Third ACM

# PSG INSTITUTE OF TECHNOLOGY AND APPLIED RESEARCH,

**COIMBATORE - 641 062**

(Autonomous college affiliated to Anna University)

**R2025**

**Courses of Study, Scheme of Assessment and Syllabi for All Semesters**

**for**

# M.E . Structural Engineering

# M.E. STRUCTURAL ENGINEERING

**(Minimum No. of credits to be earned: 70)**

| S.No. | Course Code | Course Title | Hours / Week | | | Credits | Maximum Marks | | | CAT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | CA | FE | Total | |
| **SEMESTER I** | | | | | | | | | | |
| 1 | MA25101 | Applied Numerical Methods | 3 | 1 | 0 | 4 | 40 | 60 | 100 | PC |
| 2 | SE25101 | Applied Elasticity and Plasticity | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 3 | SE25102 | Computer Analysis of Structures | 3 | 1 | 0 | 4 | 40 | 60 | 100 | PC |
| 4 | SE25103 | Advanced Reinforced Concrete Design | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 5 | SE25104 | Advanced Structural Steel Design | 3 | 1 | 0 | 4 | 40 | 60 | 100 | PC |
| 6 | SE25105 | Research Methodology and IPR | 2 | 0 | 0 | 2 | 40 | 60 | 100 | RMC |
| 7 | SE25A__ | Audit Course I | 2 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 8 | SE25111 | Advanced Concrete Laboratory | 0 | 0 | 4 | 2 | 60 | 40 | 100 | PC |
| 9 | SE25112 | Structural Engineering Laboratory | 0 | 0 | 4 | 2 | 60 | 40 | 100 | PC |
| | | **Total 30 periods** | **19** | **3** | **8** | **24** | **460** | **440** | **900** | |
| **SEMESTER II** | | | | | | | | | | |
| 1 | SE25201 | Finite Element Method | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 2 | SE25202 | Structural Dynamics | 3 | 1 | 0 | 4 | 40 | 60 | 100 | PC |
| 3 | SE25203 | Structural Stability | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PC |
| 4 | SE25P__ | Professional Elective – I | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 5 | SE25P__ | Professional Elective – II | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 6 | SE25A__ | Audit Course II | 2 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 7 | SE25211 | Symbolic and Numerical Computation Laboratory | 0 | 0 | 4 | 2 | 60 | 40 | 100 | PC |
| 8 | SE25212 | Computer Aided Structural Analysis and Design Laboratory | 0 | 0 | 4 | 2 | 60 | 40 | 100 | PC |
| 9 | SE25213 | Industrial Visit and Technical Seminar | 0 | 0 | 4 | 2 | 60 | 40 | 100 | EEC |
| | | **Total 30 periods** | **17** | **1** | **12** | **22** | **480** | **420** | **900** | |
| **SEMESTER III** | | | | | | | | | | |
| 1 | SE25P__ | Professional Elective III | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 2 | SE25P__ | Professional Elective IV | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 3 | SE25311 | Project Work I | 0 | 0 | 12 | 6 | 60 | 40 | 100 | EEC |
| | | **Total 18 periods** | **6** | **0** | **12** | **12** | **140** | **160** | **300** | |
| **SEMESTER IV** | | | | | | | | | | |
| 1 | SE25411 | Project Work II | 0 | 0 | 24 | 12 | 60 | 40 | 100 | EEC |
| | | **Total 24 periods** | **0** | **0** | **24** | **12** | **60** | **40** | **100** | |

**CAT – Category; PC – Professional Core; PE - Professional Elective; RMC - Research Methodology and IPR; EEC – Employability Enhancement Course; MC - Mandatory Course; Grade – Completed / Not complete**

**SUMMARY OF CREDIT DISTRIBUTION**

| M.E. STRUCTURAL ENGINEERING | | | | | | Total Credits |
|---|---|---|---|---|---|---|
| S. No | Course Category | Credits Per Semester | | | | |
| | | I | II | III | IV | |
| 1 | PC | 22 | 14 | 0 | 0 | 36 |
| 2 | RMC | 2 | 0 | 0 | 0 | 02 |
| 3 | PE | 0 | 6 | 6 | 0 | 12 |
| 4 | EEC | 0 | 2 | 6 | 12 | 20 |
| 5 | MC | - | - | - | - | - |
| **TOTAL** | | **24** | **22** | **12** | **12** | **70** |

**PROFESSIONAL ELECTIVE THEORY COURSES (Four to be opted)**

| S. No. | Course Code | Course Title | Hours / Week | | | Credits | Maximum Marks | | | CAT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | CA | FE | Total | |
| 1 | SE25P01 | Prestressed Concrete Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 2 | SE25P02 | Bridge Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 3 | SE25P03 | Aseismic Design of Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 4 | SE25P04 | Behaviour and Design of Tall Buildings | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 5 | SE25P05 | Advanced Concrete Technology | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 6 | SE25P06 | Advanced Optimization Techniques | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 7 | SE25P07 | Shell and Spatial Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 8 | SE25P08 | Experimental Techniques and Instrumentation | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 9 | SE25P09 | Theory of Plates | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 10 | SE25P10 | Industrial Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 11 | SE25P11 | Mechanics of Composite Materials | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 12 | SE25P12 | Soft Computing in Structural Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 13 | SE25P13 | Design of Steel Concrete Composite Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 14 | SE25P14 | Prefabricated Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 15 | SE25P15 | Maintenance and Rehabilitation of Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 16 | SE25P16 | Smart Materials and Smart Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 17 | SE25P17 | Structural Health Monitoring | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 18 | SE25P18 | Foundation Structures | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 19 | SE25P19 | Ground Improvement Techniques | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 20 | SE25P20 | Geotechnical Earthquake Engineering | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |
| 21 | SE25P21 | Soil-Structure Interaction | 3 | 0 | 0 | 3 | 40 | 60 | 100 | PE |

**CAT – Category; PC – Professional Core; PE - Professional Elective; RMC - Research Methodology and IPR; EEC – Employability Enhancement Course; MC - Mandatory Course; Grade – Completed / Not complete**

## List of Audit Courses

| S. No. | Course Code | Course Title | Hours / Week | | | Credits | Maximum Marks | | | CAT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | CA | FE | Total | |
| 1 | SE25A01 | Sustainable Development Goals | 2 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 2 | SE25A02 | English for Research Paper Writing | 2 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 3 | SE25A03 | Disaster Management | 2 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 4 | SE25A04 | Constitution of India | 2 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 5 | SE25A05 | Building Communication Skills | 2 | 0 | 0 | Grade | 100 | 0 | 100 | MC |

## List of One Credit Courses

| S. No. | Course Code | Course Title | Hours / Week | | | Credits | Maximum Marks | | | CAT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | | CA | FE | Total | |
| 1 | SE25O01 | Advanced Structural Design using Professional Software | 1 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 2 | SE25O02 | Non-Destructive Testing & Structural Health Monitoring | 1 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 3 | SE25O03 | Performance-Based Seismic Design of Structures | 1 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 4 | SE25O04 | Construction Planning, Contracts & Claims Management | 1 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 5 | SE25O05 | Advanced Concrete Technology for Structural Applications | 1 | 0 | 0 | Grade | 100 | 0 | 100 | MC |
| 6 | SE25O06 | Structural Forensics, Failure Analysis & Retrofitting | 1 | 0 | 0 | Grade | 100 | 0 | 100 | MC |

## MA25101 APPLIED NUMERICAL METHODS
## (Common to ED and SE)

**3 1 0 4**

**NUMERICAL SOLUTION OF SYSTEM OF EQUATIONS:** System of linear equations – Thomas algorithm, Gauss Jacobi and Seidel methods, successive over relaxation method, system of non-linear equations - Newton Raphson method, eigenvalues - power method and inverse power method. Curve fitting - linear regression, multiple linear regression, cubic splines – Bezier curves**.** **(12+4)**

**NUMERICAL SOLUTION TO ORDINARY DIFFERENTIAL EQUATIONS:** Runge-Kutta method of fourth order**.** Boundary value problem **-** Shooting method. Finite difference method, derivative boundary conditions. Finite Element Method - Rayleigh-Ritz method, Collocation and Galerkin methods. **(11+4)**

**NUMERICAL SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS:** Elliptic Equations - Liebmann's method for Laplace and Poisson equations, alternating direct implicit method, irregular and non-rectangular grids. Parabolic equations - explicit method and Crank-Nicolson method, second order parabolic equations – explicit method. Hyperbolic equations - explicit method. **(12+4)**

**MODELLING AND SIMULATION:** System modelling, system studies, principles of mathematical modelling, technique of simulation, types and components of simulation study, Monte Carlo Method, random number generation, test for randomness, test for uniform distribution. Static simulation - model for profit on sales, probabilistic simulation - inventory model: consumer demand. **(10+3)**

**Total L: 45 +T:15 = 60 periods**

**REFERENCES**


1. Curtis F. G and Patrick O. W, 'Applied Numerical Analysis'. Pearson Education, New Delhi, 2019.
2. Richard L. B, J. Douglas F, 'Numerical Analysis'. Cengage Learning, New Delhi, 2019.
3. Steven C. C and Raymond P. C, 'Numerical Methods for Engineers'. Tata McGraw-Hill, New Delhi, 2021.
4. Geoffrey G, 'System Simulation'. Pearson Education, New Delhi, 2017.
5. Frank R. G, William P. F and Steven B. H, 'First course in Mathematical Modeling'. Cengage Learning, New Delhi, 2015.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Explain the concepts related to numerical methods, modelling and simulation. | **K2** |
| **CO2** | Apply the techniques of numerical methods, modelling and simulation.to solve engineering problems. | **K3** |
| **CO3** | Analyze the solutions of engineering problems employing numerical methods, modelling and simulation. | **K4** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | | | | | |
| **CO2** | 3 | | | | | |
| **CO3** | | | | | | |
| | **3** | | | | | |

**1-low, 2-medium, 3-high**

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## SE25101 APPLIED ELASTICITY AND PLASTICITY

**3 0 0 3**

**ANALYSIS STRESS, STRAIN, STRESS STRAIN RELATIONS FORMULATION PROBLEMS:** Analysis of stress (two and three dimensions) - Body force, surface forces and stresses, uniform state of stress - principal stresses - stress transformation laws - Differential equations of equilibrium. Analysis of Strain (two and three dimensions) - strain and displacement relation - compatibility equations - state of strain at a point - strain transformations - principle of superposition. - Stress strain relation - generalised Hooke's law -Lame's constants- Formulation of Problems -Methods of Formulation - Equilibrium equations in terms of displacements - Compatibility equations in terms of stresses - boundary value problems **(12)**

**TWO DIMENSIONAL PROBLEMSI CARTESIAN COORDINATES:** Plane Stress problem, Plane Strain Problem–Formulation- Boundary condition - examples - Airy's stress function - polynomials - Direct method of determining Airy's stress functions - solution of Bi-harmonic equation - St.Venant`s principle - Two dimensional problems in Cartesian coordinates -bending of cantilever loaded at end **(11)**

**TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES & TORSION OF CYLINDRICAL BARS:** General Equations In polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar co- ordinates - displacements for symmetrical stress distribution - bending of a curved bar - effect of a circular hole on stress distribution – Thick cylinder - Forces on wedges - a circular disk with diametric loading -Torsion of prismatic bars - General solution of the problem by displacement (warping function) and force (Prandtl`s stress function) approaches-Torsion of shafts of circular and non-circular cross sectional -Torsion of thin rectangular section and hollow thin-walled sections. **(11)**

**INTRODUCTION TO PLASTICITY & ELASTO PLASTIC PROBLEMS:** Introduction to stress strain curve - ideal plastic body -criterion of yielding - Rankine`s theory - St.Venant`s theory - Tresca criterion - Beltrami`s theory - Von Mises criterion - Mohr`s theory of yielding - yield surface - Flow rule (plastic stress - strain of relation) – Prandtl Reuss equations - Plastic work - stress -strain relation based on Tresca - Plastic potential- Elastic plastic problems of beams in bending- thick hollow spheres and cylinders subjected to internal pressure. **(11)**

**Total L: 45 periods**

**REFERENCES**


1. Timoshenko and Goodier J N, ‘Theory of Elasticity’. McGraw Hill Book Co., 2017.
2. Sadhu Singh, ‘Theory of Elasticity’. Khanna Publications, New Delhi, 2015.
3. Cheap and Henry D J, ‘Plasticity for Structural Engineers’. Springer Verlag, New York, 2009.
4. Chakrabarty, ‘Theory of Plasticity’. McGraw Hill, 2012.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Understand the fundamental principles of stress and strain analysis in two and three dimensions, along with stress-strain relations and problem formulation techniques. | **K2** |
| **CO2** | Analyse two-dimensional elasticity problems in Cartesian and polar coordinates, including torsion of prismatic bars and application of Airy's stress functions. | **K3/K4** |
| **CO3** | Evaluate elastoplastic behaviour of structural elements using various yield criteria and plasticity models for beams, cylinders, and spheres. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

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## SE25102 COMPUTER ANALYSIS OF STRUCTURES

**3 1 0 4**

**FUNDAMENTAL CONCEPTS:** Introduction – Forces and Displacement Measurements – Principle of superposition – Methods of Structural Analysis – Stiffness and Flexibility matrices of the Elements – Flexibility and Stiffness approach to spring problems – Strain energy – Betti's Law and its applications – Transformation of system force 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 – Normal and orthogonal transformation. **(11+3)**

**FLEXIBILITYMETHOD:** Choice of redundants – Ill and well-conditioned equations – Automatic choice of redundants – Rank technique – Flexibility method – Flexibility analysis due to loads, settlement of supports, lack of fit and thermal expansion – Application to pin-jointed plane truss, continuous beams, frames and grids – Transformation of one set of redundants to another set **(11+4)**

**STIFFNESS METHOD**: Development of stiffness method – Difference between flexibility and stiffness – Stiffness analysis due to loads, thermal expansion, lack of fit – Application to pin-jointed plane and space trusses, continuous beams, frames and grids, space frames. **(11+4)**

**SPECIAL TOPICS**: Static condensation technique – Substructure technique – Symmetry and anti-symmetry of structures – Reanalysis technique – Direct stiffness approach – Application to two- and three-dimensional pin-jointed trusses, plane frames, grids. **(12+4)**

**Total L: 45 + T: 15 = 60 periods**

**REFERENCES**

1. Mcguire and Gallagher R H, 'Matrix Structural Analysis'. John Wiley, 2000.
2. Rajasekaran S and Sankarasubramanian G, 'Computational Structural Mechanics'. Prentice Hall of India, New Delhi, 2nd Ed. 2015.
3. Nelsm J K, Nelson K James and Mc Cormac J C, 'Structural Analysis Using Classical and Matrix Methods'. John Wiley & Sons, 2002.
4. Godbole P N, Sonparote R S and Dhote S U, 'Matrix Methods of Structural Analysis'. PHI, New Delhi, 2014.
5. Madhu B Kanchi, 'Matrix Methods of Structural Analysis'. New Age International, New Delhi, 2016.
6. Devadas Menon, 'Advanced Structural Analysis'. Narosa Publishers in India and Alpha Science International, UK,2009.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply the flexibility and stiffness matrix methods to analyze trusses, beams, and frames under various loading and boundary conditions. | **K2** |
| **CO2** | Demonstrate proficiency in developing and solving matrix formulations through computational tools for real-time structural analysis applications. | **K3/K4** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | **3** | **-** | **3** | **3** | **-** | **3** |
| **CO2** | **-** | **3** | **3** | **3** | **-** | **3** |
| | **3** | **3** | **3** | **3** | **-** | **3** |

**1-low, 2-medium, 3-high**

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**SE25103 ADVANCED REINFORCED CONCRETE DESIGN**

**3 0 0 3**

**DESIGN OF SPECIAL RC ELEMENTS:** Strain compatibility analysis of flexural cross-sections - design of slender columns -design of shear walls- Design of corbels and deep beams -Tie and strut model - arch analogy. **(12)**

**FLAT SLABS AND GRID FLOORS:** Design of flat slabs and flat plates according to IS and ACI method – design for shear reinforcement and spandrel beams: - design of grid floors - yield line theory for slabs. **(12)**

**DESIGN OF RC CHIMNEYS**, **BUNKERS AND SILOS:** Design of chimneys**:** Introduction– design of RCC chimneys for combined effect of self-load, wind load and temperature-design of bunkers and silos -Janssen's theory, Airy's theory. **(12)**

**INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND SLABS:** Principles of moment - rotation curves, moment redistribution and Baker's method of plastic design –RC members for fire resistance and ductile detailing: Introduction –Classification–Effects of high temperature on steel and concrete – Effects of high temperature on different structural members – Structural detailing –Ultimate moment capacity Ductile Detailing**:** Concepts of ductility – factors influencing ductility–design principles and codal provisions – beam to column junction. **(9)**

**Total L: 45 periods**

**REFERENCES**


1. Varghese P C,'Advanced Reinforced Concrete'. Prentice-Hall India Ltd., New Delhi, 2011.
2. McGregar G J and James K Wight, "Reinforced Concrete Mechanics and Design", Prentice hall,2012
3. Krishna Raju N and Pranesh R N, "Advanced Reinforced Concrete Design", New Age International Publishers, New Delhi, 2016.
4. Park. R and Paulay. T," Reinforced Concrete Structures", Wiley India, New Delhi, 2013.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply advanced design principles for special RC elements such as slender columns, corbels, deep beams, and shear walls using relevant codal methods. | **K3** |
| **CO2** | Analyse and design flat slabs, grid floors, chimneys, silos, and bunkers based on IS, ACI, and theoretical models such as yield line theory and Janssen's theory. | **K4** |
| **CO3** | Evaluate inelastic behaviour, moment redistribution, fire resistance, and ductile detailing of RC members and incorporate these principles into structural designs. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 3 | 2 | 3 |
| **CO2** | 2 | 1 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 | 3 |
| | **3** | **2** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25104 ADVANCED STRUCTURAL STEEL DESIGN

**3 1 0 4**

**COMPRESSION MEMBERS:** Introduction – Practical end conditions and effective length factors – Elastic compression members – Restrained compression members – Torsional buckling – Built-up compression members with lacings and battens – Column splices – In-plane behaviour of isolated beam-column – Design of beam-columns under biaxial loading – Column bases **(12+4)**

**FLEXURALMEMBERS:** Introduction–section classification–elastic analysis of beams–bending stresses–shear stresses–strength design – serviceability design – lateral buckling of beams – laterally restrained and unrestrained beams – design of plate girders and gantry girders–web and flange splices. **(12+4)**

**CONNECTIONS:** Introduction – Gable frame connection – beam to beam connection – beam to column connection -bolted and welded connections–framed connection–seated connection–moment resistant connections **(11+4)**

**LATERALLOADANDPLASTICANALYSIS&DESIGN:** Analysis of frames subjected to lateral loads–Portal method and Cantilever method; Plastic theory – plastic hinge concept – shape factor – load factor – methods of plastic analysis – plastic moment capacity of various sections– collapse load of beams and portal frames **(10+3)**

**Total L: 45 + T: 15=60 periods**

**REFERENCES**

1. Subramanian N, 'Design of Steel Structures-Limit state method'. Oxford University Press, New Delhi, 2016.
2. Trahair N S, Brandford M A, Nethercot D M, and Gardner L, 'The Behaviour and Design of SteelStructurestoEC3'. Taylor and Francis, London and Newyork,2008.
3. Bhavikatti S.S, 'Design of Steel Structures'. I. K. International Publishing House Pvt. Ltd, New Delhi, 2017.
4. Duggal S.K, 'Design of Steel Structures'. Tata McGraw Hill Publishing Company Ltd., New Delhi, 2011.
5. Ramachandra & Vivendra Gehlot, 'Design of Steel Structures'. Volume I & II, Scientific Publishers (India) Jodhpur, 2016.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply design principles to compression and flexural steel members including built-up columns and plate girders. | **K3** |
| **CO2** | Analyze and design various bolted and welded connections used in steel structures. | **K4** |
| **CO3** | Evaluate structural behavior under lateral loads and perform plastic design of steel beams and frames. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 3 | 2 | 3 |
| **CO2** | 2 | 1 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 | 3 |
| | **3** | **2** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

**SE25105 RESEARCH METHODOLOGY AND IPR**
**(Common to ED and SE)**

**2 0 0 2**

**RESEARCH PROBLEM FORMULATION:** Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap. **(4)**

**RESEARCH DESIGN AND DATA COLLECTION**: Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools. **(6)**

**DATA ANALYSIS, INTERPRETATION AND REPORTING**: Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research. **(10)**

**INTELLECTUAL PROPERTY RIGHTS AND PATENTS:** Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, copy rights, applicability of these IPR; IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance. Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents. **(10)**

**Total L: 30 periods**

**REFERENCES**

1. Cooper Donald R, Schindler Pamela S and Sharma J K, 'Business Research Methods'. Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, 'Research methodology for natural sciences'. IISc Press, Kolkata, 2022,
3. Catherine J. Holland, 'Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets'. Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, 'Patent searching: tools & techniques'. Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, 'Professional Programme Intellectual Property Rights, Law and practice'. September 2013.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Outline the principles of research problem formulation, research design, data collection, the basic features and significance of IPR. | **K2** |
| **CO2** | Utilize research methodology principles to develop a research plan, conduct literature reviews, analyze data using appropriate statistical methods, and prepare structured research reports or proposals following ethical guidelines. | **K3** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | 2 | 1 | 1 | - |
| **CO2** | - | 2 | 2 | 2 | 2 | - |
| | 1 | 2 | 2 | 2 | 2 | - |

**1-low, 2-medium, 3-high**

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## SE25111 ADVANCED CONCRETE LABORATORY

**0 0 4 2**

In this course, students will be exposed to the various topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

**Topics for orientation/ List of Experiments**

1. Physical and chemical properties of concrete ingredients
2. Fresh properties of cement composites
3. Mechanical properties of concrete specimens
4. Mix design of high strength/ performance concrete as per IS method for M40 to M60grade,
5. Mix design - ACI method up to M80 grade.
6. Flow Characteristics of Self Compacting concrete.

**CASE STUDY:**

Each student is required to perform a case study that involves the application and/or integration of one or more orientation topics.

**Total P: 60 periods**

**REFERENCES**


1. Laboratory Manual prepared by the Department of Civil Engineering, PSG Institute of Technology and Applied Research, Coimbatore
2. Zonjin Li, Xiangming Zhou, Hongyan Ma, Dongshuai Hou, ‘Advanced Concrete Technology’ Wiley, Second edition, 2023
3. Michael Thomas, ‘Supplementary Cementing Materials in Concrete’. CRC press, 2017
4. Mustafa Toyay, ‘Cement and Concrete - Mineral Admixture’. CRC Press, 2016
5. Mehta P K, Pauls J M and Monteiro, ‘Concrete: Micro Structure, Properties and Materials’. Tata McGraw Hill Education Private limited, NewDelhi, 2014


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Apply knowledge of materials and concrete mix design methods (IS and ACI) to evaluate physical, chemical, and mechanical properties of concrete. | **K3** |
| **CO2** | Analyse and synthesize literature and experimental results to identify a problem and develop a relevant project using orientation techniques. | **K5** |
| **CO3** | Prepare and present a detailed technical report based on experimental observations and project findings, justifying conclusions effectively. | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 2 | 3 | 3 | 3 | 2 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25112 STRUCTURAL ENGINEERING LABORATORY**

**0 0 4 2**

In this course, students will be exposed to the various topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

**Topics for orientation/ List of Experiments**

1. Specimen preparation and testing of Under-reinforced RC beams for flexure and shear under gravity loading.
2. Short and slender reinforced concrete columns under axial compression
3. Permeability test on hardened concrete (RCPT)
4. Identification and Grid mapping of rebar location in RC member
5. Estimation of compressive strength of concrete using rebound hammer.
6. Hardened concrete core test.
7. Estimation of compressive strength of concrete using UPV
8. Analyse the quality of the concrete

**CASE STUDY:**

Each student is required to perform a case study that involves the application and/or integration of one or more orientation topics.

**Total P: 60 periods**

**REFERENCES**


1. Laboratory Manual prepared by the Department of Civil Engineering, PSG Institute of Technology and Applied Research, Coimbatore
2. Subramanian N, 'Design of Steel Structures - Limit state method'. Oxford University Press, New Delhi, 2016.
3. Park.R and Paulay.T, 'Reinforced concrete structures'. Wiley India, New Delhi, 2013.
4. Subramanian N, 'Design of Reinforced Concrete Structures'. Oxford University Press, New Delhi, 2014.
5. Sai Ram KS, 'Design of Steel Structures'. Pearson, New Delhi, 2020.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply experimental techniques and tools introduced in the orientation to evaluate the behaviour of RC structural elements and concrete quality. | **K3** |
| **CO2** | Analyse a structural engineering problem using literature review and formulate a project with appropriate methodology, tools, and interpretation of results. | **K5** |
| **CO3** | Create and present a comprehensive technical report based on experimental/project findings with proper justification, analysis, and engineering conclusions. | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 2 | 3 | 3 | 3 | 2 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25201 FINITE ELEMENT METHOD

**3 0 0 3**

**INTRODUCTION:** Concepts – Two dimensional truss element – algorithm to generate stiffness matrix – Assembly & Boundary conditions - NUMERICAL METHODS – Gaussian elimination method – band and skyline form of storage – band solver –interpolation – Lagrangian and Hermitian – Numerical integration using Gaussian quadrature.-ENERGYPRINCIPLESANDMETHOD OF WEIGHTED RESIDUAL: Variational principles - Rayleigh Ritz method - Method of collocation – Subdomain method - Galerkin`s method - Method of least squares - CONVERGENCE & COMPATIBILITY REQUIREMENTS**:** Properties of single element -assumed displacement field – various element shapes – Pascal triangle – Melosh criteria **(12)**

**TRIANGULAR, RECTANGULAR AND ISO PARAMETRIC ELEMENTS:** Constant strain triangle - Element stiffness matrix -Various methods of evaluating element stiffness-Higher order triangular elements-comparison of different methods - rectangular element – serendipity family – Lagrangian family – Hermitian family. ISO PARAMETRIC ELEMENTS- sub- iso – super parametric elements – shape functions mapping – linear Iso – parametric quadrilateral. – Simple problems **(11)**

**THREE DIMENSIONAL ELEMENTS & PLATE SHELL ELEMENTS:** Tetrahedron element family - Hexahedron element family-ZIB8 and ZIB 20 elements – comparison. Axi-symmetric stress analysis - PLATE/SHELL ELEMENTS: Triangular and rectangular elements-BFS element–Concepts of Shell Elements-Degenerated shell elements. Introduction to Finite Strip Method **(11)**

**NONLINEAR ANALYSIS:** Types of non-linearities - solution techniques- stability analysis- Load deformation response considering geometric, material and both non-linearities– Newton Raphson and Riks Wempner methods – Eigen value analysis.- APPLICATION TO FIELD PROBLEMS: Finite Element Modelling - Field problems such as seepage - torsion etc. -programming organization of finite element schemes – mesh generation aspects, adaptive mesh refinement – software packages- Introduction to meshless methods – principles - applications. **(11)**

**Total L: 45 periods**

**REFERENCES**


1. Rao S S, 'The Finite Element Method in Engineering'. Elsevier, 2017.
2. Cook R D, Malkus D S, Plesha M E and Witt R J, 'Concepts and Applications of Finite Element Analysis'. John Wiley &Sons,2007.
3. Rajasekaran S, 'Finite Element Analysis in Engineering Design'. S Chand & Co., 2008.
4. Zienkiewicz O C and Taylor, R Land J.Z. Zhu, 'The Finite Element Method'. Elsevier Butterworth and Heimann., 2013.
5. Krishnamoorthy C S, 'The Finite Element Analysis – Theory and Programming'. Tata McGraw-Hill, 2017.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Understand the fundamental principles and mathematical formulation of the finite element method including variation principles, interpolation, and numerical integration. | **K2** |
| **CO2** | Analyse structural systems using different finite elements like triangular, rectangular, iso parametric, 3D, plate, and shell elements. | **K4** |
| **CO3** | Evaluate nonlinear problems and apply FEM tools to solve field-specific structural issues including adaptive meshing and introduction to meshless methods. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25202 STRUCTURAL DYNAMICS

**3 1 0 4**

**SINGLE DEGREE OF FREEDOM SYSTEM:** Introduction - vibration studies and their importance to structural engineering problems - elements of vibratory systems- simple harmonic motion - vibration with and without damping - constraints -generalized mass - D`Alembert's principle - Hamilton's principle - degree of freedom - equation of motion for single degree of freedom (SDOF) system - damped and un damped free vibrations – un damped forced vibration - critical damping – logarithmic decrement – response to support motion – response of SDOF system to harmonic excitation damped or un damped – evaluation of damping resonance - band width method to evaluate damping – force transmissibility - displacement transmissibility -vibration isolation. **(12+4)**

**RESPONSE TO GENERAL DYNAMIC LOADING:** Fourier Series Expression for loading- response to general dynamic loading - (blaster earthquake) - Duhamel's integral. Numerical Evaluation: Newmark's method- Wilson θ method– recurrence formula. SDOF system: Expression for generalised system properties - vibrational analysis with Rayleigh's variational method –Rayleigh- Ritz Method. **(11+4)**

**MULTI DEGREES OF FREEDOM SYSTEM:** Response to free and forced vibration of undamped and damped systems –application of Hamilton's principle - Lagrange equations coupling - evaluation of structural property matrices - natural vibration -solution of the eigen value problem - orthogonality and normality principles of natural modes - iteration due to Stodola – Holzer method -Transfer matrix method -Rayleigh-Ritz and Dunkerley approximation. **(12+4)**

**DISTRIBUTED PARAMETER SYSTEM:** Differential equation of motion – analysis of undamped free vibration of simply supported and cantilever beams - effect of axial loads - numerical evaluation of modes - frequencies and response system -vibration analysis using finite element method for beams and frames. Idealisation of multi-storied frames for dynamic analysis-modal analysis-time history analysis- wind induced vibration of structures -moving load, impact blast loading. **(10+3)**

**Total L: 45 + T: 15 = 60 periods**

**REFERENCES**


1. Anil K Chopra, 'Dynamics of Structures- Theory and Applications to Earthquake Engineering'. Prentice Hall, New Delhi, 2014.
2. Paz M, 'Structural Dynamics -Theory and Computation'. Springer, 2007.
3. Craig RR, 'Structural Dynamics – An Introduction to Computer Methods'. John Wiley & Sons, 2006.
4. Clough R W and Penzien, 'Dynamics of Structures'. Mc Graw Hill Book Co. Ltd, 2003.
5. Thomson W T, 'Theory of Vibration'. Prentice Hall of India, 2003.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Understand the fundamental concepts of vibrations in structural systems including single and multi-degree freedom systems and distributed parameter systems. | **K2** |
| **CO2** | Analyse and solve vibration problems using analytical and numerical methods such as Duhamel's Integral, Rayleigh's method, and Newmark's method. | **K4** |
| **CO3** | Evaluate and design structures subject to dynamic loads including blast and earthquake using advanced tools like FEM, modal analysis, and time-history analysis. | **K5** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25203 STRUCTURAL STABILITY**

**3 0 0 3**

**CONCEPTS OF STABILITY AND COMPRESSION MEMBERS:** Introduction – Stability Criteria – Equilibrium, Energy and dynamic approaches - South well Plot – Stability of link models. Higher order Differential equations – Analysis for various boundary conditions–Behaviour of imperfect column–Initially bent column–Eccentrically loaded column-Energy method-Rayleigh Ritz, Galerkin methods–Numerical techniques–Newmark's method–Finite Element Method **(13)**

**STABILITY OF PLATES AND ELEMENTS OF NON-LINEAR THEORY OF BUCKLING:** Governing Differential equation –Equilibrium, Energy concepts–Buckling of plates of various end conditions–Finite Difference Method–Post-buckling strength–Finite Element Method. Perfect Systems–Imperfect Systems–Imperfection in-sensitive and sensitive systems–Symmetric and Asymmetric Bifurcation–Non-linear analysis of shell and spatial structures–Basic concepts **(11)**

**LATERAL STABILITY OF BEAMS AND BEAM-COLUMNS:** Differential equations for lateral buckling – Lateral buckling of beams in pure bending – Lateral buckling of cantilever and simply supported 'I' beams. Beam-columns with concentrated lateral load–Distributed loads–Effect of axial loads on bending stiffness–Stability of frames–Stability functions– PΔ effect. **(11)**

**IN ELASTIC BUCKLING AND BUCKLING OF THIN-WALLED OPEN & CLOSED SECTIONS:** Introduction–Double modulus theory (reduced modulus) – Tangent modulus theory – Shanley's theory – Determination of double modulus for various sections. Torsional buckling–Torsional flexural buckling–Equilibrium and Energy approaches. **(10)**

**Total L: 45 periods**

**REFERENCES**


1. Timoshenko, S. P. and Gere J. M., 'Theory of Elastic Stability'. 2ndEd. McGraw-Hill, 2017.
2. Alfutov N. A., 'Stability of Elastic structures'. Springer verlog, 2000.
3. El Naschie M. S., 'Stress, Stability and Chaos in Structural Engineering: An Energy Approach'. McGraw Hill International Editions, 1992.
4. Iyengar N.G. R., 'Structural Stability of Columns and Plates'. Affiliated East West press Pvt Ltd., New Delhi, 2007.
5. Chajes A., 'Principles of Structural Stability Theory'. Prentice Hall, New Jersey, 1980.
6. Gambhir, M. L., 'Stability Analysis and Design of Structures'. Springer, NewYork, 2009.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply theoretical and numerical methods to evaluate the stability of structural elements including columns, beams, plates, and shells. | **K3** |
| **CO2** | Analyze and interpret post-buckling behavior and P-Δ effects in beam-columns through assignments or case studies. | **K4** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 3 | | 3 | 3 | | 3 |
| **CO2** | | 3 | 3 | 3 | 3 | |
| | 3 | 3 | 3 | 3 | 3 | 3 |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25211 SYMBOLIC AND NUMERICAL COMPUTATION LABORATORY**

**0 0 4 2**

In this course, students will be exposed to the various topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

**Topics for orientation:**

1. Free and forced vibration of damped and undamped systems
2. Numerical methods – New marks – Wilson Theta methods
3. Extracting frequencies and mode shapes
4. Vibration of strings, beams and shear building
5. Application of finite element method to trusses, beams and frames
6. Response spectrum
7. Problems of base excitation

**CASE STUDY:**

Each student is required to perform a case study that involves the application and/or integration of one or more orientation topics.

**Total P: 60 periods**

**REFERENCES**


1. Laboratory Manual prepared by the Department of Civil Engineering, PSG Institute of Technology and Applied Research, Coimbatore
2. Anil K Chopra, 'Dynamics of Structures - Theory and Applications to Earthquake Engineering'. Prentice Hall, New Delhi, 2014.
3. Craig R R, 'Structural Dynamics - An Introduction to Computer Methods'. John Wiley & Sons, 2006.
4. Clough R W and Penzien, 'Dynamics of Structures'. McGraw Hill Book Co. Ltd, 2003.


**COURSE OUTCOMES:**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Analyze and interpret dynamic structural behavior using symbolic and numerical methods through project-based case studies involving vibrations, FEM, and response spectra. | **K4** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | 3 | 3 | 3 | |
| | | 3 | 3 | 3 | 3 | |

**1-low, 2-medium, 3-high**

## SE25212 COMPUTER AIDED STRUCTURAL ANALYSIS AND DESIGN LABORATORY

**0 0 4 2**

In this course, students will be exposed to the various topics mentioned below which are relevant to the laboratory course. This exposure will be for a duration of 12 hours. After this exposure/orientation, each student is expected to formulate and complete a project of interest and of industrial relevance, which has to be derived from the orientation programme under the guidance of a faculty. The details like background, problem definition, state of technology/knowledge in that area by a good literature review (five recent publications), objectives, methodology, software and equipment that can be used (from the orientation programme), experimental results and their interpretation with respect to the assumptions/background and a formal conclusion are expected in the report which is to be submitted at the end of the semester. This work is evaluated for the credit assigned. Expected hours needed for this work is 48 hours.

**Topics for orientation:**

1. Matrix methods of Structural Analysis – stiffness and flexibility approaches, direct stiffness approach
2. Structural Analysis and Design of RC Structures for gravity and lateral loads
3. Structural Analysis of Design of Steel Structures for gravity and lateral loads
4. Structural Analysis and Design of Pre-Stressed Concrete Structures
5. Study of neural network & genetic algorithms application to structural engineering problems– concepts and case studies

**CASE STUDY:**

Each student is required to perform a case study that involves the application and/or integration of one or more orientation topics.

**Total P: 60 periods**

**REFERENCES**

1. Laboratory Manual prepared by the Department of Civil Engineering, PSG Institute of Technology and Applied Research, Coimbatore
2. Rajasekaran S and Sankarasubramanian G, 'Computational Structural Mechanics'. Prentice Hall of India, New Delhi, 2nd Ed. 2015.
3. Krishna Raju N and Pranesh R N, 'Advanced Reinforced Concrete Design'. New Age International Publishers, New Delhi, 2016.
4. Subramanian N, 'Design of Steel Structures - Limit state method'. Oxford University Press, New Delhi, 2016.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Analyze complex structural systems by applying computer-aided methods (matrix analysis, AI techniques, or design codes for RC/steel/prestressed concrete) through project-based case studies of industrial relevance. | **K4** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | 3 | 3 | 3 | |
| | | 3 | 3 | 3 | 3 | |

**1-low, 2-medium, 3-high**

## SE25213 INDUSTRIAL VISIT AND TECHNICAL SEMINAR

**0 0 4 2**

The student will make at least four one-and-a-half-day industry visits and technical presentations. The same will be assessed by the committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his / her presentations together with the observation in industry visits. A quiz covering the above will be held at the end of the semester.

**Total L: 60 periods**

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Summarize and present insights gained through industry visits and technical observations using effective communication. | **K2** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | | 2 | 3 | 2 | 1 | |
| | | 2 | 3 | 2 | 1 | |

**1-low, 2-medium, 3-high**

## SE25311 PROJECT WORK I

**0 0 12 6**

The student individually works on a specific topic approved by the faculty member who is familiar with this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and a methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply theoretical and practical knowledge to solve problems, conduct literature reviews, develop methodology, identify research gaps with key parameters, and effectively present findings. | **K5** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25411 PROJECT WORK II

**0 0 24 12**

The student should continue the phase I work on the selected topic as per the formulated methodology / Undergo internship. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Explore research in Structural Engineering, apply theoretical and practical knowledge creatively, represent data clearly, derive meaningful conclusions, and effectively report findings with structured presentation. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25P01 PRESTRESSED CONCRETE STRUCTURES

**3 0 0 3**

**ANALYSIS AND DESIGN FOR FLEXURE**: Principles - types - prestressing - materials definition of Type I, Type II and Type III structures – requirements - behaviour of PSC elements - force transmitted by pretensioned and post tensioned systems-analysis - service loads - methods - losses - ultimate strength-Design for flexure And Deflection: Philosophy - limit states -concepts - collapse and serviceability - service load - basic requirements - stress range approach - Lin's approach – Magnel 's approach – cable layouts. Deflection- importance-short- and long-term deflection of un cracked and cracked members. Specifications on formwork removal. **(12)**

**DESIGN FOR SHEAR, TORSION & TRANSMISSION OF PRESTRESS:** Shear and principal stresses - limit state shearing resistance of cracked and un cracked sections - design of shear reinforcement by limit state approach. Behaviour under torsion - modes of failure - design for combined torsion, shear and bending. Transfer of prestress: Transmission of prestressing force by bond in pretensioned members - Transmission length - Factors affecting transmission length - check for transmission length - transverse tensile stresses - end zone reinforcement. Anchorage zone stresses in post-tensioned members - Magnel's method - Calculation of bearing stress and bursting tensile forces-code provisions- Reinforcement in anchorage zone. **(14)**

**COMPOSITE CONSTRUCTION OF PRESTRESSED & INSITU CONCRETE:** Need-types of composite construction- behaviour - analysis for flexural stresses- shear - differential shrinkage - design for flexure and shear. **(09)**

**CIRCULAR PRESTRESSING & STATICALLY INDETERMINATE STRUCTURES:** Tanks and Pipes: Circular prestressing in liquid retaining tanks - analysis for stresses - design of tank wall. PSC pipes - types - design of noncylinder pipes Methods of achieving continuity - assumptions in elastic analysis – pressure line-linear transformation-concordant cables-Guyon's theorem-analysis and design of continuous beams. **(10)**

**Total L: 45 periods**

**REFERENCES**

1. Rajagopalan N, ‘Prestressed Concrete’. Narosa Publishing House, New Delhi, 2010.
2. Krishna Raju N, ‘Prestressed Concrete’. Tata Mc Graw Hill Publishing Company Ltd., New Delhi 2018.
3. Dayaratnam P, ‘Prestressed Concrete Structures’. Oxford& IBH, Publishing Co. Pvt., 2018.
4. Praveen Nagarajan, ‘Prestressed Concrete Design’. Pearson. 2013.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Apply the principles of prestressing and analyze prestressed concrete members under flexure, shear, and torsion, incorporating appropriate loss calculations and deflection checks. | **K3** |
| **CO2** | Design pre tensioned and post-tensioned structural elements, including composite and statically indeterminate systems, using relevant codal provisions and analytical methods. | **K4** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | | | 3 | | 3 |
| **CO2** | | 3 | | 3 | 3 | |
| | **3** | **3** | | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25P02 BRIDGE ENGINEERING**

**3 0 0 3**

**HYDRAULIC AND GEOMENTRIC DESIGN OF BRIDGES:** Definition and components of a bridge – layout and planning of abridge–classification–investigation of a bridge–preliminary data collection–choice and type of a bridge hydraulic design of a bridge. Traffic design–loading–high way and railway loading–specification –Provisions of IRC: 6 **(10)**

**REINFORCED CONCRETE BRIDGES:** Straight and curved bridge decks–decks of various types–slab hollow and voided slab–beam–slab box–reinforced concrete slab bridges–load distribution–Pigeaud's theory–skew slab deck–RC tee beam and slab bridge–Balanced Cantilever bridge–rigid frame bridge–box girder bridge-Provisions of IRC:112. **(13)**

**PRESTRESSED CONCRETE AND STEEL BRIDGES:** Pre-stressed concrete bridge – Composite beam bridge– Analysis and Design for static, moving and dynamic loading. Plate girder bridge–box Girder Bridge–truss bridge–influence lines for forces in member-cable stayed bridge-Analysis for static, moving and dynamic loading.-Provisions of IRC: 18 **(13)**

**SUB STRUCTURE DESIGN, CONSTRUCTION AND MAINTENANCE OF BRIDGES:**
Piers and abutments – bridge bearings – steel rocker and roller bearings – reinforced concrete rocker and roller bearings –elastomeric bearings. Construction methods–short span–long span–false work for concrete bridges–construction management–inspection and maintenance–lessons from bridge failures–rehabilitation of a bridge–load testing of bridge. **(9)**

**Total L: 45 periods**

**REFERENCES**


1. Johnson Victor D, 'Essentials of Bridge Engineering'. Oxford & IBH publishing co. Pvt. Ltd., New Delhi, 2019.
2. Krishna Raju N, 'Design of Bridges'. Oxford Publishing co Pvt. Ltd., New Delhi, 2018.
3. Raina V K 'Concrete Bridge Practice'. Tata Mc Graw-Hill publishing co, New Delhi, 2014.
4. Ponnuswamy S, 'Bridge Engineering'. Tata Mc Graw Hill Pub co New Delhi, 2017.
5. Jagadeesh.T. T., Jayaram. M.A, 'Design of Bridge Structures'. PHI Learning Pvt Ltd, 2014.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply principles of hydraulic and geometric design for planning and selecting appropriate bridge types. | **K3** |
| **CO2** | Analyze and design reinforced and prestressed concrete bridges, including load distribution and IRC provisions. | **K4** |
| **CO3** | Evaluate bridge substructure systems, construction methods, and maintenance strategies for performance and safety. | **K5** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 3 | 2 | 3 |
| **CO2** | 2 | 1 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 | 3 |
| | **3** | **2** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25P03 ASEISMIC DESIGN OF STRUCTURES**

**3 0 0 3**

**BASIC CONCEPTS AND ANALYSIS:** Elements of Engineering Seismology – Indian Seismology-earthquake history-catastrophes- failures - lessons learnt in past earthquakes - time history and response spectrum method-modal analysis -earth quake response to linear systems- response spectrum characteristics - ground motion parameters - construction of design spectrum-lumped mass system - shear building - symmetrical and unsymmetrical buildings-multiple support excitation introduction to deterministic earthquake response to continuous systems on rigid base. **(13)**

**STRUCTURAL DESIGN CRITERIA:** Principles and design criteria for structures as per IS1893 - modal response contribution –modal participation factor-response history-spectral analysis-problems-design and construction of buildings as per IS 4326 - general principles - special construction features - types of construction - building categories - construction of masonry walls-precast floors and roofs- guidelines for earthquake resistant of low strength masonry buildings as per IS13828- behavior and design of masonry structures- behavior of masonry in fills in RC frame guidelines for improving earthquake resistance of earthen buildings as per IS13827- guidelines for repair and seismic strengthening of buildings as per IS13935. **(12)**

**BEHAVIOUR OF RC STRUCTURES:** Capacity design- design and detailing as per IS13920- behavior of RC structures-cyclic load - shear wall frame system - Khan and Saboron is method - Coupled shear wall system - Rosman’s method – ductility requirements in concrete structures- beam column junction-pushover analysis. **(10)**

**BEHAVIOUR OF STEEL STRUCTURES:** Behaviour of steel under cyclic load - behavior of flexural members under cyclic loading-steel bracing systems-behavior and design aspects-ductile design of frame members-frame members subjected to axial compression and bending - beam column joints - detailing of steel connections - retrofitting and strengthening of steel frames- analysis for lateral loads – base isolation techniques. **(10)**

**Total L: 45 periods**

**REFERENCES**


1. Anil K Chopra, ‘Dynamics of Structures - Theory and Applications to Earthquake Engineering’. Prentice Hall, New Delhi, 2014.
2. Duggal S K, ‘Earthquake Resistant Design of Structures’. Oxford University Press, New Delhi, 2013.
3. Agarwal P and Shrikande M, ‘Earthquake Resistant Design of Structures’. Prentice Hall of India, 2011.
4. Chen W F and Scawthorn, ‘Earthquake Engineering Hand Book’. CRC press, 2003.
5. Naeim F, ‘The Seismic Design Hand Book’. Kluwer Academic Publishers, London, 2001.
6. Hand Book on Seismic Retrofitting of Buildings, published by CPWD & Indian Building Congress in Association with IIT, Madras, Narosa Publishing House, 2008.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Understand basic concepts, guidelines, structural criteria for aseismic design and behavior RCC and Steel structures. | **K2** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | | | 2 | 1 | |
| | **2** | **-** | **-** | **2** | **1** | **-** |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25P04 BEHAVIOUR AND DESIGN OF TALL BUILDINGS**

**3 0 0 3**

**LOADING AND STRUCTURAL SYSTEMS:** History- Design Philosophy- Strength and Stability- Stiffness and Drift- Creep, Shrinkage and Temperature – Fire - Settlement. Loading – Gravity loading, wind loading, Earthquake loading and combinations offloading. Structural Forms - Floor Systems – RCC and Steel. Modelling for Approximate and Accurate Analysis – Reduction Techniques. **(10)**

**BEHAVIOUR OF FRAMED SYSTEMS:** Braced Frame-Behaviour of Bracing and Braced bents- Member Force Analysis – Drift Analysis. Rigid Frame – Behaviour- Approximate Analysis for Gravity and Lateral Loading. Drift Analysis – Flat Plate Structures - Reduction Techniques. In-filled Frame–Behaviour-Forces–Design of infill, Frame and Horizontal Deflection. **(12)**

**BEHAVIOUR OF SHEAR WALL SYSTEMS:** Shear Wall-Behaviour- Proportionate and Non-proportionate-Twisting and Non-Twisting - Effects of Discontinuity- Stress Analysis Coupled Shear Wall- Behaviour-Continuous Medium Method – Frame Analogy Method – Wall - Frame – Behaviour – Approximate analysis - Solution for UDL and Alternative Loading – Analysis using Graphs. **(12)**

**OUTRIGGER STRUCTURES AND STABILITY OF TALL BUILDINGS:** Outrigger Braced – Analysis of Forces and Horizontal Deflections – Generalized Solutions – Optimum Locations – Performance Stability –overall buckling analysis of Frames, Wall frames. Second-Order Effects –P-Delta Analysis – Translational-Torsional instability - Out of Plumb Effect Concepts and Behaviour of Core and Tubular Structures. Behaviour of Connections-Rigid and Semi rigid-Beam and Beam-Column Connections-Connections for Ductility. **(11)**

**Total L: 45 periods**

**REFERENCES**


1. Smith B. S. and Coull A., 'Tall Building Structures Analysis and Design'. John Wiley and Sons, Inc, 2011.
2. Bryan Stanfford Smith, Alex Coull, 'Tall Building Structures: Analysis and Design'. John Wiley and Sons, 2011.
3. Bungale. S. Taranath, 'Reinforced Concrete Design of Tall Buildings'. CRC Press, 2010.
4. Mark Sarkisian, 'Designing Tall Buildings: Structure as Architecture'. Taylor & Francis, 2016.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Understand the structural systems, load considerations, and modelling techniques used in the design of tall buildings. | **K2** |
| **CO2** | Analyse the behaviour of different structural systems including braced frames, rigid frames, infilled frames, and shear wall systems under lateral and gravity loads. | **K4** |
| **CO3** | Evaluate the performance and stability of outrigger and tubular structures including second-order effects, torsional behaviour, and connection detailing. | **K5** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25P05 ADVANCED CONCRETE TECHNOLOGY

**3 0 0 3**

**CONSTITUENTSOF CONCRETE:** Composition and properties of Portland cement –hydration of cement– structure of hydrated cement paste-gel theories – Effect of cement characteristics on strength and heat of hydration – physical properties – acceptance criteria – types of cements and applications – aggregates – fine aggregate characteristics and significance –mechanical properties of coarse aggregates – acceptance criteria – influence of aggregate properties on strength of concrete - alkali-aggregate reaction – grading requirements. **(11)**

**PROPERTIES OF CONCRETE:** Microstructure of concrete – nanometer scale –C-S-H structure – transition zone and microcracking -Workability - Factors affecting workability - Tests for workability -segregation - bleeding - Modern trends in concrete production , placement, compaction and curing –- Vacuum dewatering and underwater concreting – special formwork -Factors affecting strength of concrete - Maturity of concrete – Rheological properties of concrete - Shrinkage - Creep of concrete – Factors affecting creep and shrinkage of concrete – Compression, Split Tension, Flexure, Bond strength – IS code provisions - Factors affecting strength test results - Accelerated strength tests - Stress strain characteristics - Determination of modulus of elasticity – Non-destructive evaluation of reinforced concrete – load test on structural components **(12)**

**DURABILITY ASPECTS AND MIX DESIGN:** Permeability – causes of concrete deterioration – Chemical attack – Sulphate Attack - Quality of water - Marine environment – effect of fire- frost action- thermal properties of concrete - fire resistance and corrosion protection – Methods to improve durability – Mix design – Basic considerations – frequency of sampling – nominal and design mixes – quality control and acceptance criteria – Factors in the choice of mix proportions – Mix design methods -ACI method, IS method – Mix proportions for weigh batching and volume batching – correction for moisture content and bulking – yield of concrete – design of high strength concrete (Shacklok and Entroy). **(11)**

**ADMIXTURES AND SPECIAL CONCRETES :** Classification of admixtures- uses of chemical and mineral admixtures-influences of admixtures on properties of concrete- Lightweight concrete - Fibre reinforced concrete - Polymer concrete – High Performance Concrete and future trends – Pumpable concrete – Self compacting concrete – tests for key properties and aspects of mix design – pre placed concrete – smart concrete – geopolymer concrete – concrete using industrial, agro and construction & demolition waste materials – sprayed concrete-reactive powder concrete – ready mixed concrete – high toughness and ductile concrete – concrete composites-post tensioned concrete **(11)**

**Total L: 45 periods**

**REFERENCES**


1. Neville A M and Brooks J J, ‘Concrete Technology’. Pearson Education Asia Pvt. Ltd, 2018.
2. Mehta P K, Pauls J M and Monteiro, ‘Concrete: Micro Structure, Properties and Materials’. Tata McGraw Hill Education Private limited, New Delhi, 2014.
3. Zongjin Li, ‘Advanced Concrete Technology’. John-Wiley & Sonsinc, New York, 2012.
4. Jayant D Bapat, ‘Mineral Admixtures in Cement and Concrete’. CRC Press, New Delhi, 2017.
5. Malhotra V M and Carino N J, ‘Hand book on Non-destructive Testing of Concrete’. CRC Press, 2003.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Explain the composition, properties, and behavior of concrete constituents including cement, aggregates, and admixtures with respect to strength and durability. | **K2** |
| **CO2** | Analyze the fresh and hardened properties of concrete, including microstructure, workability, strength, and rheological behavior, and apply IS code provisions and testing methods. | **K4** |
| **CO3** | Evaluate and design durable and sustainable concrete mixes for various applications using ACI and IS methods, incorporating special concretes and innovative materials. | **K5** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 3 | 2 | 2 |
| **CO2** | 2 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25P06 ADVANCED OPTIMIZATION TECHNIQUES

**3 0 0 3**

**CONCEPTS OF OPTIMIZATION AND LINEAR PROGRAMMING:** Introduction – Engineering applications of optimization –statement of an optimization problem- classification of optimization problems. Standard form of a Linear Programming Problem – plastic design of frames – Graphical method – Simplex method – Basic solution – computation – maximization and minimization. Duality in Linear Programming – General Primal – Dual relations – Dual simplex method – Transportation problem–Assignment method. **(13)**

**NONLINEAR PROGRAMMING:** One dimensional minimization method – Dichotomous search, Fibonacci method and Golden section method. Unconstrained optimization techniques – Classification – Direct search, Pattern search, Cauchy's steepest Descent method, Conjugate Gradient method and Davidon Fletcher Powell method–Constrained function of a single variable–several variables **(13)**

**DYNAMIC PROGRAMMING:** Bellman's principle of optimality - Multistage decision processes – representation and types –concept of sub optimization problems using Classical and Tabular methods – conversion of a final value problem into an initial value problem–Linear Programming as a case of dynamic Programming **(10)**

**GENETIC ALGORITHM, EVOLUTION STRATEGIES AND ANT COLONY OPTIMIZATION:** Introduction–Representation of design variables, objective function and constraints – Choice of population – Genetic operators – survival of the fittest – generation – generation history – application to trusses. Probability – finding the shortest path – pheromone trail – travelling salesman problem – Application to structural engineering problems. **(9)**

**Total L: 45 periods**

**REFERENCES**


1. Rajasekaran S. and Vijayalakshmi Pai G. A, 'Neural Networks, Fuzzy Systems and evolutionary Algorithms: Synthesis and applications'. Prentice Hall of India, NewDelhi, 2017.
2. K. Deb, 'Multi – objective Optimization using Evolutionary Algorithms'. John Wiley and Sons, 2009.
3. Goldberg D. E., 'Genetic Algorithms in Search, Optimization and Machine Learning'. Pearson Education, 2008.
4. Iyengar N. G. R and Gupta S. K, 'Structural Design Optimization'. Affiliated East West Press Ltd., New Delhi, 1997.
5. Rao S.S. 'Optimization Theory and Applications'. Wiley Eastern, 2000.
6. R.T. Hafta and Z. Gurdal, 'Elements of Structural Optimization'. 3rd Ed. KluwerAcademicPublishers,1996.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Explain the concepts related to optimization techniques. | **K2** |
| **CO2** | Apply the optimization techniques to solve engineering problems. | **K3** |
| **CO3** | Analyze the solutions of engineering problems employing optimization techniques | **K4** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | | 1 | | 2 | 2 |
| **CO2** | 3 | | 1 | | 3 | 2 |
| **CO3** | | | 1 | | 3 | 2 |
| | **3** | | **1** | | **3** | **2** |

**1-low, 2-medium, 3-high**

**SE25P07 SHELL AND SPATIAL STRUCTURES**

**3 0 0 3**

**THEORY OF SHELLS AND SPATIAL STRUCTURES:** Definition - Historical development - types - materials – practical difficulties – construction – support conditions – cladding – aesthetics – Structural behaviour of thin shells – General specification of shells - Analysis of shells - Membrane theory of shells - Edge disturbances - classification of shells - methods of generating the surface of different shells like conoid, hyperbolic and elliptic paraboloid-form exdata generation of space structure **(11)**

**DESIGN OF CYLINDRICAL AND HYPERBOLIC PARABOLOID SHELLS:** Surface definition - Design of cylindrical shells with edge beam using theory for long shells – Design of cylindrical shell with ASCE manual coefficients – Detailing of reinforcement in shells and edge beams. Geometry of hypar shell- Analysis of membrane forces and moments- Determination of forces in the edge members - types of hyperbolic paraboloid roofs - Design of hypar shell roof of the inverted and tilted inverted umbrella types. **(12)**

**SINGLE AND MULTI-LAYER GRIDS AND DOMES:** Advantages - cladding - water drainage - progressive collapse and composite space trusses - Network domes - geodesic domes - double dome - ice dome - erection - connectors - ORS**:** Classification - ball joint systems - socket joint - plate joint - slot joint - shell joint - modular system - composite system -prefabricated systems. **(12)**

**STRESSEDSKIN-CABLE SUSPENDED STRUCTURES:** Stressed skin steel buildings – stressed skin grids-cable suspended roofs - design of cable roofs - erection of cable roofs - Finite element analysis of skeletal structures - approximate methods - optimal design of space structures-Failure of shell and space structures-case histories. **(10)**

**Total L: 45 periods**

**REFERENCES**

1. Ramaswamy. S, 'Design and Construction of Concrete Shell roofs'. CBS Publishers & Distributors, New Delhi, 2005.
2. Ramaswamy G. S., Eekhout M. and Suresh G. R., 'Analysis, Design and Constructions of Space Structures'. Thomas Telford, 2002.
3. Subramanian N., 'Space Structures: Principles and Practice'. Multi – Science Publishing, Co. Ltd.,2008.
4. Chatterjee B. K., 'Theory and Design of Concrete Shells'. Chapman and Hall Ltd., London,1990.
5. Varghese, P.C, 'Design of Reinforced Concrete Shells and Folded Plates'. PHI Learning Pvt.Ltd.,2010.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Understand the behaviour, classification, and analytical principles of shells and spatial structures including membrane theory and geometric generation of shell surfaces. | **K2** |
| **CO2** | Analyse and design cylindrical and hyperbolic paraboloid shells using membrane theory and applicable codes including reinforcement detailing. | **K4** |
| **CO3** | Evaluate and develop advanced spatial structures such as domes, cable suspended systems, and stressed skin structures through optimal and finite element-based approaches. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25P08 EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION**

**300 3**

**FORCES AND STRAIN MEASUREMENT:** Measurement system: purpose system and elements- characteristics of measurement system - accuracy, precision, repeatability, Errors in measurements - Strain gauge, principle, types, performance and uses. Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges - Electronic load cells – Proving Rings - Calibration of Testing Machines - Long term monitoring-vibrating wire sensors - fiber optic sensors - Introduction to structural modeling. **(12)**

**MEASUREMENT OF VIBRATION AND WIND FLOW:** Characteristics of Structural Vibrations - Linear Variable Differential Transformer (LVDT) - Transducers for velocity and acceleration measurements. Vibration meter - Seismographs – Vibration Analyzer - Display and recording of signals - Cathode Ray Oscilloscope — wind tunnels-flow meter-venturimeter - Digital Data Acquisition Systems. **(10)**

**DISTRESSMEASUREMENTS AND ITS CONTROL:** Diagnosis of distress in structures-crack observation and measurements Corrosion of reinforcement in concrete-Half cell, construction and use-damage assessment - techniques for residual stress measurements-structural health monitoring. **(11)**

**NON DESTRUCTIVE TESTING METHODS:** Load testing on structures, buildings, bridges and towers - IS 516 provisions- Rebound Hammer –acoustic emission- ultrasonic testing principles and application-Holography- use of laser for structural testing-Brittle coating- Advance NDT methods - ultrasonic pulse echo, impact echo, impulse radar techniques, advanced rebar corrosion rate determination system, ground penetrating radar (GPR) - Applications of NDT for quality assessment and damage detection of structures and materials, probability application in NDT, statistical quality control. **(12)**

**Total L: 45 periods**

**REFERENCES**

1. Sadhu Singh, ‘Experimental Stress Analysis’. Khanna Publishers, New Delhi, 2006.
2. Ganesan T P, ‘Model analysis of Structures’. University Press, 2000.
3. Srinath et.al L.S, ‘Experimental Stress Analysis’. Tata Mc Graw Hill Company, New Delhi, 2003.
4. Sirohi RS, Radhakrishna H C, ‘Mechanical Measurements’. New Age International (P) Ltd., 2013.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Apply instrumentation principles to select and operate measurement systems (strain gauges, LVDTs, NDT methods) for structural forces, vibrations, and distress diagnostics. | **K3** |
| **CO2** | Analyze experimental data from case studies/mini-projects involving structural health monitoring or NDT to evaluate structural integrity and propose mitigation strategies. | **K4** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 2 | 3 | 1 | 2 | 2 |
| **CO2** | | | 3 | | 3 | 3 |
| | | **3** | **3** | **1** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25P09 THEORY OF PLATES

**3 0 0 3**

**ELEMENTS OF PLATE - BENDING THEORY AND BENDING OF ISOTROPIC RECTANGULAR PLATES:** General behaviour of plates - Small deflection theory of thin plates - Governing differential equation for deflection of plates – Boundary conditions – Kirchoff's theory - Navier solution for an all - round simply supported rectangular plate subjected to uniformly distributed load, sinusoidal load and Patch load - Levy's solution for a rectangular plate with different boundary conditions and subjected to uniformly distributed load. **(13)**

**BENDING OF CIRCULAR PLATES:** Symmetrical bending of circular plates - Simply supported solid circular plate subjected to an uniformly distributed load, an end moment and a partially distributed load. **(11)**

**NUMERICAL METHODS:** Finite difference method - Isotropic Rectangular plates - Boundary conditions - All round simply supported square plate and fixed square plate subjected to uniformly distributed load. Plates of various shapes – Rectangular plate -All round clamped square plate subjected to an uniform load. **(12)**

**ANISOTROPIC PLATES:** Bending of anisotropic plates- large deflection theory of plates - Plates on elastic foundation. **(9)**

**Total L: 45 periods**

**REFERENCES**

1. Timoshenko S and Kreiger S. W., 'Theory of Plates and Shells'. McGraw Hill Book Company, India, 2010.
2. Chandrasekhara, K., 'Theory of Plates'. Universities Press (India) Ltd., Hyderabad, 2001.
3. Ansel C. Ugural, 'Plates and shells - theory and analysis'. CRC press, Taylor and Francis Inc 2018.
4. Reddy J. N. 'Theory and Analysis of Elastic Plates and Shells'. McGraw Hill Book Co., 2006.
5. Gambhir, M. L. 'Stability Analysis and Design of Structures'. Springer, New York, 2013.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | Bloom's Level |
|---|---|---|
| **CO1** | Understand the fundamental theories and behaviour of isotropic and anisotropic plates under various loading and boundary conditions | **K2** |
| **CO2** | Apply classical analytical methods (Navier and Levy solutions) and numerical methods (Finite Difference Method) to solve plate bending problems. | **K3/K4** |
| **CO3** | Evaluate the complex behaviour of plates including large deflections, anisotropic behaviour, and plates on elastic foundations to support structural design. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25P10 INDUSTRIAL STRUCTURES

**3 0 0 3**

**PLANNING AND FUNCTIONAL REQUIREMENTS:** Classification of Industries and Industrial Structures – planning for layout requirements regarding lighting, ventilation and fire safety - protection against noise and vibration – industrial flooring- guidelines from factories act - material handling systems-structural loads - Estimation of wind load. **(10)**

**SINGLE STOREY INDUSTRIAL STRUCTURES:** Types of roofing – roofing sheets – purlins – light gauge sections–built-up sections–roof trusses–pre-engineered structures. Foundations for industrial structures. **(13)**

**MATERIAL HANDLING SYSTEMS:** Design Philosophy and practices - Cranes – Types design of EOT overhead travelling cranes, zib cranes and Goaliath cranes. Design of Gantry girders for overhead cranes. Conveyor systems – Supports for conveyor systems-Foot Bridge-Transmission line towers. **(10)**

**INDUSTRIAL STORAGE & ENVIRONMENTAL CONTROL STRUCTURES:** Silos, Bins and Bunkers – Design of supporting system for storage hoppers and bunkers - Electro Static Precipitators – Wet and dry Scrubbers – Chimneys –Self-supporting Guyed and Braced chimneys – Corrosion protection of steel structures - Fire and Fatigue resistant design. **(12)**

**Total L: 45 periods**

**REFERENCES**


1. Shiyekar M.R, ‘Limit State Design in Structural Steel’. PHI Learning private limited, New Delhi, 2017.
2. Subramanian N, ‘Design of Steel Structures’. Oxford university press, New Delhi, 2016.
3. Karuna Moy Ghosh, ‘Analysis and Design Practice of Steel Structures’. PHI Learning private limited, New Delhi, 2014.
4. Sai Ram KS, ‘Design of Steel Structures’. Pearson, New Delhi, 2020.
5. Alexander Newman, ‘Metal Building Systems– Design and Specifications’. McGraw-Hill, New Delhi, 2014. Switzerland, 2003.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Apply instrumentation principles to select and operate measurement systems (strain gauges, LVDTs, NDT methods) for structural forces, vibrations, and distress diagnostics. | **K3** |
| **CO2** | Analyze experimental data from case studies/mini-projects involving structural health monitoring or NDT to evaluate structural integrity and propose mitigation strategies. | **K4** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | 3 | 3 | 3 | |
| **CO2** | | | 3 | 3 | 3 | |
| | | 3 | 3 | 3 | 3 | |

**1-low, 2-medium, 3-high**

**Third ACM**

## SE25P11 MECHANICS OF COMPOSITE MATERIALS

**3 0 0 3**

**BASICS AND MACROMECHANICS OF COMPOSITES:** Classification – polymer - metal – ceramic – carbon-carbon –recycling of fiber reinforced composites–mechanics terminology–advantages Stress and strain– Hooke's law- Engineering Constants of angle lamina-Hydrothermal stresses. **(12)**

**MICROMECHANICAL ANALYSIS OF A LAMINA:** Volume and mass fraction – density – evaluation of elastic moduli – semi-empirical models–elasticity approach–ultimate strength of uni-directional lamina–coefficients of thermal expansion. **(10)**

**MICROMECHANICAL ANALYSIS OF LAMINATE:** Introduction – laminate code – stress – strain for a laminate – in-plane and flexural modulus of a laminate–hydrothermal effects–warpage of laminates **(12)**

**FAILURE, ANALYSIS AND DESIGN OF LAMINA & LAMINATES:** Special cases of laminates–symmetric–cross-ply, angle–ply, antisymmetric, Balanced, Quasi-isotropic – strength failure theories – Tsai – Hill failure theory – Tsai –Wu failure theory – failure criterion - design of a laminated **(11)**

**Total L: 45 periods**

**REFERENCES**


1. Kollar L. P .and Springer G. S., 'Mechanics of Composite Structures'. Cambridge University Press,2009.
2. Reddy J. N., 'Mechanics of Laminated Composite Plates – Theory and Analysis'. CRC Press, USA, 2003.
3. Jones R. M.,'Mechanics of Composite Materials'. CRC Press, USA, 2018.
4. Kaw A. K., 'Mechanics of Composite Materials'. CRC Press, 2006, USA.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Understand the classification, mechanical behaviour, and stress-strain characteristics of composite materials at both macro and micro levels. | **K2** |
| **CO2** | Analyse the micromechanical and macro mechanical behaviour of laminated composites including hydrothermal effects and laminate warpage. | **K4** |
| **CO3** | Apply failure theories and design principles to evaluate and develop laminated composite structures for various engineering applications. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25P12 SOFT COMPUTING IN STRUCTURAL ENGINEERING**

**3 0 0 3**

**NEURAL NETWORKS, ASSOCIATIVE MEMORY AND ADAPTIVE RESONANCE THEORY:** Basic Concepts–Artificial Neural Network (ANN) Architecture - Learning Methods - Back Propagation Network (BPN) - Single layer ANN - Multilayer ANN- Learning Method of Effect of tuning parameters. Kosko's Discrete (Bi-directional Associative Memory) BAM - input normalization - Evolution Equation - vector quantization - Architecture of ART1 and ART2 - Application to structural engineering problems **(13)**

**FUZZYLOGIC:** Fuzzy sets and relations –Fuzzy sets and Crispsets-Predicatelogic-Fuzzy quantifiers-Fuzzy Rulebased Systems–Fuzzification and Defuzzification Methods-Applicationto controllers-Application to structural Engineering problems **(11)**

**GENETICALGORITHMS:** Basic concepts – Representation of design variables, objective function and constraints –Genetic operators - reproduction - selection - cross over - mutation — Choice of population — Survival of the fittest — generation —generation history- convergence of GA- optimal design using GA-Application to structural engineering problems **(12)**

**HYBRID SYSTEMS AND SUPPORT VECTOR MACHINES:** Neuro - Fuzzy Hybrids - Fuzzy genetic hybrids - Neuro genetic hybrid- Fuzzy BPN- Fuzzy Art Map-Fuzzy controlled GA. Support vector regression—Classifications. Introduction to Artificial Intelligence and machine learning **(9)**

**Total L:45 periods**

**REFERENCES**


1. Rajasekaran S. And Vijayalakshmi Pai G. A., 'Neural Networks, Fuzzy Logic and Genetic Algorithms'. Prentice Hall of India, New Delhi,2017.
2. Goldberg D. E., 'Genetic Algorithms in Search Optimization and Machine Learning'. Addison Wesley, Rading Mass, USA, 2013.
3. Tsoukalas H.L. and Uhrig E.R., 'Fuzzy in Neural Approaches in Engineering'. John Wiley and Sons, USA, 2007.
4. Adeli H. and Hung S. L., 'Machine Learning, Neural Networks, Genetic Algorithms and Fuzzy Systems'. JohnWiley and Sons, New York, 2005.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply soft computing techniques (neural networks, fuzzy logic, genetic algorithms) to model, optimize, and solve structural engineering problems such as design optimization, damage detection, or adaptive control systems. | **K3** |
| **CO2** | Design and evaluate hybrid soft computing models (e.g., neuro-fuzzy, genetic-neural) through case studies/mini-projects for complex structural scenarios, comparing performance against conventional methods. | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | 3 | 3 | 3 | |
| **CO2** | | | 3 | 3 | 3 | |
| | | **3** | **3** | **3** | **3** | |

**1-low, 2-medium, 3-high**

## SE25P13 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

**3 0 0 3**

**CONNECTIONS:** Introduction – limit states of composite sections –Design philosophies-codes of practice-shear connectors –types of shear connectors–degree of shear connection–partial and complete shear connections–Load bearing mechanism-strength of shear connectors-standard tests for shear connectors. **(10)**

**COMPOSITE BEAMS:** Elastic behavior of composite beams-Ultimate load behavior-Full Types of Profile steel sheeting-Design of composite beam propped and un propped construction– simply supported and continuous beams– beam with profile sheeted deck slab-Analysis and design of composite beams without profile sheet **(10)**

**COMPOSITE SLABS:** Introduction of composite floors-shear transferring mechanism in profile deck system–resistance to longitudinal shear-resistance to vertical shear-Bending resistance of composite slab-Design considerations of composite floor profiled sheeting – sheeting parallel to span – sheeting perpendicular to span – analysis and design of composite floor system-limit state of serviceability **(13)**

**COMPOSITE COLUMNS AND COMPOSITE CONSTRUCTION**: Types–design of composite columns–Relative slenderness-resistance to axial, uniaxial and biaxial loading-Transverse and longitudinal shear- in-filled and encased columns-Design Philosophy. Case studies on steel concrete composite construction in buildings-beam column joints-classification of joints-Effects of Temperature, shrinkage, creep and vibration on composite beams

**(12)**

**Total L: 45 periods**

**REFERENCES**

1. Qing Quan Liang, 'Analysis and Design of Steel and Composite Structures'. CRC Press, Taylor and Francis Group,2015.
2. Johnson R. P, 'Composite Structures of Steel and Concrete'. Wiley India Pvt. Ltd, India, 2013.
3. Sai Ram K S, 'Design of Steel Structures'. Pearson Education, 2010.
4. Oehers D. J. and Bradford M. A., 'Composite Steel and Concrete Structural Members, Fundamental Behaviour'. Permagon Press, Oxford, 2013.
5. Teaching resource material for, 'Structural Steel Design'. Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.
6. Narayanan R, 'Composite Steel Structures–Advances, Design and Construction'. Elsevier, Applied Science, UK, 1987.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply design philosophies and codes to analyze and design shear connectors and composite connections. | **K3** |
| **CO2** | Analyze and design composite beams and slab systems considering load transfer mechanisms and serviceability requirements. | **K4** |
| **CO3** | Evaluate structural behavior under lateral loads and perform plastic design of steel beams and frames. | **K5** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 3 | 2 | 3 |
| **CO2** | 2 | 1 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 2 | 3 | 3 | 3 | 3 |
| | **3** | **2** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## SE25P14 PREFABRICATED STRUCTURES

**3 0 0 3**

**DESIGN PRINCIPLES:** Road to industrialization in buildings – History - Standardization and Components - Types of prefabrication – Prefabrication systems - Disuniting of structures - IS Code Specifications - Construction principles –Manufacture of prefabricated components – Transport and Erection of structural components – Finishing and Fitting –up operations–Dimensional deviation and Tolerance–Principles of structural design of prefabricated components. **(11)**

**ROOF, FLOOR UNITS AND WALL PANELS:** Roofing slabs – Large slab type roof components – Floor units – Structural design of roof and floor units – Manufacture of roof and floor units– Dimensional variations– General consideration on external wall construction - Types of wall panels - Load bearing walls – Wind bracing (shear wall) – Curtain walls – Window panels –Connections and joints for wall panels–External wall panel examples–Manufacture, transport and erection of wall panels –Structural design and problems. **(12)**

**INDUSTRIAL BUILDINGS:** Structural Systems-Single bay-Multi-bay buildings-Low rise buildings-Applications-Design and Detailing-Crane track beams -Columns–Frames-Structural Connections-Execution of construction work –Structural design and stability problems **(10)**

**SEISMIC DESIGN OF PRECAST CONCRETE BUILDING STRUCTURES:** Lessons from previous earthquakes-Demand versus capacity Assessment-Ductility provisions for structural members- Lateral Force resisting systems-Diaphragms- Seismic Detailing of Diaphragms-Inelastic behaviour of connections between precast structural elements **(12)**

**Total L: 45 periods**

**REFERENCES**

1. Handbook on Precast Concrete Buildings, Indian Concrete Institute, 2016.
2. Kim S. Elliot, Collin K. Jolly, 'Multi storey Precast Concrete Framed Structures'. Wiley Black well, Hoboken, United States, 2013.
3. Kim S. Elliot, 'Precast concrete structures'. CRC Press (Taylor and Francis Group), London,2016.
4. PCI Design Handbook, Precast/Prestressed Institute, Eighth Edition, 2015.
5. Fib27, 'Seismic design of precast concrete building structures'. International federation for structural concrete (Fib), Switzerland, 2003.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Understand the basic principles, manufacturing and design various precast structural elements for residential and industrial buildings as per IS Codes and standards. | **K3** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | 3 | 2 | - |
| | **3** | **-** | **-** | **3** | **2** | **-** |

**1-low, 2-medium, 3-high**

## SE25P15 MAINTENANCE AND REHABILITATION OF STRUCTURES

**3 0 0 3**

**DIAGONOSIS AND CONDITIONAL ASSESSMENT OF EXISTING STRUCTURES:** Types of maintenance—Routine maintenance works in buildings– Inspection–Structural appraisal. Crack–principal sources for crack formation-Durability aspects. Conditional survey–visual inspection–field and laboratory testing stage–concrete strength assessment **(11)**

**SELECTION OF REPAIR MATERIALS & DEMOLITION TECHNIQUES:** Construction chemicals–repair chemicals–epoxies–polymers and latex– acrylic polymers–polyester resins-corrosion inhibitors as admixture–bondingcoatsforreinforcement–shrinkagecompensatingcompounds –waterproofing compounds. Special materials for construction and repair of buildings and special methods of placing concrete–Demolition Technique

**(11)**

**REPAIR OF STRUCTURAL ELEMENTS & NON-STRUCTURAL ELEMENTS:** Repair against rising dampness and efflorescence in masonry wall, repair of cracks in masonry wall and concrete member. Repair against rainwater leakage in building, renovation of water proofing works of RC flat roofs against rain, repair of valley gutters of sloping roof, leakage in bathing area of toilets, sunken floors of toilets in multistoried building.

**(11)**

**STRENGTHENING OF EXISTING STRUCTURES:** Strengthening of superstructure - Conversion to composite construction –Post stressing – Jacketing – Bonded overlays – Addition of reinforcement – Strengthening of substructure – Underpinning **(12)**

**Total L: 45 periods**

**REFERENCES**


1. Poonam I. Modi &Chirag N Patel, 'Repair and Rehabilitation of Concrete Structures'. PHI, Delhi2016.
2. Varghese P. C, 'Maintenance, Repair and Rehabilitation & Minor works of Buildings'. PHI Learning Pvt. Ltd., Delhi, 2014.
3. Malhotra V. M, 'Handbook on Non-Destructive testing of Concrete'. CRC Press,2014.
4. Allen R.T. L and Edwards S.C., 'The repair of Concrete Structures'. Thompson Press (India) Ltd., Delhi,2019.
5. Bhattacharjee, 'Concrete Structure Repair Rehabilitation & Retrofitting'. CBS, 2005.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Apply diagnostic and repair techniques to assess structural distress (cracks, dampness, corrosion) and select appropriate rehabilitation materials (epoxies, polymers, inhibitors) for buildings and infrastructure. | **K3** |
| **CO2** | Design rehabilitation strategies through case studies/mini-projects involving structural strengthening (jacketing, underpinning) or leakage remediation for distressed RC/masonry structures. | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | 3 | 3 | 3 | |
| **CO2** | | | 3 | 3 | 3 | |
| | | **3** | **3** | **3** | **3** | |

**1-low, 2-medium, 3-high**

**Third ACM**

## SE25P16 SMART MATERIALS AND SMART STRUCTURES

**3 0 0 3**

**INTRODUCTION AND MEASURING TECHNIQUES:** Properties of smart materials - mechanisms – instrumented structures functions and response sensing system–self-diagnosis–signal processing consideration–actuation systems and effectors. Strain measuring techniques using electrical strain gauges, types–resistance-capacitance–inductance–Wheatstone bridges- pressure transducers- load cells-temperature compensation–strain rosettes **(13)**

**SENSORS AND ACTUATORS:** Sensing technology – types of sensors – physical measurement using piezo electric strain measurement – inductively read transducers – LVDT – fiber techniques - fiber optic strain sensors - Actuator techniques –Actuator and Actuator materials - piezo electric and electro resistive material – magneto structure material – shape memory alloys electrorheological fluids (ER)–electromagnetic actuation–role of actuators and actuator materials **(12)**

**SIGNAL PROCESSING AND CONTROL SYSTEMS:** Data Acquisition and processing – signal processing and control for smart structures–sensors as geometrical processors–signal processing–control system–linear and nonlinear **(9)**

**INTRODUCTION TO STRUCTURAL HEALTH MONITORING (SHM):** Definition and characters of SHM, SHM and biomimetic, SHM as a part of system management, Passive and Active SHM, NDE, SHM and NDECS – basic components of SHM–Applications–SHM of a bridge–applications for external posttensioned cables, monitoring historical buildings **(11)**

**Total L: 45 periods**

**REFERENCES**


1. Gauenzi, P., 'Smart structures'. Wiley, 2009.
2. Hand Book on Seismic Retrofitting of Buildings, Published by PWD & Indian Building Congress in Association with IIT, Madras, Narosa PublishingHouse,2008.
3. Daniel Balageas, Claus Peter Fritzenam I Alfredo Guemes, Structural Health Monitoring, Published by ISTE Ltd., U.K.2006.
4. Brain Culshaw, 'Smart Structures and Materials'. Artech House, London, 2004.
5. L. S. Srinath, 'Experimental Stress Analysis'. Tata Mc GrawHill,2001.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Grasp the core concepts of smart materials and structures, including their properties, sensing techniques (e.g., strain gauges, fiber optics), and actuation systems. | **K3** |
| **CO2** | Apply knowledge through case studies and mini-projects to design solutions for real-world problems like structural health monitoring (SHM) in bridges or historical buildings. | **K6** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | 3 | 3 | 3 | |
| **CO2** | | | 3 | 3 | 3 | |
| | | **3** | **3** | **3** | **3** | |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25P17 STRUCTURAL HEALTH MONITORING**

**3 0 0 3**

**INTRODUCTION AND VIBRATION BASED TECHNIQUES FOR SHM:** Definition and characters of SHM, SHM as a way of making materials and structures smart, SHM and Biomimetics, Process and pre-usage monitoring as a part of SHM, Passive and active SHM, NDE, SHM and NDECS. Basic vibration concepts for SHM, Local and global methods, Damage diagnosis as an inverse problem, Model-based damage assessment, Mathematical description of structural systems with damage, General dynamic behavior, State-space description of mechanical systems, Modeling of damaged structural elements, Damage identification in non-linear systems **(13)**

**FIBER-OPTIC SENSORS:** Classification of fiber optic sensors, Photo-elasticity in a plane stress state, Structures with embedded fiber Bragg gratings, Orientation of the optical fiber optic with respect to the reinforcement fibers, Ingress/Egress from the laminate, Fiber Bragg gratings as damage sensors for composites, Measurement of strain and stress variations, Examples of applications in civil engineering **(10)**

**SHM WITH PIEZOELECTRIC SENSORS:** The use of embedded sensors as acoustic emission (AE) detectors, Experimental results and conventional analysis of acoustic emission signals, Algorithms for damage localization, Algorithms for damage characterization, New concepts in acoustic emission, State of the-art and main trends in piezoelectric transducer-based acousto- ultrasonic SHM research, Acousto-ultrasonic signal and data reduction methods **(9)**

**SHMUSING ELECTRICAL RESISTANCE and LOW FREQUENCY ELECTROMAGNETIC TECHNIQUES:** Composited damage, Electrical resistance of unloaded composite, Percolation concept, Anisotropic conduction properties in continuous fiber reinforced polymer, Influence of temperature, Composite strain and damage monitoring by electrical resistance, unidirectional and Multidirectional laminates, Damage localization. Theoretical considerations on electromagnetic theory, Maxwell's equations, Applications to the NDE/NDT domain and SHM domain, General principles, Magnetic method, Electric method and Hybrid methods. **(13)**

**Total L: 45 periods**

**REFERENCES**


1. Douglas E Adams, 'Health Monitoring of Structural Materials and Components Methods with Applications'. John Wiley and Sons, 2007.
2. Hua-Peng Chen, 'Structural Health Monitoring of Large Civil Engineering Structures'. Wiley Publishers, 2018
3. Huston D, 'Structural Sensing, Health Monitoring and Performance Evaluation'. CRC Press, A Taylor & Francis book, 2011
4. Victor Giurglutiu, 'Structural Health Monitoring with Piezoelectric Wafer Active Sensors'. Academic Press Inc,2014.
5. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, 'Structural Health Monitoring'. Wiley-ISTE,2006.
6. J.P. Ou, H. Li and Z. D. Duan, 'Structural Health Monitoring and Intelligent Infrastructure'. Vol-1, Taylor and Francis Group, London, U.K, 2006


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Learn to analyze and apply SHM methods to detect and characterize damage in structures using various sensor technologies. | **K3** |
| **CO2** | Design and apply SHM systems to real-world problems, effectively selecting sensors, managing data, and interpreting results for structural assessment. | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | 3 | 3 | 3 | |
| **CO2** | | | 3 | 3 | 3 | |
| | | **3** | **3** | **3** | **3** | |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25P18 FOUNDATION STRUCTURES**

**3 0 0 3**

**SHALLOW FOUNDATIONS:** Site investigation – Field penetration tests – Bearing capacity based on N-value - Choice of shallow foundations for different situations – Proportioning of foundations for equal settlement, Sizing of foundations based on bearing capacity–strip, isolated, combined and strap–raft foundation. **(9)**

**DEEP FOUNDATIONS:** Pile foundation- Provisions of IS 2911 (Part1 and Part3) on structural design of piles-Structural design of straight piles - Different shapes of pile cap - Structural design of pile cap - selection of rig for piling - Well foundation - Different types based on shape in plan — Grip length — Load carrying capacity based on SPT results — Thickness of staining and bottom plug — Forces acting on the well–Stability of well subjected to lateral load by Terzaghi's approach–Methods to rectify tilt of well foundation. **(14)**

**SHEET PILE WALL AND ANCHORED BULKHEADS:** Different types of sheet pile — Cantilever sheet pile wall in granular soils, in cohesive soils with granular backfill–Anchored bulk head-Free earth and Fixed earth support methods–in cohesive soils, in cohesive soil with cohesion less backfill. **(10)**

**INTRODUCTION TO MACHINE FOUNDATIONS, SOIL-STRUCTURE INTERACTION PROBLEMS AND SHELL FOUNDATION :** Fundamentals of soil dynamics –Determination of dynamic properties of soil based on Block Vibration Test and Cyclic plate load test – Barkan's method of design of block foundation subjected to vertical vibrations – Vibration Isolation –Transmissibility–Methods of Isolation–Modulus of sub grade reaction–Winkler model–Analysis of infinite beams resting on elastic medium and subjected to point load, Uniformly distributed load and moment– Introduction to shell foundation. **(12)**

**Total L: 45 periods**

**REFERENCES**


1. Kurian K. P, 'Design of Foundation Systems'. Narosa Publishing House, New Delhi, 2014.
2. Varghese P. C, 'Foundation Engineering'. Prentice Hall of India Ltd., New Delhi, 2013.
3. Murthy V N S, 'Textbook of Soil Mechanics and Foundation Engineering Geotechnical Engineering Series'. CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2017.
4. Bowles J E, 'Foundation Analysis and Design'.s Mc Graw-Hill International Editions, 2017.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Illustrate the fundamental principles of various foundation systems, including shallow and deep foundations, sheet pile walls, machine foundations, and the associated soil-structure interaction concepts. | **K2** |
| **CO2** | Utilize appropriate design methods and standards to determine the type, proportioning, and structural design of foundation elements, and analyze soil-structure interaction effects in practical engineering scenarios. | **K3** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 2 | 3 | | 2 | 2 |
| **CO2** | | | 2 | | 2 | |
| | | 2 | 3 | | 2 | 2 |

**1-low, 2-medium, 3-high**

## SE25P19 GROUND IMPROVEMENT TECHNIQUES

**3 0 0 3**

**INTRODUCTION AND MECHANICAL MODIFICATION:** Need for ground improvement - methods of ground improvement -geotechnical problems in alluvial and black cotton soils — selection of suitable ground improvement techniques based on soil conditions; Methods of compaction, principles of soil densification, properties of compacted soil, dynamic compaction, Pre-consolidation techniques **(12)**

**SOILNAILING AND MICRO PILING:** Introduction – functions and applications of soil nailing – methods of construction of soil nailed cut – components of sail nail system; Reinforcing mechanism of micro pile – installation of micro pile. **(11)**

**GEOSYNTHETICS AND DEWATERING SYTEMS:** Introduction – functions of geo-synthetics – types of geo synthetics –properties of geosynthetics and its applications; Dewatering techniques-well points – vacuum and electro osmatic methods **(11)**

**GROUTING TECHNIQUES AND SOIL STABILIZATION:** Types of grouts, grouting equipment and machinery, injection methods, grout monitoring — applications of grouting; Lime stabilization - Base exchange mechanism, Pozzolanic reaction, lime-soil interaction, Design of Foundation on lime columns. Cement stabilization: Mechanism, amount, age and curing **(11)**

**Total L: 45 periods**

**REFERENCES**

1. Satyendra Mittal, "An Introduction to Ground Improvement Techniques", Scientific International Pvt. Ltd., New Delhi, 2013.
2. Nihar Ranjan Patra, "Ground Improvement Techniques", Vikas Publishing House Pvt. Ltd., New Delhi, 2012.
3. Purushothama Raj P, “Ground Improvement Techniques”, Laxmi Publications (P) Ltd., 2016.
4. Sivakumar Babu G L, “An Introduction to Soil Reinforcement and Geosynthetics”, Universities Press, Hyderabad, 2013.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Explain the principles and mechanisms of different ground improvement techniques, including mechanical modification, soil nailing, micro piling, geosynthetics, dewatering systems, grouting, and stabilization methods | **K2** |
| **CO2** | Apply appropriate ground improvement techniques for specific soil conditions, selecting suitable methods to address geotechnical challenges in alluvial and black cotton soils | **K3** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | | | 3 | 3 |
| **CO2** | | 3 | | | 3 | 3 |
| | | 3 | | | 3 | 3 |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25P20 GEOTECHNICAL EARTHQUAKE ENGINEERING**

**3 0 0 3**

**ELEMENTS OF EARTHQUAKE SEISMOLOGY AND DYNAMIC SOIL PROPERTIES:** Mechanism of earthquakes, causes of earthquake, earthquake fault sources, elastic rebound theory, seismic wave in earthquake shaking, definition of earthquake terms, Quantification of earthquakes — Dynamic soil properties — Representation of state of stresses by Mohr circle, Measurement of soil properties–Field and laboratory tests. **(12)**

**LIQUEFACTION AND DYNAMIC ANALYSIS OF SOLID WASTE LANDFILLS AND LINING SYSTEMS:** Liquefaction and its related phenomena, Evaluation of liquefaction hazards, Liquefaction susceptibility — Historical, geologic, compositional and state criteria — Initiation of liquefaction, Effects of liquefaction — Alteration of ground motion, sand boils, settlement and instability. Performance of solid waste landfills during earthquakes, Analysis of solid waste landfills stability during earthquakes, Monitoring and safety control of landfills, Safety and risk analyses **(13)**

**SEISMIC SLOPE STABILITY:** Types of earthquake induced landslides, Earthquake induced landslide activity, Evaluation of slope stability. Review of static slope stability analysis, Seismic slope stability analysis — Analysis for inertial and weakening instability **(10)**

**SEISMIC DESIGN OF RETAINING WALLS:** Review of calculation of static pressures on retaining walls, Dynamic response of retaining walls, Seismic pressures on retaining walls — Yielding and non-yielding walls, Effect of water, finite element analysis, Seismic displacements on retaining walls, seismic design considerations. **(10)**

**Total L: 45 periods**

**REFERENCES**


1. Swamisaran, Soil Dynamics and Machine Foundations, Galgotia Publications Pvt. Ltd., New Delhi, 2017.
2. Prasad B. B., 'Fundamentals of Soil Dynamics and Earthquake Engineering'. PHI Learning Private Limited, NewDelhi,2013.
3. Ansal A., 'Recent Advances in Earthquake Geotechnical Engineering and Microzonation'. Kluwer Academic Publishers, The Netherlands,2011.
4. Kramer S. L., 'Geotechnical Earthquake Engineering'. Pearson Education (Singapore) Private Ltd. (Indian Branch), NewDelhi,2007.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Outline the fundamental concepts of earthquake seismology, dynamic soil properties, liquefaction phenomena, seismic slope stability, and seismic design of retaining walls in geotechnical earthquake engineering. | **K2** |
| **CO2** | Organize principles of earthquake engineering and geotechnical analysis to evaluate liquefaction potential, analyze seismic slope stability, and design retaining structures and landfill systems for earthquake-resistant performance. | **K3** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 2 | 2 | | 1 | 2 |
| **CO2** | | | 3 | | 2 | 2 |
| | | 2 | 3 | | 2 | 2 |

**1-low, 2-medium, 3-high**

**Third ACM**

## SE25P21 SOIL STRUCTURE INTERACTION

**3 0 0 3**

**SOIL-FOUNDATION INTERACTION:** Introduction to soil – foundation interaction problems— Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, two parameter models, Elastic plastic behaviour, Time dependent behavior **(10)**

**BEAM ON ELASTIC FOUNDATION-SOIL MODELS:** Infinite beams, two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams based on their stiffness **(11)**

**PLATE ON ELASTIC MEDIUM:** 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. **(11)**

**ELASTIC ANALYSIS OF PILE:** 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. Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Pile draft system, Solutions by influence charts. **(13)**

**Total L: 45 periods**

**REFERENCES**


1. Timoshenko S.P and Young D. H., 'Theory of Structures'. McGraw Hill International Editions, 2017.
2. Poulos H.G. and Davis, E.H. 'Pile Foundation Analysis and Design'. John Wiley,2008.
3. Selvadurai A. P. S., 'Elastic Analysis of Soil Foundation Interaction'. Elsevier, 2013.
4. Bowles J E, 'Foundation Analysis and Design'. Mc Graw-Hill International Editions, 2017.


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Illustrate the fundamental concepts of soil-foundation interaction, foundation behavior, interface behavior, and various soil response models such as Winkler, elastic continuum, and two-parameter models. | **K2** |
| **CO2** | Apply analytical techniques to solve practical problems involving elastic foundations, including the analysis of settlement, load distribution in pile groups, and prediction of load-deflection behavior of laterally loaded piles | **K3** |
| **CO3** | Analyze the interaction effects between soil and foundation systems on elastic media, and interpreting load-settlement behavior in single piles and pile groups under various loading and boundary conditions. | **K3** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | | 3 | | | 1 | |
| **CO2** | | 3 | | | 2 | |
| **CO3** | | 3 | | | 1 | |
| | | 3 | | | 2 | |

**1-low, 2-medium, 3-high**

## AUDIT COURSES

## SE25A01 SUSTAINABLE DEVELOPMENT GOALS

**2 0 0 0**

**FOUNDATIONS OF SDGs:** The "5P's" of the SDGs – People, Planet, Prosperity, Peace, Partnership - No Poverty, End poverty in all its forms everywhere – Zero Hunger, End hunger, achieve food security and improved nutrition and promote sustainable agriculture –Good Health and Well-Being, ensure healthy lives and promote well-being for all at all ages. **(8)**

**SOCIAL DEVELOPMENT:** Quality Education, promote lifelong learning opportunities for all – Gender Equality, Achieve gender equality and empower all girls and women – Clean Water and Sanitation – Affordable and Clean Energy, Ensure access to affordable, reliable, sustainable and modern energy for all – Decent Work and Economic Growth. **(7)**

**SUSTAINABLE GROWTH:** Industry, Innovation and Infrastructure, Build resilient infrastructure, promote sustainable industrialization and foster innovation – Reduced Inequalities – Sustainable Cities and Communities – Responsible Consumption and Production, Ensure sustainable consumption and production patterns. **(7)**

**ENVIRONMENTAL SUSTAINABILITY:** Climate Action, Take urgent action to combat climate change and its impacts – Life below Water, Conserve and sustainably use our oceans, seas and marine resources – Life on Land, Sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss – Promote just, peaceful and inclusive societies **(8)**

**Total L: 30 periods**

### REFERENCES


1. The United Nations, 'The Sustainable Development Goals'. The United Nations, 1st Edition, 2017.
2. Stephen Browne, 'Sustainable Development Goals and Un Goal-Setting'. Routledge, 1st Edition, 2017.
3. Korbla P. Puplampu, Kobena Hanso, Timothy Shaw, Kobena T. Hanson, and Timothy M. Shaw, 'From Millennium Development Goals to Sustainable Development Goals'. Routledge, 1st Edition, 2021.
4. Julia Walker, Alma Pekmezovic and Gordon Walker, 'Sustainable Development Goals'. John Wiley& Sons Limited, 1st Edition, 2019.
5. Rianne Mahon, Susan Horton, Simon Dalby and Diana Thomaz, 'Achieving the Sustainable Development Goals'. Routledge, 1st Edition, 2019.


### ONLINE RESOURCES

1. https://sustainabledevelopment.un.org/resourcelibrary
2. https://en.unesco.org/themes/education/sdgs/material
3. https://www.unicef.org/sdgs/resources
4. https://www.undp.org/content/undp/en/home/sustainable-development-goals/resources.html
5. https://sdghub.com/resources/

### COURSE OUTCOMES

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Explain the significance of Sustainable Development Goals (SDGs) in global, national, and local development contexts. | **K2** |
| **CO2** | Analyze real-world issues through case studies and propose sustainable solutions aligned with relevant SDGs. | **K4** |

### COs – POs & PSOs MAPPING

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | 2 | 1 | 1 | - |
| **CO2** | - | 2 | 2 | 2 | 2 | - |
| | 1 | 2 | 2 | 2 | 2 | - |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25A02 ENGLISH FOR RESEARCH PAPER WRITING**

**2 0 0 0**

**INTRODUCTION TO RESEARCH PAPER WRITING:** Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. **(6)**

**PRESENTATION AND TITLE WRITING SKILLS:** Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction. Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check **(12)**

**RESULT WRITING SKILLS:** Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions **(6)**

**VERIFICATION SKILLS:** Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission **(6)**

**Total L: 30 periods**

**REFERENCES**

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006.
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Explain the principles of academic writing, including clarity, conciseness, proper structuring of sentences, and the avoidance of ambiguity, redundancy, and plagiarism in research papers. | **K2** |
| **CO2** | Apply effective writing and presentation skills to prepare well-structured sections of a research paper (title, abstract, introduction, methods, results, and discussion), ensuring academic integrity and readiness for publication. | **K3** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | | 1 | 2 | 2 |
| **CO2** | | 2 | 3 | 1 | 3 | 3 |
| | 2 | 3 | 3 | 1 | 3 | 3 |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25A03 DISASTER MANAGEMENT**

**2 0 0 0**

**INTRODUCTION TO DISASTERS:** Disaster: Definition, Factors and Significance – Difference between Hazard and Disaster – Natural and Manmade Disasters: Differences, Nature, Types and Magnitude. **(8)**

**IMPACTS AND TYPES OF DISASTERS:** Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystems – Natural Disasters: Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches – Man-made Disasters: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts. **(7)**

**DISASTER VULNERABILITY AND PREPAREDNESS IN INDIA:** Disaster-Prone Areas in India: Seismic Zones, Areas Prone to Floods, Droughts, Landslides, Avalanches, Cyclones, and Coastal Hazards (with special reference to Tsunami) – Post-Disaster Diseases and Epidemics – Preparedness: Monitoring of Phenomena Triggering Disasters, Risk Evaluation, Use of Remote Sensing, Meteorological Data, Media Reports – Government and Community Preparedness. **(8)**

**DISASTER RISK ASSESSMENT AND MANAGEMENT STRATEGIES:** Disaster Risk: Concept and Elements – Disaster Risk Reduction – Global and National Disaster Risk Situations – Techniques of Risk Assessment – Global Cooperation and Early Warning Systems – People's Participation – Strategies for Survival. **(7)**

**Total L: 30 periods**

**REFERENCES**

1. Goel S. L., ‘Disaster Administration and Management Text and Case Studies’. Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. Nishitha Rai, Singh AK, ‘Disaster Management in India: Perspectives, issues and strategies’. New Royal book Company, 2007.
3. Sahni and Pardeep. , ‘Disaster Mitigation Experiences and Reflections’. Prentice Hall of India, New Delhi, 2001.

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom’s Level** |
|---|---|---|
| **CO1** | Explain the nature, types, and impacts of natural and man-made disasters, along with India’s disaster-prone regions and their vulnerabilities. | **K2** |
| **CO2** | Apply disaster preparedness and risk assessment strategies using tools such as remote sensing, meteorological data, and community participation to propose suitable management practices. | **K3** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 1 | 2 | 2 |
| **CO2** | | 3 | 2 | 1 | 3 | 2 |
| | 3 | 3 | 2 | 1 | 3 | 2 |

**1-low, 2-medium, 3-high**

**Third ACM**

**SE25A04 CONSTITUTION OF INDIA**

**2 0 0 0**

**HISTORY AND PHILOSOPHY OF THE CONSTITUTION:** History of the Indian Constitution – Drafting Committee: Composition and Working – Philosophy of the Constitution – Preamble – Salient Features. **(8)**

**FUNDAMENTAL RIGHTS AND DUTIES:** Fundamental Rights – Right to Equality – Right to Freedom – Right against Exploitation – Right to Freedom of Religion – Cultural and Educational Rights – Right to Constitutional Remedies – Directive Principles of State Policy – Fundamental Duties. **(7)**

**STRUCTURE OF GOVERNANCE:** Organs of Governance: Parliament – Composition, Qualifications and Disqualifications – Powers and Functions – Executive: President, Governor, Council of Ministers – Judiciary: Appointment and Transfer of Judges – Qualifications, Powers and Functions. **(8)**

**LOCAL ADMINISTRATION AND ELECTORAL PROCESS:** Local Administration: District Administration – Role of District Collector – Municipalities – Mayor and Elected Representatives – Municipal Commissioner – Panchayati Raj Institutions (PRI): Zila Panchayat, Block Level, Village Level – Roles of Elected and Appointed Officials – Importance of Grassroots Democracy – Election Commission: Role and Functions – Chief Election Commissioner and Election Commissioners – Institutions for the Welfare of SC/ST/OBC and Women. **(7)**

**Total L: 30 periods**

**REFERENCES**


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


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Explain the historical evolution, philosophy, and salient features of the Indian Constitution, including its fundamental rights, duties, and directive principles. | **K2** |
| **CO2** | Evaluate the structure and functioning of governance, local administration, and electoral processes in India, and assess their role in ensuring democracy, justice, and social welfare at both national and grassroots levels. | **K2** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | | | 1 | 3 |
| **CO2** | | 3 | 2 | | 2 | 3 |
| | 2 | 3 | 2 | | 2 | 3 |

**1-low, 2-medium, 3-high**

## SE25A05 BUILDING COMMUNICATION SKILLS

**2 0 0 0**

**INTRODUCTION:** This course is aimed at enhancing the students' ability to land internships through improved communication skills. This course will cover two crucial elements –
1. Communication skills enhancement and
2. Career skills orientation with broader career guidance
At the end of this course, the students will

- be able to confidently communicate in English with improved outcomes in internships, and other career pathways
- have an orientation to the necessary digital tools & resources that can enhance communication skills
- have an understanding of best practices in professional communication
- have increasing digital literacy and understand the important of digital communication both in personal and professional lives

**COMMUNICATION SKILLS**
In this module, essential communication skills required for the workplace are covered in a multi-part lecture series. This includes skill sets in Writing, Speaking, Vocabulary & Grammar. **(18)**

**CAREER SKILLS**
In this module, an overall career orientation approach is taken to introduce students to the essential skills required to plan and progress towards crucial career choices. Sessions on profile building, workplace communication, reasoning & critical thinking, social media, privacy, digital communication, workplace communication tools & etiquette are discussed. The module concludes with a session on career planning and milestone tracking. **(12)**

**Total L: 30 periods**

**REFERENCES**

1. Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary by Norman Lewis
2. The Elements of Style (Fourth Edition or later) by William Strunk Jr and E B White
3. Idioms & Phrasal Verbs List (Various sources and provided in class)
4. The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century by Steven Pinker (Optional Resource)


**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Demonstrate improved oral and written communication skills applicable in internships and workplace environments. | **K3** |
| **CO2** | Analyze and apply career development strategies including digital tools, professional etiquette, and personal branding. | **K4** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 3 | | 3 | 3 | | 3 |
| **CO2** | | 3 | 3 | 3 | 3 | |
| | **3** | **3** | **3** | **3** | **3** | **3** |

**1-low, 2-medium, 3-high**

## ONE CREDIT COURSES
## ADVANCED STRUCTURAL DESIGN USING PROFESSIONAL SOFTWARE

**Industry Relevance:** Structural design offices, consultants, EPC firms

**Course Objectives**

- To expose students to real-time structural modelling and design workflow
- To bridge the gap between theory and professional practice

**Syllabus (15 Hours)**

1. Introduction to structural design workflow & codes (IS) – 2 h
2. Modelling of RC & steel structures (ETABS/STAAD) – 4 h
3. Load calculation & combinations as per IS codes – 3 h
4. Analysis interpretation: forces and stability – 2 h
5. Design of beams, columns, slabs using software – 3 h
6. Design report preparation & drawings – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Model RC/steel structures using professional software | **K3** |
| **CO2** | Analyze and interpret structural results | **K4** |
| **CO3** | Prepare basic design reports as per industry format | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 1 | 3 |
| **CO2** | 2 | 3 | 2 | 3 | 1 | 2 |
| **CO3** | | 2 | 3 | 2 | | 3 |
| | **3** | **3** | **3** | **3** | **1** | **3** |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation (100 Marks)**

- Software Modelling Assignment – 30
- Design Calculation & Interpretation – 30
- Mini Project / Case Study – 20
- Viva Voce – 2

**NON-DESTRUCTIVE TESTING & STRUCTURAL HEALTH MONITORING**

**Industry Relevance:** QA/QC, infrastructure maintenance, inspection agencies

**Course Objectives**

- To introduce NDT techniques used in structural evaluation
- To familiarize SHM concepts in modern infrastructure

**Syllabus (15 Hours)**

1. Need for NDT & SHM in structures – 2 h
2. Rebound hammer & UPV – principles & practice – 3 h
3. Core cutting, rebar locator – 3 h
4. Data interpretation & condition assessment – 3 h
5. Introduction to SHM sensors & instrumentation – 3 h
6. Case studies on bridges/buildings – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Select appropriate NDT techniques for structures | **K4** |
| **CO2** | Interpret NDT results for condition assessment | **K5** |
| **CO3** | Understand SHM systems used in practice | **K2** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | | 3 | 2 | 1 |
| **CO2** | 2 | 3 | 2 | 3 | 2 | 2 |
| **CO3** | | 2 | | 1 | 2 | 2 |
| | 3 | 3 | 2 | 3 | 2 | 2 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- NDT Data Interpretation Assignment – 30
- Case Study Presentation – 30
- Practical Demonstration / Video Analysis – 20
- Viva Voce – 20

**PERFORMANCE-BASED SEISMIC DESIGN OF STRUCTURES**

**Industry Relevance:** Earthquake-resistant design firms, retrofitting consultants

**Course Objectives**

- To move beyond code-based design to performance-based concepts
- To introduce nonlinear behaviour of structures

**Syllabus (15 Hours)**

1. Limitations of force-based seismic design – 2 h
2. Performance objectives & damage states – 3 h
3. Nonlinear static (pushover) analysis – 4 h
4. Capacity spectrum method – 2 h
5. Seismic retrofitting techniques – 3 h
6. Industry case studies – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Explain performance-based seismic philosophy | **K2** |
| **CO2** | Evaluate structural performance under earthquakes | **K5** |
| **CO3** | Propose suitable retrofitting strategies | **K6** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 3 | | 1 |
| **CO2** | 2 | 3 | 2 | 3 | 1 | 2 |
| **CO3** | | 2 | 3 | 3 | 2 | 2 |
| | 3 | 3 | 3 | 3 | 2 | 2 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- Numerical / Analytical Assignment – 30
- Case Study Report – 30
- Seminar Presentation – 20
- Viva Voce – 20

**CONSTRUCTION PLANNING, CONTRACTS & CLAIMS MANAGEMENT**

**Industry Relevance:** Project management, construction firms, PMC

**Course Objectives**

- To expose students to project execution realities
- To understand contractual and claim issues

**Syllabus (15 Hours)**

1. Construction planning & scheduling basics – 3 h
2. Bar charts, CPM, PERT – 3 h
3. Types of contracts & tender documents – 3 h
4. Claims, disputes & arbitration – 3 h
5. Delay analysis & case studies – 2 h
6. Industry practices – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Prepare basic construction schedules | **K3** |
| **CO2** | Interpret construction contracts | **K2** |
| **CO3** | Analyze claims and delays | **K4** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 1 | 3 | 3 |
| **CO2** | | 2 | 3 | | 3 | 2 |
| **CO3** | | 3 | 2 | | 3 | 2 |
| | 2 | 3 | 3 | 1 | 3 | 3 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- Scheduling Assignment – 30
- Contract Analysis Report – 30
- Case Study Presentation – 20
- Viva Voce – 20

**ADVANCED CONCRETE TECHNOLOGY FOR STRUCTURAL APPLICATIONS**

**Industry Relevance:** RMC plants, infrastructure projects, material consultants

**Course Objectives**

- To introduce high-performance and special concretes
- To relate mix design with structural performance

**Syllabus (15 Hours)**

1. High-strength & HPC concepts – 3 h
2. SCC & fibre reinforced concrete – 3 h
3. Durability & sustainability aspects – 3 h
4. Mix design case studies – 3 h
5. Field issues & quality control – 2 h
6. Industry standards – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Select suitable concrete for structural needs | **K3** |
| **CO2** | Understand durability and performance issues | **K2** |
| **CO3** | Analyze mix design practices | **K4** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 2 | 3 | 1 |
| **CO2** | 2 | 3 | | 2 | 3 | 1 |
| **CO3** | | 2 | 3 | 2 | 3 | 2 |
| | 3 | 3 | 3 | 2 | 3 | 2 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- Mix Design Assignment – 30
- Case Study / Lab Data Analysis – 30
- Seminar – 20
- Viva Voce – 20

**STRUCTURAL FORENSICS, FAILURE ANALYSIS & RETROFITTING**

**Industry Relevance:** Forensic consultants, safety audits, retrofitting firms

**Course Objectives**

- To understand causes of structural failures
- To learn investigation and retrofitting methods

**Syllabus (15 Hours)**

1. Types & causes of structural failures – 3 h
2. Investigation techniques & documentation – 3 h
3. Case studies of building/bridge failures – 4 h
4. Retrofitting methods for RC structures – 3 h
5. Ethical & legal aspects – 2 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Identify causes of structural failures | **K4** |
| **CO2** | Conduct basic forensic investigation | **K3** |
| **CO3** | Propose suitable retrofitting techniques | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 3 | 1 | 1 |
| **CO2** | 2 | 3 | | 3 | 2 | 1 |
| **CO3** | | 2 | 3 | 3 | 2 | 2 |
| | 3 | 3 | 3 | 3 | 2 | 2 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- Failure Case Study Report – 40
- Retrofitting Proposal – 30
- Viva Voce – 30

**ONE CREDIT COURSES**
**ADVANCED STRUCTURAL DESIGN USING PROFESSIONAL SOFTWARE**

**Industry Relevance:** Structural design offices, consultants, EPC firms

**Course Objectives**

- To expose students to real-time structural modelling and design workflow
- To bridge the gap between theory and professional practice

**Syllabus (15 Hours)**

7. Introduction to structural design workflow & codes (IS) – 2 h
8. Modelling of RC & steel structures (ETABS/STAAD) – 4 h
9. Load calculation & combinations as per IS codes – 3 h
10. Analysis interpretation: forces and stability – 2 h
11. Design of beams, columns, slabs using software – 3 h
12. Design report preparation & drawings – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Model RC/steel structures using professional software | **K3** |
| **CO2** | Analyze and interpret structural results | **K4** |
| **CO3** | Prepare basic design reports as per industry format | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 3 | 1 | 3 |
| **CO2** | 2 | 3 | 2 | 3 | 1 | 2 |
| **CO3** | | 2 | 3 | 2 | | 3 |
| | 3 | 3 | 3 | 3 | 1 | 3 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation (100 Marks)**

- Software Modelling Assignment – 30
- Design Calculation & Interpretation – 30
- Mini Project / Case Study – 20
- Viva Voce – 20

## NON-DESTRUCTIVE TESTING & STRUCTURAL HEALTH MONITORING

**Industry Relevance:** QA/QC, infrastructure maintenance, inspection agencies

### Course Objectives

- To introduce NDT techniques used in structural evaluation
- To familiarize SHM concepts in modern infrastructure

### Syllabus (15 Hours)

7. Need for NDT & SHM in structures – 2 h
8. Rebound hammer & UPV – principles & practice – 3 h
9. Core cutting, rebar locator – 3 h
10. Data interpretation & condition assessment – 3 h
11. Introduction to SHM sensors & instrumentation – 3 h
12. Case studies on bridges/buildings – 1 h

### COURSE OUTCOMES

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Select appropriate NDT techniques for structures | **K4** |
| **CO2** | Interpret NDT results for condition assessment | **K5** |
| **CO3** | Understand SHM systems used in practice | **K2** |

### COs – POs & PSOs MAPPING

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | | 3 | 2 | 1 |
| **CO2** | 2 | 3 | 2 | 3 | 2 | 2 |
| **CO3** | | 2 | | 1 | 2 | 2 |
| | 3 | 3 | 2 | 3 | 2 | 2 |

**1-low, 2-medium, 3-high**

### Scheme of Evaluation

- NDT Data Interpretation Assignment – 30
- Case Study Presentation – 30
- Practical Demonstration / Video Analysis – 20
- Viva Voce – 20

**PERFORMANCE-BASED SEISMIC DESIGN OF STRUCTURES**

**Industry Relevance:** Earthquake-resistant design firms, retrofitting consultants

**Course Objectives**

- To move beyond code-based design to performance-based concepts
- To introduce nonlinear behaviour of structures

**Syllabus (15 Hours)**

7. Limitations of force-based seismic design – 2 h
8. Performance objectives & damage states – 3 h
9. Nonlinear static (pushover) analysis – 4 h
10. Capacity spectrum method – 2 h
11. Seismic retrofitting techniques – 3 h
12. Industry case studies – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Explain performance-based seismic philosophy | **K2** |
| **CO2** | Evaluate structural performance under earthquakes | **K5** |
| **CO3** | Propose suitable retrofitting strategies | **K6** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 3 | | 1 |
| **CO2** | 2 | 3 | 2 | 3 | 1 | 2 |
| **CO3** | | 2 | 3 | 3 | 2 | 2 |
| | 3 | 3 | 3 | 3 | 2 | 2 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- Numerical / Analytical Assignment – 30
- Case Study Report – 30
- Seminar Presentation – 20
- Viva Voce – 20

**CONSTRUCTION PLANNING, CONTRACTS & CLAIMS MANAGEMENT**

**Industry Relevance:** Project management, construction firms, PMC

**Course Objectives**

- To expose students to project execution realities
- To understand contractual and claim issues

**Syllabus (15 Hours)**

7. Construction planning & scheduling basics – 3 h
8. Bar charts, CPM, PERT – 3 h
9. Types of contracts & tender documents – 3 h
10. Claims, disputes & arbitration – 3 h
11. Delay analysis & case studies – 2 h
12. Industry practices – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Prepare basic construction schedules | **K3** |
| **CO2** | Interpret construction contracts | **K2** |
| **CO3** | Analyze claims and delays | **K4** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | 1 | 3 | 3 |
| **CO2** | | 2 | 3 | | 3 | 2 |
| **CO3** | | 3 | 2 | | 3 | 2 |
| | 2 | 3 | 3 | 1 | 3 | 3 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- Scheduling Assignment – 30
- Contract Analysis Report – 30
- Case Study Presentation – 20
- Viva Voce – 20

**ADVANCED CONCRETE TECHNOLOGY FOR STRUCTURAL APPLICATIONS**

**Industry Relevance:** RMC plants, infrastructure projects, material consultants

**Course Objectives**

- To introduce high-performance and special concretes
- To relate mix design with structural performance

**Syllabus (15 Hours)**

7. High-strength & HPC concepts – 3 h
8. SCC & fibre reinforced concrete – 3 h
9. Durability & sustainability aspects – 3 h
10. Mix design case studies – 3 h
11. Field issues & quality control – 2 h
12. Industry standards – 1 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Select suitable concrete for structural needs | **K3** |
| **CO2** | Understand durability and performance issues | **K2** |
| **CO3** | Analyze mix design practices | **K4** |

**COs – POs & PSOs MAPPING**

| CO | PO1 | PO2 | PO3 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 2 | 3 | 1 |
| **CO2** | 2 | 3 | | 2 | 3 | 1 |
| **CO3** | | 2 | 3 | 2 | 3 | 2 |
| | 3 | 3 | 3 | 2 | 3 | 2 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- Mix Design Assignment – 30
- Case Study / Lab Data Analysis – 30
- Seminar – 20
- Viva Voce – 20

**STRUCTURAL FORENSICS, FAILURE ANALYSIS & RETROFITTING**

**Industry Relevance:** Forensic consultants, safety audits, retrofitting firms

**Course Objectives**

- To understand causes of structural failures
- To learn investigation and retrofitting methods

**Syllabus (15 Hours)**

6. Types & causes of structural failures – 3 h
7. Investigation techniques & documentation – 3 h
8. Case studies of building/bridge failures – 4 h
9. Retrofitting methods for RC structures – 3 h
10. Ethical & legal aspects – 2 h

**COURSE OUTCOMES**

| At the end of the course, students will be able to: | | **Bloom's Level** |
|---|---|---|
| **CO1** | Identify causes of structural failures | **K4** |
| **CO2** | Conduct basic forensic investigation | **K3** |
| **CO3** | Propose suitable retrofitting techniques | **K6** |

**COs – POs & PSOs MAPPING**

| **CO** | **PO1** | **PO2** | **PO3** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 3 | 1 | 1 |
| **CO2** | 2 | 3 | | 3 | 2 | 1 |
| **CO3** | | 2 | 3 | 3 | 2 | 2 |
| | 3 | 3 | 3 | 3 | 2 | 2 |

**1-low, 2-medium, 3-high**

**Scheme of Evaluation**

- Failure Case Study Report – 40
- Retrofitting Proposal – 30
- Viva Voce – 30