion activities in concrete. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **INTRODUCTION** | **9** | **0** | **0** | **9** |

Corrosion of steel reinforcement in concrete, definition of corrosion, forms of corrosion, phenomenon of corrosion, corrosion initiation-environment-cover thickness-quality of cover concrete-type of steel and critical chloride- presence of cracks, corrosion propagation-electrochemical process-physical process, theory of reinforcement corrosion-basic corrosion cell-anode and cathode-electrolyte-corrosion potential and rate of corrosion.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **IDENTIFICATION AND APPRAISAL OF CORROSION** | **9** | **0** | **0** | **9** |

Corrosion process and mechanism-approach to investigation-visual observation and documentation, in situ testing of concrete-rebound hammer test, cover meter survey-ultrasonic pulse velocity(UPV) test-core sampling and testing, insitu testing of steel rebar-carbonation test and pH value, chloride content-half cell potential survey- resistivity mapping-measurement of corrosion rate.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **MONITORING OF CORROSION** | **9** | **0** | **0** | **9** |

Methods used for monitoring corrosion-open circuit potential measurement, resistivity measurement, corrosion cell ratio, electrical resistance probe method, polarization resistance technique, impedance technique, guard ring technique, electrochemical noise analysis.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **PROTECTIVE MEASURES** | **9** | **0** | **0** | **9** |

Coating to reinforcement- metallic coatings-epoxy coatings-cement based coatings-coating to prestressing steel,galvanized reinforcement, stainless steel, non-ferrous reinforcement and coating to concrete surface, improving the concrete, corrosion resistant steel.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **INHIBITORS FOR CONCRETE** | **9** | **0** | **0** | **9** |

Definition of inhibitor-anodic and cathodic inhibitors-rice husk ash, fly ash, electrochemical removal of chloride from concrete, non-metallic materials, carbon FRP, glass FRP, parafil tendons.

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | 1.Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007. |
| 2 | 2.U.Kamachi Mudali Baldev Raj,S.Rangarajan Corrosion prevention and control,Narosa Publication,2009 edition. |
| | 3.R.D.Angal, Principles and prevention of corrosion,Narosa Publication,2010 edition. |


**Reference Books:**


| | |
|---|---|
| 1 | Fontanna, G,Mars,"Corrosion Engineering",ThirdEdition,McGraw-Hill Book Company,Third Edition,2017. |
| 2 | Kumar Mehta,P.,"Concrete-Structure,Properties and Materials", Prentice-Hall, INC, Englewood Cliffs, New Jersey,1993 |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | To know about phenomenon of corrosion, its propagation and the methods to monitor corrosion. |
| **CO2** | To measure the rate of corrosion using Ultrasonic Pulse Velocity technique. |
| **CO3** | To understand different protective measures like coatings to concrete structures. |
| **CO4** | To design Protection system against corrosion of infrastructure,plant,equipment and machinery.<br>Ability to undertake corrosion problem identification ,formulation and solution. |

| **22STE21** | **ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING** | | **Semester** | | | **I** |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |

| | |
|---|---|
| 1 | To familiarize the numerical solution of linear system of equations and acquire the knowledge with interpolation and curve fitting by least squares.to impart the knowledge in solving initial value problems for ordinary differential equations. To obtain the finite difference solution of one dimensional wave equation and two dimensional Laplace and Poisson equations |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS** | **9** | **0** | **0** | **9** |
| Method of false position , Iterative method , Newton Raphson method-Solutions of linear system of equations by Gauss Elimination, Gauss Jordan, Gauss Jacobi and Gauss Seidal methods-Eigen value of a matrix by Power method. | | | | | |
| **Unit II** | **INTERPOLATION AND APPROXIMATION** | **9** | **0** | **0** | **9** |
| Interpolation with Newton's divided difference, Lagrangian polynomial, Newton Forward and Backward differences- Least Square polynomial approximations (Curve fitting) | | | | | |
| **Unit III** | **NUMERICAL DIFFERENTIATION AND INTEGRATION** | **9** | **0** | **0** | **9** |
| Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoidal rule-Simpson's 1/3 rule, Simpson's 3/8 rule –Double integrals using by Trapezoidal rule and Simpson's rule | | | | | |
| **Unit IV** | **INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** | **9** | **0** | **0** | **9** |
| Single step methods: Taylor series method-Euler and modified Euler method-Fourth order Runge-Kutta method for first and second order differential equations- Multistep method: Milne and Adam's-Bashforth predictor and corrector methods | | | | | |
| **Unit V** | **BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFRENTIAL EQUATIONS** | **9** | **0** | **0** | **9** |
| Finite difference solution of second order ordinary differential equations-Finite difference solutions of one dimensional heat equation by explicit and implicit methods-One dimensional wave equation and two dimensional Laplace and Poisson equations. | | | | | |
| **Total -45Periods** | | | | | |

**Text Books:**

| | |
|---|---|
| 1 | Veerarajan. T and Ramachandran, "Numerical methods with Programs in C and C++ ",Tata McGraw Hill, New Delhi,2006 |
| 2 | Kandasamy.P, Thilagavathy.K, Gunavathi.K, "Numerical Methods" S.Chand& Co., New Delhi, 2005 |

**Reference Books:**

| | |
|---|---|
| 1 | Gerald, C. F. and Wheatley, P.O.," Applied Numerical Analysis" , Sixth Edition , Pearson Education Asia , New Delhi – 2002 |
| 2 | M.K.Venkataraman, "Numerical Methods", National Publishing Company,2000 |
| 3 | Jain M.K.Iyengar, K & Jain R.K., "Numerical Methods for Scientific and Engineering Computation ", New Age International (P) Ltd, Publishers 2003 |
| 4 | Manish Goyal, "Numerical Methods and Statistical techniques Using 'C' ", 1st Edition, Laxmi Publications (P) Ltd, 2009 |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Obtain the numerical solutions of linear and non-linear equations |

| | |
|---|---|
| **CO2** | Acquire the techniques of interpolation and approximations |
| **CO3** | Familiarize with the numerical differentiation and integration. |
| **CO4** | Solve the initial value problems for ordinary differential equations |
| **CO5** | Good knowledge about different concreting methods |

| | | | | | | |
|---|---|---|---|---|---|---|
| **22STE22** | **STRUCTURAL HEALTH MONITORING** | | **Semester** | | | **I** |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | To diagnose the distress in the structure understanding the causes and factors and Assess the health of structure using static field methods. To Assess the health of structure using dynamic field tests and Suggest repairs and rehabilitation measures of the structure | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **STRUCTURAL HEALTH** | **9** | **0** | **0** | **9** |
| Philosophy for design to resist earthquake, cyclone and flood – National and international codes of practice – Bye law of urban and semi-urban area – Traditional and modern structures | | | | | |
| **Unit II** | **STRUCTURAL HEALTH MONITORING** | **9** | **0** | **0** | **9** |
| Concepts, Various Measures, Structural Safety in Alteration | | | | | |
| **Unit III** | **STRUCTURAL AUDIT** | **9** | **0** | **0** | **9** |
| Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, Issue of Stability certificate | | | | | |
| **Unit IV** | **FIELD TESTING** | **9** | **0** | **0** | **9** |
| **Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement, Issue of stability certificate.<br>**Dynamic Field Testing:** Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring. | | | | | |
| **Unit V** | **INTRODUCTION TO REPAIRS AND REHABILITATIONS OF STRUCTURES** | **9** | **0** | **0** | **9** |
| Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique. | | | | | |
| **Total -45Periods** | | | | | |

| **Text Books:** | |
|---|---|
| 1 | Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2010. |
| 2 | Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007 |
| **Reference Books:** | |
| 1 | Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006 |
| 2 | Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2nd Edition 2014 |
| 3 | Handbook on Repair and Rehabilitation of RCC Buildings, Central Public Works Department, Government of India. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Able to demonstrate the condition of structures |
| **CO2** | Will able to inspect and evaluate the damaged structures |
| **CO3** | Will able to implement the repairing techniques of a structure |
| **CO4** | Will demonstrate the dismantling and demolishing structures |

| 22STE23 | STRUCTURAL OPTIMIZATION | | Semester | | | I |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |
| Course Learning Objectives | | | | | | |
| 1 | To impart knowledge to the students on structural optimization techniques, computer search methods and optimization theorems. | | | | | |
| Unit I | BASIC PRINCIPLES, CLASSICAL OPTIMIZATION TECHNIQUES | | 9 | 0 | 0 | 9 |

Definition – Objective function, Constraints – Equality and inequality – Linear and non-linear, Side, Non-negativity, Behaviour and other constraints – Design space – Feasible and infeasible – Convex and Concave – Active constraint – Local and global optima. Differential calculus – Optimality criteria – Single variable optimization – Multivariable optimization with no constraints – Lagrange Multiplier Method with equality constraints – Khun-Tucker Criteria with inequality constraints.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **LINEAR PROGRAMMING** | **9** | **0** | **0** | **9** |

Formulation of problems – Graphical solution – Analytical methods – Standard form – Slack, Surplus and Artificial variables – Canonical form – Basic feasible solution – Simplex Method – Two phase method – Penalty method – Duality theory – Primal-Dual algorithm.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **NON-LINEAR PROGRAMMING** | **9** | **0** | **0** | **9** |

One dimensional minimization methods: Unidimensional – Unimodal function – Exhaustive and Unrestricted search – Dichotomous search – Fibonacci Method – Golden Section Method – Interpolation methods. Unconstrained optimization techniques.

Multivariables: Unconstrained multivariable functions – Univariate method – Cauchy's steepest descent method – Conjugate gradient method (Fletcher Reeves) – Variable metric method (Davidon Fletcher Powell).

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **GEOMETRIC & DYNAMIC PROGRAMMING** | **9** | **0** | **0** | **9** |

Posynomial – degree of difficulty – reducing GPP to a set of simultaneous equations – Unconstrained and constrained problems with zero degree of difficulty – Concept of solving problems with one degree of difficulty. Bellman's principle of optimality – Representation of a multistage decision problem – Concept of sub-optimization problems using classical and tabular methods.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **STRUCTURAL APPLICATIONS** | **9** | **0** | **0** | **9** |

Methods for optimal design of structural elements, continuous beams and single storeyed frames using plastic theory – Minimum weight design for truss members – Fully stressed design.

**Total -45Periods**

**Text Books:**

| | |
|---|---|
| 1 | Singiresu S Rao, Optimization Theory and Applications, New Age International (P) Ltd., Publishers, New Delhi, 2018 |
| 2 | Uri Krish, Optimum Structural Design, McGraw-Hill Book Co. |

**Reference Books:**

| | |
|---|---|
| 1 | Gupta P.K. &Hira D.S, Operations Research and Quantitative Analysis, S.Chand& Company Ltd., New Delhi 2015 |
| 2 | Spunt, Optimization in Structural Design, Prentice-Hall, New Jersey 1971 |
| 3 | Spunt, Optimization in Structural Design, Prentice-Hall, New Jersey 2005. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Apply the knowledge of engineering fundamentals to formulate and solve the Engineering problems by classical optimization techniques. |

| | |
|---|---|
| **CO2** | Identify, formulate and solve engineering problems by linear and non-linear Programming. |
| **CO3** | Analyse the problem and reducing G.P.P to a set of simultaneous equations. |
| **CO4** | Design various structural elements with minimum weight. |

| | | | | | | |
|---|---|---|---|---|---|---|
| **22STE24** | **EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION** | | **Semester** | | | **I** |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | To impart knowledge about the measurement of force, strain, vibration, wind flow, distress and nondestructive testing techniques | | | | | |
| **Unit I** | **FORCE AND STRIN MEASUREMENTS** | | **9** | **0** | **0** | **9** |

Strain gauges, Principle, Types, Performance and Uses-Photo elasticity, Principle and applications – Hydraulic jack and pressure gauges – Electronic load cell – Proving rings – Calibration of testing machines

| Unit II | VIBRATION MEASUREMENTS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Characteristics of structural vibrations – Linear Variable Differential Transducer (LVDT) – Transducers for velocity and acceleration measurements – Vibration meter – Seismographs – Vibration analyzer – Electro dynamic exciters – Display and recording of signals – Cathode Ray Oscilloscope – XY plotters – Chart plotters – Digital and Acquisition systems - Principles and Applications.

| Unit III | ACOUSTICS AND WIND FLOW MEASUREMENTS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Principles of pressure and flow measurements – Pressure transducer – Sound level meter – Venturimeter and Flow meters – Wind tunnel and its use in structural analysis – structural modeling - Direct and indirect model analysis

| Unit IV | DISTRESS MEASUREMENTS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Diagnosis of distress in structures- Crack observation and measurement – Corrosion of reinforcement in concrete – Half cell , construction and use – damage assessment – Controlled blasting for demolition

| Unit V | NON DESTRUCTIVE TESTING METHODS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Load testing of structures, buildings, bridges and towers – Rebound hammer – Ultra sonic testing, principle and applications – Moiré fringes – brittle coatings – Holography – Use of lasers for structural testing

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Sadhu Singh, "Experimental Stress Analysis",Khanna Publishers, New Delhi, 2009. |


**Reference Books:**


| | |
|---|---|
| 1 | Karthick and Balaji S, "Applications and Techniques for Experimental Stress Analysis", 2019. |
| 2 | Dalley.J.W.andRiley.W.F., "Experimental Stress Analysis", Tata McGraw Hill Book Co. |
| 3 | Srinath L.S., et al, Experimental Stress Analysis, Tata McGraw Hill Co., New Delhi, 1984. |
| 4 | Sironi R.S and Radha Krishna H.C.,Mechanical Measurements, New Age International (P) Ltd. |


**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Familiarize with various types of measuring devices and their working principles |
| **CO2** | Able to select a measuring device for a specific experimental work |
| **CO3** | Able to conduct experiments, observe and interpret data. |
| **CO4** | Obtained the expected results from the interpretation. |

| 22STE31 | ADVANCED STEEL DESIGN | | Semester | | | II |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |
| Course Learning Objectives | | | | | | |
| 1 | To understand the property of structural steel and gain knowledge of design of steel structures. To understand about connections and the knowledge about design of beam columns and study about the light gauge steel structures | | | | | |
| Unit I | INTRODUCTION | | 9 | 0 | 0 | 9 |

**Properties of Structural Steel**: Mechanical Properties, Hysteresis, Ductility.Hot Rolled Sections: Compactness and non compactness, slenderness, residual stresses.

**Design of Steel Structures**: Inelastic bending curvature, plastic moments, design criteria stability, strength, drift. Methods of Designs: Allowable stress design, Philosophies of limit state design, Plastic Design, Load and Resistance factor design

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **ECCENTRIC AND MOMENT CONNECTIONS** | **9** | **0** | **0** | **9** |

Introduction – Beam-Column Connections- Connections Subjected to Eccentric Shear – Moment Resistant Connections – Bolted & Welded - Framed Connections- Seated Connections –Bracket Connections.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **DESIGN OF BEAM COLUMNS** | **9** | **0** | **0** | **9** |

Introduction – General behavior of beam-columns – codal provision for local capacity check and overall buckling check – Design of beam-columns.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **PRE-ENGINEERED BUILDINGS** | **9** | **0** | **0** | **9** |

Introduction – connection details – design of typical portal frame from Industrial shed using IS: 800-2007.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **LIGHT GAUGE STEEL STRUCTURES** | **9** | **0** | **0** | **9** |

Types of cross sections - local buckling and lateral buckling - concepts of elastic width – design of compression and tension members, beams, deflection of beams and design of beam webs.

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Duggal S.K., Limit State Design of Steel Structures,TataMcGraw Hill Education Private Ltd.,New Delhi , 2017 |
| 2 | Subramanian N, Design of Steel Structures, Oxford University Press, 2013 |
| 3 | Ramchandra S and VirendraGehlot, Limit State Design of Steel Structures, Standard Publication, New Delhi, 2013 |
| 4 | M.R. Sheyekar "Limit state design in Structural Steel", 1st Edition, PHI Publications, 2010. |
| 5 | Wie-Wen Yu.,"Cold-Formed Steel Structures"-Wheeler Publishing.2012 |
| 6 | William T.Segui"LFRD Steel Design" PWS Publishing, 2013 |


**Reference Books:**


| | |
|---|---|
| 1 | Gaylord E.H, Gaylord N.C. and Stallmeyer, J.E, Design of Steel Structures, 3rd edition, McGraw-Hill Publications, 1992. |
| 2 | IS:875(part-III)-1987, Code of for design loads(other than earthquake for building and structures) |
| 3 | Teaching Resources for Structural Steel Design – Vol.I& II, INSDAG, Kolkatta. |
| 4 | IS: 811-1987, Cold Formed Light Gauge Structural Steel Sections |
| 5 | IS: 800-2007, Code of practice for general construction in steel |
| 6 | SP: 6(5) ISI Hand book for Structural Engineers – Cold-Formed Light gauge steel structures |
| 7 | IS: 801-1967, Code of practice for use of cold-formed light gauge steel structural members in general building construction |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Understand the behaviour of steel and design philosophies |
| **CO2** | They acquire knowledge to analysis and design of eccentric connections. |
| **CO3** | To acquire the knowledge of stability behavior of beam and column sections |
| **CO4** | Understand the behaviour of moment resistant frames used in pre-engineering buildings |
| | To learn the behavior and design of of light gauge steel axial and flexural members. |

| **22STE32** | **DESIGN OF FORMWORK** | | **Semester** | | | **II** |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | To gain knowledge of formwork and its materials and the various methods of design of formwork.<br>To study the design of special formwork structures and gain knowledge of flying formwork and understand about the failure of formwork. | | | | | |
| **Unit I** | **INTRODUCTION** | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| Requirements and Selection of Formwork.<br>Formwork Materials- Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Horizontal and Vertical Formwork Supports | | | | | |
| **Unit II** | **FORMWORK DESIGN** | **9** | **0** | **0** | **9** |
| Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams | | | | | |
| **Unit III** | **FORMWORK DESIGN FOR SPECIAL STRUCTURES** | **9** | **0** | **0** | **9** |
| Shells, Domes, Folded Plates, OverheadWater Tanks, Natural Draft Cooling Tower, Bridges. | | | | | |
| **Unit IV** | **FLYING FORMWORK** | **9** | **0** | **0** | **9** |
| Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award. | | | | | |
| **Unit V** | **FORMWORK FAILURES** | **9** | **0** | **0** | **9** |
| Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story Building Construction. | | | | | |
| **Total -45Periods** | | | | | |

**Reference Books:**


| | |
|---|---|
| 1 | Formwork for Concrete Structures, Peurify, McGraw Hill India, 2015. |
| 2 | Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012. |
| 3 | IS 14687: 2014, False work for Concrete Structures - Guidelines, BIS |


**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Select proper formwork, accessories and material. |
| **CO2** | Design the form work for Beams, Slabs, columns, Walls and Foundations. |
| **CO3** | Design the form work for Special Structures. |
| **CO4** | Understand the working of flying formwork. |
| **CO5** | Judge the formwork failures through case studies. |

| 22STE33 | DESIGN OF HIGH RISE STRUCTURES | Semester | | | II |
|---|---|---|---|---|---|
| PREREQUISITES | Category | PE | Credit | | 3 |
| | Hours/Week | L | T | P | TH |
| | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | The student is expected to understand the design of high rise structures and incorporate this in the design of structures to achieve both safety and economy. |

| Unit I | INTRODUCTION | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Design Philosophy - History - advantages and disadvantages - Vertical city concepts - essential amenities - fire safety - water supply - drainage and garbage disposal - service systems - structural and foundation systems. Factors affecting height, growth and form - Human comfort criteria.

| Unit II | DESIGN OF TRANSMISSION / TV TOWER | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Mast and trestles: Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.

| Unit III | ANALYSIS AND DESIGN OF RC CHIMNEY | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

RC Chimney-analysis and design, Foundation design for varied soil strata.

| Unit IV | BEHAVIOR OF STRUCTURAL SYSTEMS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Factors affecting the height and structural form,Behavior of Braced frames,Rigid frames,In filled frames,Shear walls,Coupled shear walls,Wall-Frames,Tubular.Outrigger braced,Hybrid systems.

| Unit V | ANALYSIS AND DESIGN OF TALL STRUCTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

| |
|---|
| Modeling for approximate analysis,Accurate analysis and reduction techniques,Analysis of structures as an integral unit,Analysis for member forces,drift and twist,Computerized 3D analysis,Firefighting design provisions. |
| **Total -45Periods** |

| **Reference Books:** | |
|---|---|
| 1 | Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., SouthAsian Publishers, New Delhi, 2002. |
| 2 | Structural Analysis and Design of Tall Buildings, Taranath B. S., McGraw Hill, 1988. |
| 3 | Illustrated Design of Reinforced Concrete Buildings(GF+3storeyed), Shah V. L. &Karve S. R., Structures Publications, Pune, 2013. |
| 4 | Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976. |
| 5 | Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991. |
| 6 | High Rise Building Structures, Wolfgang Schueller, Wiley., 1971. |

| **Course Outcomes:** Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | To understand the behavior of tall structures. |
| **CO2** | Analyze, design and detail Transmission/TV tower. |
| **CO3** | Analyze. design and detail of chimneys. |
| **CO4** | To understand the behavior of various structural forums. |
| **CO5** | To carry out the stability analysis. |

| **22STE34** | **DESIGN OF MASONRY STRUCTURES** | **Semester** | | | **II** |
|---|---|---|---|---|---|
| **PREREQUISITES** | **Category** | **PE** | **Credit** | | **3** |
| | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | **3** | **0** | **0** | **3** |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about masonry materials and to gain knowledge in determining the flexural and shear strength of the structure. This also guides to know its behavior and to study its modeling techniques. |

| **Unit I** | **INTRODUCTION** | **9** | **0** | **0** | **9** |
|---|---|---|---|---|---|
| Introduction Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces. | | | | | |
| **Unit II** | **FLEXURAL STRENGTH** | **9** | **0** | **0** | **9** |
| Flexural strength of Reinforced Masonry Members: In plane and Out-of-plane Loading. | | | | | |
| **Unit III** | **INTERACTIONS** | **9** | **0** | **0** | **9** |
| Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation | | | | | |
| **Unit IV** | **SHEAR STRENGTH** | **9** | **0** | **0** | **9** |
| Shear Strength and Ductility of Reinforced Masonry Members. Prestressed Masonry - Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams. | | | | | |
| **Unit V** | **ELASTIC AND INELASTIC ANALYSIS** | **9** | **0** | **0** | **9** |

| |
|---|
| Modeling Techniques, Static Push Over Analysis and use of Capacity Design Spectra. |
| **Total -45Periods** |

| **Reference Books:** | |
|---|---|
| 1 | Design of Reinforced Masonry Structures, NarendraTaly, ICC, 2nd Edn, |
| 2 | Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., Pearson College Div; 2nd edition (May 1, 1993). |
| 3 | Mechanics of Masonry Structures, Editor: Maurizio Angelillo, Springer; 2014 edition (March 21, 2014).India, 1986. |
| 4 | Earthquake-resistant Design of Masonry Buildings, TomaeviMiha, Imperial College Press, 1999. |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Understand the masonry design approaches. |
| **CO2** | Analyze Reinforced Masonry Members. |
| **CO3** | Determine interactions between members. |
| **CO4** | Check the stability of walls |
| **CO5** | Perform elastic and Inelastic analysis of masonry walls. |

| **22STE35** | **DESIGN OF PREFABRICATED STRUCTURES** | **Semester** | | | **II** |
|---|---|---|---|---|---|
| **PREREQUISITES** | **Category** | **PE** | **Credit** | | **3** |
| | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | **3** | **0** | **0** | **3** |

| **Course Learning Objectives** | |
|---|---|
| 1 | To impart knowledge to the students about structural design of prefabricated structures, industrial buildings and shell roof structures. |

| **Unit I** | **INTRODUCTION AND DESIGN PRINCIPLES** | **9** | **0** | **0** | **9** |
|---|---|---|---|---|---|
| General civil engineering requirements, specific requirements for planning and layout of prefabricating plant - IS Codal specifications - Modular co- ordinations, standardizations, Disuniting of Prefabricates, productions, transportations, erection, stages of loading and codal provisions, safety factor, material properties, deflection control, lateral load resistance. | | | | | |
| **Unit II** | **REINFORCED CONCRETE PREFARICATED STRUCTURAL ELEMENTS** | **9** | **0** | **0** | **9** |
| Prefabricated Structures – long wall, cross- wall, large panel buildings, one way and two way prefabricated slabs, framed buildings with partials and curtain walls, single storey industrial buildings with trusses, shells, crane- gantry systems. | | | | | |
| **Unit III** | **FLOORS, STAIRS, ROOFS AND WALLS** | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| Types of floor slabs, analysis and design example of cored and panel types and two- way systems, staircase slabs design, types of roof slabs and insulation requirements, description of joints, their behavior and reinforcement requirements, deflection control for short term and long term loads, ultimate strength calculations in shear and flexure. Types of wall panels, blocks and large panels, shear walls, curtain, partition and bearing walls, load transfer from floor to wall panels, vertical loads, eccentricity and stability of wall panels. | | | | | |
| **Unit IV** | **DESIGN OF INDUSTRIAL BUILDINGS** | **9** | **0** | **0** | **9** |
| Components of single- storey industrial sheds with crane gantry systems, design of R.C Roof trusses, roof panels, design of R.C. crane gantry girders, corbels and columns, wind bracing design. | | | | | |
| **Unit V** | **DESIGN OF SHELL ROOFS FOR INDUSTRIAL SHEDS** | **9** | **0** | **0** | **9** |
| Cylindrical, folded plate and hyper- prefabricated shells, erection and jointing, joint design, hand book based design. | | | | | |
| **Total -45Periods** | | | | | |

**Text Books:**


| | |
|---|---|
| 1 | Lewicki B, Building with large Prefabricates, Elsevier Publishing Company, Amsterdam/ London/ New York, 1998. |
| 2 | Koncz T, Manual of Precast Concrete Constructions, Vol. I, II and III,Bauverlag, GMBH, 1976. |


**Reference Books:**


| | |
|---|---|
| 1 | Structural Design Manual, Precast Concrete Connections & Details, Society for the Studies in the use of Precast Concrete, NeatherlandBetorVerlag, 1978. |
| 2 | LasslоMokk, Prefabricated Concrete for Industrial and Public Sectors,AkademiaiKiado, Budapest, 1964. |
| 3 | Murashev V, Sigalov E and Bailov V, Design of Reinforced Concrete Structures, Mir Publishers, 1976. |
| 4 | CBRI, Building Materials and Components, 1990, India |
| 5 | Gerostiza C.Z, Hendrikson C, Rehat D.R, Knowledge Based Process Planning for Construction and Manufacturing, Academic Press, Inc., 1989. |
| 6 | Warzawski A, Industrializations and Robotics in Building – AManagerial Approach, Harper & Row, 1990. |


**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Able to gain knowledge about the requirements for planning and layout of prefabricating plant |
| **CO2** | Will be familiar with the IS codal provisions, for prefabrication of structural elements |
| **CO3** | Will be able to design large panel walls, one way and two way prefabricated slabs, curtain walls, single storey industrial buildings with trusses, and gantry systems |

| 22STE36 | DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES | Semester | | | II |
|---|---|---|---|---|---|
| PREREQUISITES | Category | PE | Credit | | 3 |
| | Hours/Week | L | T | P | TH |
| | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about design of composite members, behavior of box girders and its design concepts. The case studies were investigated to know the seismic behavior of the structures. |

| Unit I | INTRODUCTION | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Introduction to steel-concrete composite construction – Theory of composite structures – Introduction to steel- concrete-steel sandwich construction

| Unit II | DESIGN OF COMPOSITE MEMBERS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Behaviour of composite beams, columns – Design of composite beams, steel-concrete composite columns – Design of composite trusses

| Unit III | DESIGN OF CONNCTIONS IN COMPOSITE MEMBERS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Introduction – Types of connections – Design of connections in composite structures – Shear connection, Design of onnections in composite trusses. | | | | | |
| **Unit IV** | **DESIGN OF COMPOSITE BRIDGES** | **9** | **0** | **0** | **9** |
| Introduction to Composite Box Girder Bridges – Behaviour of box girder bridges – design concepts | | | | | |
| **Unit V** | **CASE STUDIES** | **9** | **0** | **0** | **9** |
| General case studies on steel-concrete composite construction in buildings – Seismic behaviour of composite structures. | | | | | |
| | | | | | **Total -45Periods** |

| | |
|---|---|
| **Text Books:** | |
| 1 | Johnson R.P., Composite structures of steel and concrete, Blackwell Scientific Publications, 2nd edition, U.K., 2004. |
| 2 | Owens G.W and Knowels P., Steel Designers manual,5th edition, Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992. |
| **Reference Books:** | |
| 1 | Arya, A.S., Design of Steel Structures, New Chand & Brothers, New Delhi 2014. |
| 2 | Workshop on Steel concrete composite structures conducted at Anna University 2000. |
| 3 | Necessary Indian & Eurocodes |
| 4 | INSDAG teaching resources for structural steel design, Vol.2, INSDAG, IspanNiketan, Calcutta. |

| | |
|---|---|
| **Course Outcomes:** Upon completion of this course, the students will be able to: | |
| **CO1** | Have a thorough understanding of the behavior of steel concrete composite structure components – slabs, beams, columns and trusses. |
| **CO2** | Design the meeting out the desired specifications and requirements. |
| **CO3** | Have the ability to solve Structural engineering problems. |
| **CO4** | Have the knowledge to conduct advanced experiments on steel concrete composite structural components. |

| | | | | | |
|---|---|---|---|---|---|
| **22STE41** | **DESIGN OF ADVANCED CONCRETE STRUCTURES** | **Semester** | | | **II** |
| **PREREQUISITES** | **Category** | **PE** | **Credit** | | **3** |
| | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | |
| 1 | To impart knowledge to the students with regard to the design of special R.C. members. Also learn about Elastic behaviour of structural members and expose them to the concepts of ductile detailing of R.C. members as per I.S. codes. | | | | |
| **Unit I** | **DESIGN OF BEAMS CURVED IN PLAN AND DEEP BEAMS** | **9** | **0** | **0** | **9** |
| Design for limit state of collapse – Design for limit state of serviceability – Calculation of deflection and crack width – Design of beams for combined effect of shear, bending moment and torsion – Analysis and design of beams curved in plan and spandrel beams- Design of deep beams. | | | | | |
| **Unit II** | **DESIGN OF SPECIAL R.C. ELEMENTS** | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| Design of slender columns – Design of RC walls and shear walls –Classification and design principles – Design of rectangular and flanged shear walls – Design of corbels. | | | | | |
| **Unit III** | **DESIGN OF FLAT SLAB AND GRID FLOORS** | **9** | **0** | **0** | **9** |
| Yield line theory of slabs – Hillerberg's method of design of slab – Design of flat slab - Equivalent frame method of design – Approximate analysis and design of grid floors. | | | | | |
| **Unit IV** | **INELASTIC BEHAVIOUR OF R.C. BEAMS** | **9** | **0** | **0** | **9** |
| Inelastic behaviour of concrete beams – moment rotation curves – Moment redistribution – Baker's method of analysis and design – Design of cast in situ joints in frame. | | | | | |
| **Unit V** | **DETAILING REQUIREMENTS** | **9** | **0** | **0** | **9** |
| Design and detailing of structural members using seismic design – Reinforcement detailing of structural members as per SP: 34& IS: 5525 – Earthquake resistant Design – Detailing requirements for Ductility as per IS:13920 – Fire resistance of buildings. | | | | | |
| **Total -45Periods** | | | | | |

| | |
|---|---|
| **Text Books:** | |
| 1 | S Unnikrishna Pillai, Devdas Menon. **"**Reinforced Concrete Design" McGraw Hill**,** 2021 |
| 2 | Varghese P.C., Advanced Reinforced Concrete Design, Prentice Hall of India, 2005 |
| **Reference Books:** | |
| 1 | KirshnaRaju N., Advanced Reinforced Concrete Design, CBS Publishers and Distribuors , 2016 |
| 2 | Purushothaman P., Reinforced Concrete Structural Elements. Behaviour Analysis and Design, Tata Mcgraw Hill. |
| 3 | Park R. and Paulay T., Reinforced Concrete Structures, John Wiley & Sons.2017. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Analyse the special structures by understanding their behaviour |
| **CO2** | .Design and prepare detail structural drawings for execution. |
| **CO3** | Design the special elements like corbels, deep beams, spandrel beams and grid floors |
| **CO4** | Predict the moment curvature behavior, design and detailing of concrete elements based on ductility parameter |

| 22STE42 | ADVANCED DESIGN OF FOUNDATIONS | | Semester | | | II |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To understand the basic philosophy of planning of Soil Exploration for Different Projects and gain knowledge about the Settlement of Footings and Rafts. To estimate Load Transfer of Piles, Settlement of Pile Foundations and Pile Groups. To understand the provision of IS and IRC Design Code and gain knowledge of Sheeting and Bracing Systems. |

| Unit I | SOIL EXPLORATION | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.

| Unit II | SHALLOW FOUNDATIONS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.

| Unit III | PILE FOUNDATIONS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Design of pile group & pile cap, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles. | | | | | |
| **Unit IV** | **WELL FOUNDATION** | **9** | **0** | **0** | **9** |
| IS and IRC Design Code Provisions, Elastic Theory and Ultimate Resistance Methods. Tunnels and Arching in Soils, Pressure Computations around Tunnels. | | | | | |
| **Unit V** | **OPEN CUTS** | **9** | **0** | **0** | **9** |
| Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types. Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction | | | | | |
| | | | | | **Total -45Periods** |

| | |
|---|---|
| **Text Books:** | |
| 1 | Design of foundation system, N.P. Kurian, Narosa Publishing House, 2014 (3rd edition) |
| 2 | Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York, 2001 (5th edition) |
| **Reference Books:** | |
| 1 | Design of foundation system, N.P. Kurian, Narosa Publishing House, 2014 (3rd edition) |
| 2 | Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill New York, 2001 (5th edition) |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Decide the suitability of soil strata for different projects. |
| **CO2** | Design shallow foundations deciding the bearing capacity of soil. |
| **CO3** | Analyze and design the pile foundation |
| **CO4** | Understand analysis methods for well foundation. |

| 22STE43 | DESIGN OF INDUSTRIAL STRUCTURES | | Semester | | | II |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about industrial design of built-up girders, portal frames, steel bunkers and silos, steel chimneys and water tanks. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | PLANNING AND FUNCTIONAL REQUIREMENTS | **9** | **0** | **0** | **9** |

Classification of Industries and Industrial Structures-planning for layout requirements regarding lighting,ventilation and fire safety-protection against noise and vibration-guidelines from factories act-material handling systems-structural loads.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **BUILT-UP GIRDERS** | **9** | **0** | **0** | **9** |

Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction details, design procedure.- Plate girder – elements of plate girder – flexural strength – shear strength of web – stiffeners – Connection – design procedure.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **PORTAL FRAMES** | **9** | **0** | **0** | **9** |

Design of portal frame with hinged base, design of portal frame with fixed base – Gable structures – light weight structures.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **STEEL BUNKERS AND SILOS** | **9** | **0** | **0** | **9** |

Design of square bunker – Jansen's and Airy's theories – IS code provisions – Design of side plates – stiffeners – Hooper – Longitudinal beams – Design of cylindrical silo – side plates – ring girder - stiffeners.

| Unit V | STEEL CHIMNEYS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Introduction – Types - dimensions of steel stacks, chimney lining, breech openings and access girder, loading and load combinations, design considerations, stability considerations, design of base plate, design of foundations bolts, design of foundation.

**Total -45Periods**

**Text Books:**

| | |
|---|---|
| 1 | Procs. of advanced course on Industrial Structures, Structural Engineering Research Center, 1982. |
| 2 | Design of steel structures, Bunmia P.c.., Jain Ashok Kr., Jain Arun Kr., 2nd edition, Lakshmi publishers, 2012. |
| 3 | Shiyekar M R,"Limit State Design in Structural Steel",PHI Learning private limited,New Delhi,2017. |
| 4 | Subramanian N,"Design of Steel Structures",Oxford university press,New Delhi,2016. |

**Reference Books:**

| | |
|---|---|
| 1 | Manohar S.N, Tall Chimneys – Design and Construction, Tata McGrawHill,1985. |
| 2 | Rajagopalan Dr. K, Storage Structures, Oxford IBH Publishing Company Ltd 1989. |
| 3 | IS: 875(part-III)-1987, Code of for design loads (other than earthquake for building and structures). |
| 4 | IS: 4995(part-I)-1974, Criteria for design of Reinforced concrete bins for the storage of granular and powdery materials. |
| 5 | Hand book on functional requirements of Industrial buildings, SP-32-1986, Bureau of Indian Standards, New Delhi, 1990. |
| 6 | IS: 800-1984, Code of practice for general construction in steel. |
| 7 | SP(6) Steel tables ; IS: 804-1967,Specifications for rectangular pressed steel tanks. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Acquire knowledge about functional requirements of Industrial buildings. |
| **CO2** | Understand the behavior and design of plate and gantry girders. |
| **CO3** | Acquire knowledge about the design of portal frames. |
| **CO4** | Understand the design concept of steel bunkers and silos. |
| **CO5** | Design of steel chimneys and understand the design behavior. |

| 22STE44 | SUBSTRUCTURE DESIGN | | Semester | | | II |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |
| **Course Learning Objectives** | | | | | | |
| 1 | To impart knowledge about the design of shallow foundation, deep foundation, foundation for bridges, machine foundation and tower foundation. | | | | | |
| **Unit I** | **INTRODUCTION** | | **9** | **0** | **0** | **9** |
| Design of soil investigation report for design of foundation structure-Types-Selection of foundation-Basic requirement of Foundation-Computation of loads-General principle of design of reinforced concrete shallow and deep foundation. | | | | | | |
| **Unit II** | **DESIGN OF SHALLOW FOUNDATION** | | **9** | **0** | **0** | **9** |
| Deep foundation-Load carrying capacity of different types of piles and detailing of reinforcement according to IS 2911-Design of pile caps-Uplift capacity of piles-Lateral pile load test. | | | | | | |
| **Unit III** | **DESIGN OF DEEP FOUNDATION** | | **9** | **0** | **0** | **9** |
| Deep foundation-Load carrying capacity of different types of piles and detailing of reinforcement according to IS 2911-Design of pile caps-Uplift capacity of piles-Lateral pile load test. | | | | | | |
| **Unit IV** | **FOUNDATION FOR BRIDGES AND MACHINES** | | **9** | **0** | **0** | **9** |

Foundation for bridges – Well and caisson foundation – Design of pier cap –Design of pier-General principles, planning and design of machine foundation.

| Unit V | TOWER FOUNDATIONS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Introduction- Design of foundation for towers – forces on tower foundation – General design criteria – Structural design of supports for foundation excavation – Design of ground anchors.

**Total -45Periods**

**Text Books:**

| | |
|---|---|
| 1 | Tomlinson M.J and Boorman R, Foundation design and construction, ELBS longman VI Edition, 1995. |
| 2 | Swamisaran, Analysis and design of substructures, Limit state design, Oxford and IBH Publishing Co. Pvt. Lt, NewDelhi, 1996. |

**Reference Books:**

| | |
|---|---|
| 1 | Nayak N.V, Foundation design manual for practicing engineers, DhanpatRai & sons,1982. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Able to adopt a suitable foundation based on the soil condition and the type of structure. |
| **CO2** | Familiarize with principles, planning and design of various types of foundation as per IS codal specifications and requirements. |
| **CO3** | Able to design and detailing of reinforcement for foundations. |

| 22STE45 | DESIGN AND CONSTRUCTION OF FERROCEMENT STRUCTURES | Semester | | | II |
|---|---|---|---|---|---|
| PREREQUISITES | Category | PE | Credit | | 3 |
| | Hours/Week | L | T | P | TH |
| | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge on the material properties of ferrocement, analysis, design and construction of ferrocement structures. |

| Unit I | FERROCEMENT AS A STRUCTURAL MATERIAL | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Ferrocement – definition, constituent materials of ferrocement, Distinct characteristics of ferrocement versus reinforced concrete, similarities between ferrocement and reinforced concrete, Mechanical properties, advantages of ferrocement as a construction material, ferrocement for structural applications, Construction methods, design parameters.

| Unit II | ANALYSIS METHODS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Effective area of reinforcement, Typical moment curvature response, Analysis methods for bending under service loads – Flexure formula for uncracked section, Transformed area method for the cracked section, Analysis methods for nominal bending resistance – compatibility method, simplified method based on all tensile reinforcement yielding, simplified method using plastic moment, simplified method using design chart or prediction equation, Computation of deflection.

| Unit III | DESIGN METHODS THROUGH CRACK WIDTH AND DUCTILITY | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Design based on crack width- Relationship between crack width -its spacing and stress in steelwire.. Equation establishing relationships between crack width, spacing of cracks, modular ratio, modulus of elasticity and tensile stress of mortar. Crack control method of design- applied to pipes, silos, water tanks and waterproofing systems. Design of ductility -Strain energy absorbed per unit volume of ferrocement. Its use in design of structures

subjected to dynamic loading-earthquake, wind, machine foundations.

| Unit IV | DESIGN THROUGH SHAPE AND COMPOSITE CONSTRUCTION | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Shaping ferrocement to gain strength, stress pattern changed due to shaping, Different shapes and stress Patterns like flexure to compression, different ways of giving forms, boxing, corrugating, folding, ribbing, stiffening, arching, waffling. Giving shapes in three dimensions. Analysis of various forms for stress pattern under loading- cavity walls, hollow floors, hollow columns and beams, stiffened plates in compression and flexure, built in sections like H, U, T, +, L. Shells of translation and rotation, domes, pyramids, folded plates. Design of composite structures of ferrocement with RCC, steel and masonry. Precast ferrocement elements with in-built RCC framework. Joints of precast members as structural members their design and construction, Confining and strengthening damaged structures, retrofitting.

| Unit V | FERROCEMENT CONSTRUCTIONS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Applications in building construction: Parabolic foundations, under-reamed piles, Panelled cavity walls and box- sectioned hollow floors, hollow beams. Stiffened plates as slabs. Design and construction of multi-storied buildings and mass scale housing using in-situ mortaring method and method of joining precast walling and floor panels. Water and soil retaining structures: Applications in water treatment and effluent treatment plants and in Irrigation, Highways and Bridges.

**Total -45Periods**

**Text Books:**

| | |
|---|---|
| 1 | Ferrocement, Authors: B R Paul and R P Pama, Published by International Ferrocement Information Centre. A.I.T.Bangkok, Thailand. |
| 2 | Ferrocement and laminated cementitious composites, Author: A E Naaman, Publisher: Techno-press, Ann Arbor, Michigan, U S A. |

**Reference Books:**

| | |
|---|---|
| 1 | State-of-the-art report and guide for Design, Construction and Repairs of Ferrocement; ACI committee Report. No ACI-549R- 88 and ACI 549.1R.88,Published by American Concrete Institute, Detroit, USA. |
| 2 | Ferrocement, Authors: B R Paul and R P Pama, Published by International Ferrocement Information Centre. A.I.T.Bangkok, Thailand. |
| 3 | Chapter 1 titled 'Ferrocement' by S P Shah and P N Balaguru, in book 'Concrete Technology and Design Vol II Editor; R N Swamy. |
| 4 | Proceedings of International Symposiums on 'Ferrocement and thin reinforced composites.- Ferro 1 to Ferro 10. |
| 5 | Ferrocrete Technology- A Construction Manual, Author: Dr. B. N. Divekar,Published by the Author. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | On completion of the course the student will be able to understand the concepts of ferrocement technology. |
| **CO2** | The student will be in a position to analyse and design ferrocement structures. |
| **CO3** | The student will gain the knowledge of the method of construction of the structures. |

| 22STE51 | DESIGN OF PRESTRESSED CONCRETE STRUCTURES | | Semester | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | This course covers the principles analysis and design of prestressed concrete elements and other structures. In addition to the BIS codal provisions, ACI and British code, FIB specifications shall also be compared. |

| Unit I | PRINCIPLES, ANALYSIS FOR FLEXURE AND DEFLECTION | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Principles of Prestressing – Types of prestressing systems – Materials – Systems and devices – Analysis and design for flexure- Behavior of prestressed concrete elements – General concept of prestress – Force transmitted by pretensioned and post tensioned systems - losses in prestress – analysis for Ultimate strength – Comparison of codal provisions - at service load and Magnel's approach - short term and longterm deflection.

| Unit II | DESIGN FOR FLEXURE | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Principles of Prestressing – Types of prestressing systems – Materials – Systems and devices – Analysis and design for flexure- Behavior of prestressed concrete elements – General concept of prestress – Force transmitted by pretensioned and post tensioned systems - losses in prestress – analysis for Ultimate strength – Comparison of codal provisions - at service load and Magnel's approach - short term and longterm deflection.

| Unit III | DESIGN FOR SHEAR, TORSION AND ANCHORAGE ZONE | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Analysis of indeterminate structures – Continuous beams – Concept of concordance and linear transformations – Single storied rigid frames – Choice of cable profiles.

| Unit IV | STATICALLY INDETERMINATE STRUCTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Analysis of indeterminate structures – Continuous beams – Concept of concordance and linear transformations – Single storied rigid frames – Choice of cable profiles.

| | PRESTRESSED CONCRETE SPECIAL STRUCTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Concept of circular prestressing – Design of prestressed concrete pipes and cylindrical water tanks - Composite construction- types, behaviour, flexural stresses, longitudinal shear transfer, transverse shear – Compression members – Design of poles and piles - Partial prestressing – Principles, analysis and design concepts.

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Rajagopalan N, Prestressed Concrete, Narosa Publishing House, 2002. |
| 2 | Krishnaraju N, Prestressed Concrete, Tata McGraw-Hill Publishing Company, 6th Ed 2018. |


**Reference Books:**


| | |
|---|---|
| 1 | Lin.T.Y Ned Burns, Design of Prestressed Concrete Structures, 3rd edition,John Wiley & Sons, 1982. |
| 2 | Sinha N.C & Roy S.K, Fundamentals of Prestressed Concrete, S.Chand& Co, New Delhi 1985. |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Students will able to find out the basics and losses in prestressed concrete structures |
| **CO2** | Understand the basic concept of pre and post-tensioning processes, analyze prestressed concrete members |
| **CO3** | Design prestressed concrete deck slab and end blocks |

| 22STE52 | ANALYSIS OF LAMINATED COMPOSITE PLATES | Semester | | | |
|---|---|---|---|---|---|
| PREREQUISITES | Category | PE | Credit | | 3 |
| | Hours/Week | L | T | P | TH |
| | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about theory of plates, laminated, composite plates and approximate methods of analysis of plates. |

| Unit I | INTRODUCTION | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending of Rectangular Laminated Plates using CLPT.

| Unit II | GOVERNING EQUATIONS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply-Supported Plates, Determination of Stresses.

| Unit III | ANALYTICAL SOLUTIONS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Levy Solutions for Plates with Other Boundary Conditions. Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT.

| Unit IV | FINITE ELEMENT SOLUTIONS USING CLPT | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT. Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses.

| Unit V | FINITE ELEMENT SOLUTIONS USING FSDT | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, C0 Element Formulation, Post Computation of Stresses. Analysis of Rectangular Composite Plates using Analytical Methods.

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Mechanics of Laminated Composites Plates and Shells, Reddy J. N.,2nd edition CRC Press. |


**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Analyze the rectangular composite plates using the analytical methods. |
| **CO2** | Analyze the composite plates using advanced finite element methods. |
| **CO3** | Develop the computer programs for the analysis of composite plates. |

| 22STE53 | FRACTURE MECHANICS OF CONCRETE STRUCTURES | Semester | | | |
|---|---|---|---|---|---|
| PREREQUISITES | Category | PE | Credit | | 3 |
| | Hours/Week | L | T | P | TH |
| | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge on various fracture mechanisms, the occurrence of cracks and its properties. To analyze and study the failure modes with models of concrete structures, special structures. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **INTRODUCTION** | **9** | **0** | **0** | **9** |
| Basic Fracture Mechanics, Crack in a Structure, Mechanisms of Fracture and Crack Growth. | | | | | |
| **Unit II** | **TYPES OF FRACTURE** | **9** | **0** | **0** | **9** |
| Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment assisted Cracking, Service Failure Analysis. | | | | | |
| **Unit III** | **STRESS AT CRACK TIP** | **9** | **0** | **0** | **9** |
| Stress at Crack Tip, Linear Elastic Fracture Mechanics, Griffith's Criteria, Stress Intensity Factors, Crack Tip Plastic Zone, Erwin's Plastic Zone Correction, R curves, Compliance, J Integral, Concept of CTOD and CMD. | | | | | |
| **Unit IV** | **MATERIAL MODELS** | **9** | **0** | **0** | **9** |
| General Concepts, Crack Models, Band Models, Models based on Continuum Damage Mechanics. | | | | | |
| **Unit V** | **APPLICATION ON SPECIAL CONCRETE AND NUMERICAL MODELING** | **9** | **0** | **0** | **9** |
| Applications to High Strength Concrete, Fiber Reinforced Concrete, Crack Concepts and Numerical Modeling. | | | | | |
| | | | | | **Total -45Periods** |

**Text Books:**

| | |
|---|---|
| 1 | Fracture Mechanics, Sun C. T. and Jin Z.H., 1st Edition, Elsevier Academic Press, 2012. |
| 2 | Elementary Engineering Fracture Mechanics, BroekDavid, 3rd Rev. Ed. Springer, 1982. |

**Reference Books:**

| | |
|---|---|
| 1 | Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen., RILEM Report, Chapman and Hall, 1989. |
| 2 | Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACI Detroit, 1989. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Identify and classify cracking of concrete structures based on fracture mechanics. |
| **CO2** | Implement stress intensity factor for notched members |
| **CO3** | Apply fracture mechanics models to high strength concrete and FRC structures. |
| **CO4** | Compute J-integral for various sections understanding the concepts of LEFM. |

| 22STE54 | DESIGN OF PLATES AND SHELLS | | Semester | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about design of plates, shells, folded plates and the analysis of these structures. |

| Unit I | LATERALLY LOADED PLATES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Thin plates with small deflection. Laterally loaded thin plates, governing differential equations, boundary conditions.

| Unit II | DESIGN OF FOLDED PLATES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Folded plate structures - Structural behaviour - Types - Design by ACI-ASCE Task Committee method.

| Unit III | MEMBRANE AND BENDING THEORY OF SHELLS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Classification of shells - Types of shells - Structural action - Membrane theory - Shells of revolution and shells of translation- Examples- Limitations of membrane theory.

| Unit IV | DESIGN OF CYLINDRICAL SHELLS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Analysis and design of cylindrical shells and their structural behaviour

| Unit V | DESIGN OF DOUBLY CURVED SHELLS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Membrane theory for general shells of double curvature - Synclastic and anticlastic shells - Approximate bending theory of shallow shells - Design of cooling tower shells - Hyperbolic Paraboloid roofs - Determination of forces in shells and edge members - Design of conoidal shells - New shell forms - Funicular shells.

**Total -45Periods**

**Text Books:**

| | |
|---|---|
| 1 | Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata McGraw Hill Edition, 2010. |
| 2 | Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition, 2005. |

**Reference Books:**

| | |
|---|---|
| 1 | Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 1st Edition, PHI. |
| 2 | Design of Plate and Shell Structures, JawadMaan H., Springer Science. |

**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Analyze and design prismatic folded plate systems |
| **CO2** | Analyze and design shells using approximate solutions |
| **CO3** | Analyze and Design Cylindrical Shells |
| **CO4** | Design Doubly Curved Shells using Approximate Solutions. |

| 22STE55 | DESIGN OF BRIDGES | | Semester | | | III |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | At the end of the course the students shall have knowledge about design of long and short span bridges, prestressed concrete bridges and also about bearing, substructures and footings for bridges. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **INTRODUCTION** | **9** | **0** | **0** | **9** |

Components of bridge - Classification - Need for investigation Data collection - design discharge - linear waterway - economical span scour depth - traffic projection - choice of bridge type.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **LOADS ON BRIDGES** | **9** | **0** | **0** | **9** |

Indian Road Congress (IRC) bridge codes - dimensions - dead and live loads - impact effect - wind and seismic forces - longitudinal and centrifugal forces - hydraulic forces - earth pressure - temperature effect and secondary stresses.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **SLAB AND T-BEAM BRIDGES** | **9** | **0** | **0** | **9** |

Design of slab bridges - skew slab culverts - box culverts. T - Pigeaud curves - Courbon's theory - Hendry Jaegar method design of T - beam bridges

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **LONG SPAN GIRDER BRIDGES** | **9** | **0** | **0** | **9** |

Design principles of continuous bridges, box girder bridges, and balanced cantilever bridges.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **BEARINGs AND SUBSTRUCTURES FOR BRIDGES** | **9** | **0** | **0** | **9** |

Design of bearings for slab, girder, skew bridges - Design of piers abutments - trestles, Joints - expansion joints

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Raina V.K. “Concrete Bridge Practice”, Tata McGraw-Hill Publishing Company, New Delhi, 1991. |
| 2 | Krishnaraju N, “Design of Bridges”, Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi 1988 |
| 3 | Ponnuswamy S, “Bridge Engineering”, Tata McGraw-Hill, 1989 |


**Reference Books:**


| | |
|---|---|
| 1 | Bakht, B. and Jaegar, L.G., “Bridge Analysis Simplified”, McGraw-Hill,1985. |
| 2 | Derrick Beckett, “An Introduction to Structural Design of Concrete Bridges”, Surrey University Press, Henley Thomes, Oxford Shire, 1973 |
| 3 | Taylor F.W, Thomson S.E. and Smulski E, “Reinforced Concrete Bridges”, John Wiley and Sons, New York,1955 |
| 4 | Edwin H.Gaylord Jr., Charles N.Gaylord, James E. Stallmeyer “Design of Steel Structures”, McGraw-Hill International Editions, 1992. |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Have a complete knowledge about the components , classification, Design Requirements of bridge structures |
| **CO2** | gain Knowledge on various loads on Bridges |
| **CO3** | To design of components of Slab and T- Beam bridges |
| **CO4** | To design Long Span Bridges |
| **CO5** | To design bearing, Abutments and various joints in bridges |

| 22STE56 | MODERN CONSTRUCTION MATERIALS | | Semester | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | At the end of this course the student shall have a good knowledge about the recent materials and types used in construction and their significance. |

| Unit I | SPECIAL CONCRETES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Concretes, Behavior of concrete - High Strength and High Performance Concrete - Fiber Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete - Aerocon blocks - Self Curing Concrete.

| Unit II | METALS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Steels - New Alloy Steels - Aluminum and its Products - Coatings to reinforcement – Applications - Galvalume roofing sheets - M2 panels for wall panels.

| Unit III | COMPOSITES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Plastics - Reinforced Polymers - Fiber Reinforced Concrete - Steel Fiber-reinforced cement composites - Fiber reinforced plastic composites - carbon fibers and composite reinforcement - Applications

| Unit IV | OTHER MATERIALS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Water Proofing Compounds - Non-weathering Materials - Flooring and Façade Materials

| Unit V | SMART AND INTELLIGENT MATERIALS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Smart and Intelligent Materials for intelligent buildings - Special features

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Santhakumar A.R., Concrete Technology, Oxford University press, New Delhi. 2007 |
| 2 | Shetty M.S, Concrete Technology: Theory and Practice, S.Chand& Company Ltd., 2005 |


**Reference Books:**


| | |
|---|---|
| 1 | Mamlouk M.S. and Zaniewski J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999 |
| 2 | Ashby M.F. and Jones D.R.H.H. Engineering Materials 1: An introduction to Properties, applications and designs, Elsevier Publications, 2005 |
| 3 | Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001 |
| 4 | Aitkens , High Performance Concrete, McGraw Hill, 1999 |
| 5 | Deucher K.N, Korfiatis G.P and Ezeldin A.S, Materials for civil and Highway Engineers, Prentice Hall Inc., 1998. |
| 6 | ACI Report 440.2R-02, Guide for the design and construction of externally bonded RP systems for strengthening concrete structures, American Concrete Institute, 2002 |

| **Course Outcomes:** Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Acquire good knowledge about the recent construction materials, their construction and their significance. |
| **CO2** | Able to use modern materials based on their requirements. |
| **CO3** | Able to find new construction materials. |

| 22STE61 | ADVANCED CONCRETE TECHNOLOGY | | Semester | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | At the end of this course,<br>The student shall have a good knowledge about constituents materials.to know about the types of special concrete. To understand the concept and procedure for concrete mix design as per IS code standards. To get awareness about the strength properties of concrete and type of admixture. To know about the concreting methods. |

| Unit I | CONCRETE | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Properties of fresh concrete- Hardened concrete- Thermal expansion- Permeability-Water tightness and crack control-Elastic properties - Creep and shrinkage-Variability of Concrete strength.

| Unit II | MIX DESIGN | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Principles of Concrete mix design- Methods of Concrete mix design – I.S. Method, ACI Method and DOE Method Testing of Concrete.

| Unit III | STRENGTH OF CONCRETE AND ADMIXTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Strength Under Uniaxial and Multiaxial Stresses – Failure Modes – Strength –Density Relationship- Parameters affecting strength – Accelerating and Retarding admixtures-Super plasticizers -Water proofing agents - Chemical admixtures, Mineral admixtures.

| Unit IV | SPECIAL CONCRETES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Light Weight Concrete-Fly Ash Concrete- Fiber Reinforced Concrete- Polymer Concrete, Super Plasticized Concrete- Epoxy Resins and Screeds for Rehabilitation – Properties and applications – High Performance Concrete- Ready mixed concrete

| Unit V | CONCRETING METHODS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Process of Manufacturing of Concrete - Methods of Transportation, Placing and Curing – Extreme Weather concreting - Special Concreting methods - Vacuum concrete – Shotcrete - Under water concrete, Special formwork.

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Shetty M.S., Concrete Technology, S.Chand and Company Ltd., Delhi. 2005 |
| 2 | Santhakumar A.R, Concrete Technology, Oxford University Press, 2007 |


**Reference Books:**


| | |
|---|---|
| 1 | Rudhani G, LightWeight Concrete,Hungarian Academy of science 1963 |
| 2 | Gambhir M.L, Concrete Technology, 3rd Edition, The Tata McGraw Hill Co.,2004 |
| 3 | Neville, A.M., Properties of Concrete, Pitman publishing limited, London.2004 |

| | |
|---|---|
| 4 | Krishnasamy K.T , Kama sundar Rao A and Khandekar A.A, Concrete technology,DhanpatRai and sons ,Delhi 2001 |
| 5 | Orchard D.F., Concrete Technology, Vol - 1 and Vol – 2, Asia Publishing House, Delhi 2001. |

| **Course Outcomes:** Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Know about the properties of concrete |
| **CO2** | Design the concrete mix using ACI + IS code methods |
| **CO3** | Know about the role of various types of admixtures in concrete |
| **CO4** | Design special concretes for specific applications |
| **CO5** | Apply various types of concreting methods in the field |

| 22STE62 | DISASTER RESISTANT STRUCTURES | | Semester | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To understand the basic philosophy of design of disaster resistant structures and gain knowledge about repair and rehabilitation of disturbed structures,design structures with modern materials and advanced techniques and understand the provision of relevant standard specification, requirements and usage. Also gain knowledge about the ability to conduct damage assessments and write reports. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **BEHAVIOR OF LIFE-LINE STRUCTURES** | **9** | **0** | **0** | **9** |

Philosophy for design to resist earthquake, cyclone and flood – National and international codes of practice – Bye law of urban and semi-urban area – Traditional and modern structures

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **COMMUNITY STRUCTURE** | **9** | **0** | **0** | **9** |

Response of dams, bridges, buildings – Strengthening measures – Safety analysis and rating – Reliability assessment

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **REHABILITATION AND RETROFITTING** | **9** | **0** | **0** | **9** |

Testing and evaluation – Classification of structures for safety point of view – Methods of strengthening for different disasters – Qualification test

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **DETAILING OF STRUCTURES AND COMPOSITES** | **9** | **0** | **0** | **9** |

Use of modern materials and their impact on disaster reduction – Use of modern analysis, Design and construction techniques - Optimization for performance

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **DAMAGE ASSESSMENT OF STRUCTURES** | **9** | **0** | **0** | **9** |

Damage surveys – Maintenance and modifications to improve hazard resistance- Different types of foundation and its impact on safety – Ground improvement techniques.

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Proceedings of IABSE 14th Congress "Civilization through Civil Engineering" New Delhi, May 1992. |
| 2 | Raiker R.N., Learning from failures - Deficiencies in design, construction and service, R&D center (SDCPL) Raikar Bhavan, Bombay, 1987. |


**Reference Books:**


| | |
|---|---|
| 1 | Moskwin V. et al, "Concrete and Reinforced Concrete – Deterioration and Protection,Mir publishers, Moscow, 1980. |
| 2 | Allen R.T and Edwards S.C, Repair of Concrete Structures,Blakie and Sons, U.K., 1987. |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | Will understand the basic philosophy of design of disaster resistant structures |
| **CO2** | Will demonstrate the ability of identifying, formulating and understanding repair and rehabilitation of disturbed structures. |
| **CO3** | Will demonstrates the ability in designing structures with modern materials and techniques for disaster effect reduction. |
| **CO4** | Will understand the provision of relevant standard specification, requirements and usage. |
| **CO5** | Will demonstrate the ability to conduct damage assessments and write reports. |

| 22STE63 | SOIL STRUCTURE INTERACTION | | Semester | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | The student is expected to understand the importance and significance of soil structure interaction and incorporate this in the design of structures to achieve both safety and economy. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **SOIL-FOUNDATION INTERACTION** | **9** | **0** | **0** | **9** |

Introduction to Soil-foundation interaction problems – Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior and Time dependent behavior.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **BEAM ON ELASTIC FOUNDATION- SOIL MODELS** | **9** | **0** | **0** | **9** |

Infinite beam, two parameters, Isotropic elastic half-space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **PLATE ON ELASTIC MEDIUM** | **9** | **0** | **0** | **9** |

Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, Rectangular and Circular plates, Numerical analysis of finite plates, Simple solutions.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **ELASTIC ANALYSIS OF PILE** | **9** | **0** | **0** | **9** |

Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **LATERALLY LOADED PILE** | **9** | **0** | **0** | **9** |

Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile raft system, Solutions through influence charts.

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979. |
| 2 | Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980. |


**Reference Books:**


| | |
|---|---|
| 1 | Scott R.F., Foundation Analysis, Prentice Hall, 1981. |
| 2 | Structure-Soil Interaction - State of Art Report", Institution of Structural Engineers, 1978. |
| 3 | ACI 336, Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute, Delhi, 1988. |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | The students will be able to understand various applications to soil structure interaction. |
| **CO2** | The students will able to calculate contact pressure and settlement under foundation |
| **CO3** | The student will able to calculate earth pressure on different retaining structures |

| 22STE64 | OFFSHORE STRUCTURES | | Semester | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | Category | PE | Credit | | 3 |
| | | Hours/Week | L | T | P | TH |
| | | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about structural design of concrete pipes, special purpose structures, wave theories and forces related to offshore structures, analysis and design of offshore structures, |

| Unit I | DESIGN OF PIPES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Structural design of Concrete, Prestressed Concrete, Steel and Cast Iron piping mains, sewerage tanks design.

| Unit II | DESIGN OF SPECIAL PURPOSE STRUCTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clari flocculators, aeration tanks and Imhoff tanks.

| Unit III | SEWERAGE WORKS | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Design of steel, lattice structures used in water and sewerage treatment works – protection methods of both RC and steel structures.

| Unit IV | WAVE THEORIES, FORCES OF OFFSHORE STRUCTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Wave Generation process, small, finite amplitude and non-linear wave theories.

Wind forces, wave forces on small bodies and large bodies – current forces and use of morison equation..

| Unit V | ANALYSIS AND DESIGN OF OFFSHORE STRUCTURES | 9 | 0 | 0 | 9 |
|---|---|---|---|---|---|

Static method of analysis, foundation analysis and dynamics of offshore structures.

Design of platforms, helipads, jacket tower and mooring cables and pipelines.

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Dayaratnam P., Design of Reinforced concrete structures, OXFORD and IBH Publishing Co., New Delhi. 2003. |
| 2 | Krishna Raju, Prestressed Concrete, Tata McGraw Hill Publishing Co. 2nd Edition 1988. |
| 3 | Chakrabarti S.K, Hydrodynamics of offshore structures, Computational Mechanics Publications, 1987 |
| 4 | Thomas H.Dawson, Offshore Structural Engineering, Prentice Hall Inc., Englewood Cliffs, N.J 1983. |


**Reference Books:**


| | |
|---|---|
| 1 | Sinha N.C. and Roy S. K., Reinforced concreteby S.Chand and Co. 1985. |
| 2 | Hulse R.K and Mosley, W.H., Reinforced Concrete Design by Computer, Macmillan Education Ltd., 1986. |
| 3 | Ramaswamy, G. S, Design and construction of Concrete shell roofs,CBSPublishers, India, 1986. |

| | |
|---|---|
| 4 | Green, J.K and Perkins, P.H., Concrete liquid retaining structures, AppliedScience Publishers, 1981 |
| 5 | API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication, RP2A, Dallas,Texas. |
| 6 | Wiegel R.L, Oceanographical Engineering, Prentice Hall Inc, Englewood Cliffs, N.J.1964. |
| 7 | Brebbia C.A, & Walker S, Dynamic Analysis of Offshore Structures, New-nesButterworths, U.K.1979. |
| 8 | Reddy D.V. and Arockiasamy M, Offshore structures, Vol.-1, Krieger Publishing Company Malabar, Florida, 1991. |
| 9 | Metcalf And Eddy, "Wastewater Engineering Treatment & Reuse", IV Edition, Tata McGraw Hill Publishing Co.2003 |


**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Recognizing the needs sorting out its importance and implementing practically the construction of essential environmental structures and special structures through analysis and design. |
| **CO2** | understand about the waves, force exerted by wave on coastal and offshore structures |
| **CO3** | Will be able to design small offshore structures like platforms, submerged pipelines etc |

| 22STE65 | WIND AND CYCLONE EFFECTS ON STRUCTURES | Semester | | | |
|---|---|---|---|---|---|
| PREREQUISITES | Category | PE | Credit | | 3 |
| | Hours/Week | L | T | P | TH |
| | | 3 | 0 | 0 | 3 |

**Course Learning Objectives**

| | |
|---|---|
| 1 | To impart knowledge to the students about wind and cyclone effects on structures and the design of buildings and structural components as per I.S. codes. |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | **INTRODUCTION** | **9** | **0** | **0** | **9** |

Introduction, Spectral studies, Gust factor, Wind velocity, Methods of measurements, variation of speed with height, shape factor, aspect ratio and drag effects.

| | | | | | |
|---|---|---|---|---|---|
| **Unit II** | **WIND TUNNEL STUDIES** | **9** | **0** | **0** | **9** |

Wind Tunnel Studies, Types of tunnels, Modeling requirements, Interpretation of results, Aero-elastic models.

| | | | | | |
|---|---|---|---|---|---|
| **Unit III** | **WIND EFFECT** | **9** | **0** | **0** | **9** |

Wind on structures, Rigid structures, Flexible structures, Static and Dynamic effects, Tall buildings, chimneys.

| | | | | | |
|---|---|---|---|---|---|
| **Unit IV** | **DESIGN PRINCIPLES** | **9** | **0** | **0** | **9** |

Application to design, IS 875 code method, Buildings, Chimneys, Roof Shelters

| | | | | | |
|---|---|---|---|---|---|
| **Unit V** | **CYCLONE EFFECT AND DESIGN OF CLADDING** | **9** | **0** | **0** | **9** |

Cyclone effect on structures, cladding design, window glass design

**Total -45Periods**

**Text Books:**


| | |
|---|---|
| 1 | Cook.N.J., The Designer's Guide to Wind Loading of Building Structures, Butterworth's, 1989 |
| 2 | Kolousek., et.al., Wind Effects on Civil Engineering Structures, Elsevier Publications, 1984. |


**Reference Books:**


| | |
|---|---|
| 1 | Peter Sachs, Wind Forces in Engineering, Pergamon Press, New York, 1978 |
| 2 | Lawson T.V., Wind Effects on Building Vol. I and II, Applied Science Publishers, London, 2011 |


**Course Outcomes:**

Upon completion of this course, the students will be able to:

| | |
|---|---|
| **CO1** | Have a clear understanding about wind effects and performance of wind tunnel studies. |
| **CO2** | To understand about the wind loads , their effects with codal specifications |
| **CO3** | To analyze and design structures to resist extreme wind forces and cyclones. |

## AUDIT COURSE

| 22AC01 | ENGLISH FOR RESEARCH PAPER WRITING | | SEMESTER I/II | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | CATEGORY | PE | Credit | | 0 |
| | | Hours/Week | L | T | P | TH |
| | | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

1. To help the learners to realize the necessity of English in writing a Research paper
2. To enable the learners to write different sections of a research paper
3. To train the learners to become better writers of research papers

| | | | | | |
|---|---|---|---|---|---|
| **UNIT I** | **6** | **0** | **0** | **6** |
| Research paper and its importance, Structure of a research paper, Planning and preparation. | | | | |
| **UNIT II** | **6** | **0** | **0** | **6** |
| English in research papers, Basic word order, Collocation, Being concise, Redundancy, Common errors. | | | | |
| **UNIT III** | **6** | **0** | **0** | **6** |
| Key factors that determine the style of a paper, Journal's background, Passive form, Right tense forms, Cohesion and coherence. | | | | |
| **UNIT IV** | **6** | **0** | **0** | **6** |
| Hedging and criticizing, Paraphrasing, Plagiarism, Ensuring quality of the paper and Useful phrases. | | | | |
| **UNIT V** | **6** | **0** | **0** | **6** |
| Key skills in writing Title, Abstract, Introduction, Review of Literature, Discussion and Conclusion, Highlighting findings. | | | | |

**Total(30L) = 30 Periods**

**REFERENCE BOOKS:**


| | |
|---|---|
| 1 | Adrian Wallwork, "English for Writing Research Papers," Springer New York Dorecht Heidelberg London, 2016 |
| 2 | Howe, Stephen. "Phrase Book for Writing papers and Research in English," Cambridge University Press, 2012. |
| 3 | Goldbort R. "Writing for Science," Yale University press, 2006. |
| 4 | Gabor L Lovei. "Writing and Publishing Scientific Paper," Open Book Publishers, 2021 |


| **COURSE OUTCOMES:** On completion of the course the student will be able to | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | understand and appreciate the role of English in writing a good research paper | Understand |
| CO2 | apply their knowledge in writing a research paper | Apply |
| CO3 | analyze and assess the quality of their research paper | Analysis |

| 22AC02 | DISASTER MANAGEMENT | SEMESTER I/II |
|---|---|---|

| PREREQUISITES | CATEGORY | PE | Credit | | |
|---|---|---|---|---|---|
| | Hours/Week | L | T | P | TH |
| | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES**

To have a critical understanding of key concepts in disaster risk reduction and humanitarian response and critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations and evaluate the strengths and weaknesses of disaster management approaches. Planning and programming in different countries, particularly their home country or the countries they work in.

| UNIT I | INTRODUCTION | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

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; Area 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 | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

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 | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

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 | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

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 | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

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

**Total(20L)= 20 Periods**

**REFERENCE BOOKS:**


| | |
|---|---|
| 1 | R. Nishith, Singh AK 2012 Disaster Management in India:Perspectives, issues and strategies New Royal Book Company, Lucknow |
| 2 | Sahni, PardeepEt.Al. (Eds.) 2002 Disaster Mitigation Experiences And Reflections. Prentice Hall Of India, New Delhi. |


| COURSE OUTCOMES: On completion of the course the student will be able to | | Bloom's Taxonomy Mapped |
|---|---|---|
| CO1 | Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response. | Understand |
| CO2 | Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives. | Evaluate |
| CO3 | develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations | Create |
| CO4 | Critically understand the strengths and weaknesses of disaster management approaches. | Understand |

| 22AC03 | SANSKRIT FOR TECHNICAL KNOWLEDGE | | SEMESTER I/II | | | |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **CATEGORY** | **PE** | **Credit** | | **0** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **2** | **0** | **0** | **2** |

**COURSE OBJECTIVES**

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

| | | | | | |
|---|---|---|---|---|---|
| **UNIT I** | **ALPHABETS** | **8** | **0** | **0** | **8** |
| Alphabets in Sanskrit –Past/Present/Future Tense –Simple Sentences. | | | | | |
| **UNIT II** | **LITERATURE** | **8** | **0** | **0** | **8** |
| Order –Introduction of roots –Technical information about Sanskrit Literature | | | | | |
| **UNIT III** | **CONCEPTS** | **8** | **0** | **0** | **8** |
| Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics | | | | | |

**Total(24L)= 24 Periods**

**REFERENCE BOOKS:**


| | |
|---|---|
| 1 | " Abhyasa Pustakam"- Dr.Vishwas, Samskrita- Bharati Publication,New Delhi |
| 2 | "Tech Yourself Sanskrit" PrathamaDeeksha-Vempatikutumbshastri,Rashtriya Sanskrit Sansthan,New Delhi Publication |
| 3 | India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi. |


| **COURSE OUTCOMES:** On completion of the course the student will be able to | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Understanding basic Sanskrit language | Understand |
| CO2 | Ancient Sanskrit literature about science & technology can be understood | Remembering |
| CO3 | Being a logical language will help to develop logic in students | Apply |

| 22AC04 | VALUE EDUCATION | SEMESTER I/II |
|---|---|---|

| PREREQUISITES | CATEGORY | PE | Credit | 0 |
|---|---|---|---|---|

| | Hours/Week | L | T | P | TH |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES**

To understand the Importance of value education and self-development. To imbibe good values in students and also know about the importance of character.

| UNIT I | BASIC VALUES | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

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 | CONFIDENCE | 6 | 0 | 0 | 6 |
|---|---|---|---|---|---|

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

| UNIT III | PERSONALITY DEVELOPMENT | 6 | 0 | 0 | 6 |
|---|---|---|---|---|---|

Personality and Behavior Development-Soul and Scientific attitude - Positive – Thinking - Integrity and discipline -Punctuality – Love and Kindness - Avoid fault Thinking - Free from anger - Dignity of labor - Universal brotherhood and religious tolerance –True friendship –Happiness Vs suffering –love for truth – Aware of self destructive habits- Association and Cooperation –Doing best for saving nature.

| UNIT IV | LOVE AND COMPASSION | 6 | 0 | 0 | 6 |
|---|---|---|---|---|---|

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

**Total (22L)= 22 Periods**

**REFERENCE BOOKS:**


1. Chakraborty, S.K. “Values and Ethics for Organization Theory and Practice”, Oxford University Press, New Delhi, 1998.


| COURSE OUTCOMES: On completion of the course the student will be able to | | Bloom’s Taxonomy Mapped |
|---|---|---|
| CO1 | Knowledge of self-development | Understand |
| CO2 | Learn the importance of Human values | Remembering |
| CO3 | Developing the overall personality | Create |

| 22AC05 | CONSTITUTION OF INDIA | | SEMESTER I/II | | | |
|---|---|---|---|---|---|---|
| PREREQUISITES | | CATEGORY | PE | Credit | | 0 |
| | | Hours/Week | L | T | P | TH |
| | | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES**

Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. 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. 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.

| | | | | | |
|---|---|---|---|---|---|
| **UNIT I** | **HISTORY OF MAKING OF INDIAN CONSTITUTION** | **4** | **0** | **0** | **4** |
| History, Drafting Committee (Composition & working) | | | | | |
| **UNIT II** | **PHILOSOPHY OF THE INDIAN CONSTITUTION** | **4** | **0** | **0** | **4** |
| Preamble, Salient Features. | | | | | |
| **UNIT III** | **CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES** | **4** | **0** | **0** | **4** |
| Fundamental rights, right to equality, right to freedom, right against exploitation, right to freedom of religion, cultural and education rights, right to constitutional remedies, directive principles of state policy, fundamental duties. | | | | | |
| **UNIT IV** | **ORGANS OF GOVERNANCE** | **4** | **0** | **0** | **4** |
| Parliament, composition, qualifications and disqualifications, powers and functions, executive, president, governor, council of ministers, judiciary, appointment and transfer of judges, qualifications, powers and functions. | | | | | |
| **UNIT V** | **LOCAL ADMINISTRATION** | **4** | **0** | **0** | **4** |
| Districts administration head: role and importance, municipalities: introduction, mayor and role of elected representative, CEO of municipal corporation. Panchayati raj: introduction, PRI: zila panchayat. Elected officials and their roles, CEO zila panchayat: position and role. Block level: organizational hierarchy (different departments), village level: role of elected and appointed officials, importance of grass root democracy. | | | | | |
| **UNIT VI** | **ELECTION COMMISSION** | **4** | **0** | **0** | **4** |
| Election Commission: role and functioning. Chief election commissioner and election commissioners. State election commission: role and functioning. Institute and bodies for the welfare of SC/ST/OBC and women. | | | | | |

**Total (24 L)= 24 Periods**

**REFERENCE BOOKS:**


| | |
|---|---|
| 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., LexisNexis, 2014. |
| 4 | D.D. Basu, Introduction to the Constitution of India, LexisNexis, 2015. |


| **COURSE OUTCOMES:** On completion of the course the student will be able to | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics | Understand |
| CO2 | Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India. | Understand |

| | | |
|---|---|---|
| CO3 | 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 | Understand |
| CO4 | Discuss the passage of the Hindu Code Bill of 1956. | Understand |

| 22AC06 | PEDAGOGY STUDIES | SEMESTER I/II |
|---|---|---|

| PREREQUISITES | CATEGORY | PE | Credit | 0 |
|---|---|---|---|---|
| | Hours/Week | L | T | P | TH |
| | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES**

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

| UNIT I | | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

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 | | 2 | 0 | 0 | 2 |
|---|---|---|---|---|---|

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

| UNIT III | | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school 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 | | 4 | 0 | 0 | 4 |
|---|---|---|---|---|---|

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 | | 2 | 0 | 0 | 2 |
|---|---|---|---|---|---|

Research gaps and future directions, Research design, Contexts, pedagogy, teacher education, curriculum and assessment, dissemination and research impact

**Total(16L)= 16 Periods**

**REFERENCE BOOKS:**


| | |
|---|---|
| 1 | Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261. |
| 2 | Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3) 361-379. |
| 3 | Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID |
| 4 | Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic math 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. |


| **COURSE OUTCOMES:** On completion of the course the student will be able to | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries? | Create |

| | | |
|---|---|---|
| CO2 | What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners? | Understand |
| CO3 | How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? | Rememberi ng |

| **22AC07** | **STRESS MANAGEMENT BY YOGA** | | | | **SEMESTER I/II** | | | |
|---|---|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **CATEGORY** | | | **PE** | **Credi t** | | **0** |
| | | **Hours/Week** | | | **L** | **T** | **P** | **TH** |
| | | | | | **2** | **0** | **0** | **2** |
| **COURSE OBJECTIVES** | | | | | | | | |
| To create a healthy, strong willed and intelligent young society through yoga practices. | | | | | | | | |
| **UNIT I** | **PHYSICAL AND MENTAL HEALTH** | | | | **4** | **0** | **0** | **4** |
| Pain and disease - free life, Simplified Physical Exercise- Pranayama. Concentration on Pituitary gland-Practical, Goal fixing. | | | | | | | | |
| **UNIT II** | **REJUVENATION OF LIFE FORCE AND WILL POWER** | | | | **4** | **0** | **0** | **4** |
| Principle of kayakalpa yoga, mind, life force and Biomagnetism, Practical, Concentration on Muladhara-Practical, Analysis of thought –Will power | | | | | | | | |
| **UNIT III** | **DEVELOPMENT OF VIRTUES** | | | | **4** | **0** | **0** | **4** |
| Activation of Dormant Brain cells- Practical, Moralization of dezire and its classification, Neutralization of Anger, Results of anger. | | | | | | | | |
| **UNIT IV** | **STREAM LINING OF MIND** | | | | **4** | **0** | **0** | **4** |
| Definition of Mind-Worries, Eradication of Worries. The science behind blessings. Blessing techniques. Benefits, five basic duties | | | | | | | | |
| **UNIT V** | **CAUSE AND EFFECT SYSTEM** | | | | **4** | **0** | **0** | **4** |
| Law of nature, Hereditary Imprints, Fivefold and Two-fold culture, good values and Resolution for world peace | | | | | | | | |
| **Total (24L)= 24 Periods** | | | | | | | | |

| **REFERENCE BOOKS:** | |
|---|---|
| 1 | “Thirukkural” , Pearls of Inspiration, Translation by Rajaram, Publisher :RUPA |
| 2 | “Bharathiyar Poems”, Amazon Asia – Pacific Holdings Private Limited. |
| 3 | “Yoga for Humane Excellence” , Vethathiri Maharishi, Vision for Wisdom, Vethathiri Publications |

| **COURSE OUTCOMES:**<br>On completion of the course the student will be able to | | **Bloom’s Taxonomy Mapped** |
|---|---|---|
| CO1 | Maintain good Physical health | Apply |
| CO2 | Develop will power | Create |
| CO3 | Take quick and right decisions | Evaluate |

| | | |
|---|---|---|
| CO4 | Maintain good relationship with everyone around them his creating a Health Society | Apply |

| 22AC08 | PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS | | SEMESTER I/II | | | |
|---|---|---|---|---|---|---|
| **PREREQUISITES** | | **CATEGORY** | **PE** | **Credit** | | **0** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **2** | **0** | **0** | **2** |

**COURSE OBJECTIVES**

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

| | | | | | |
|---|---|---|---|---|---|
| **UNIT I** | **PERSONALITY DEVELOPMENT** | **8** | **0** | **0** | **8** |

Neetisatakam – Holistics development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses-52,53,59(dont"s)
Verses71,73,75,78(do''s)

| | | | | | |
|---|---|---|---|---|---|
| **UNIT II** | **DUTIES AND SERVICES** | **8** | **0** | **0** | **8** |

Five Duty, Service Mortality, Introspection Cause and Effect System.

| | | | | | |
|---|---|---|---|---|---|
| **UNIT III** | **DEVELOPMENT OF VIRTUES** | **8** | **0** | **0** | **8** |

Five - Foldeed culture, Two- Folded culture, Self control & Self - Realization. Understanding the Nature Respect others' feelings.

**Total(24L)= 24 Periods**

| **Suggested Reading:** | |
|---|---|
| 1 | Thirukkural, Bharathiyar Poems |
| 2 | Yoga for Modern age - Vethathiri Maharishi |

| **COURSE OUTCOMES:** On completion of the course the student will be able to | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve The highest goal in life | Understand |
| CO2 | The person who has studied Geeta will lead the nation and mankind to peace and prosperity | Rememberi ng |
| CO3 | Study of Neetishatakam will help in developing the versatile personality of students. | Understand |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | **Semester** | | | | |
| **PREREQUISITES** | **Category** | **PE** | **Credit** | | | **3** |
| | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Unit I** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Semester** | | | |
| **PREREQUISITES** | | **Category** | **PE** | **Credit** | | **3** |
| | | **Hours/Week** | **L** | **T** | **P** | **TH** |
| | | | **3** | **0** | **0** | **3** |
| **Course Learning Objectives** | | | | | | |
| 1 | | | | | | |
| **Unit I** | | | **9** | **0** | **0** | **9** |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **Unit II** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit III** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit IV** | | **9** | **0** | **0** | **9** |
| | | | | | |
| **Unit V** | | **9** | **0** | **0** | **9** |
| | | | | | |
| | | | | | **Total -45Periods** |

| **Text Books:** | |
|---|---|
| 1 | |
| 2 | |
| **Reference Books:** | |
| 1 | |
| 2 | |
| 3 | |

| **Course Outcomes:**<br>Upon completion of this course, the students will be able to: | |
|---|---|
| **CO1** | |
| **CO2** | |
| **CO3** | |