Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus for
F. Y. M. Tech.
STRUCTURES (Civil Engineering)
(Pattern 2020)

Department of Civil Engineering

Vision:

Excellence in Civil Engineering Education

Mission:

M1: Make competent Civil Engineers with high level of professional, moral and ethical values

M2: Impart highest standards in theoretical as well as practical knowledge and skill set

M3: Establish Center of Excellence in major areas of Civil Engineering to respond to the current and future needs of the industry, higher studies as well as research

Department of Civil Engineering

First Year M. Tech. (FYMT) Structures (Civil Engineering)
Semester I (Pattern 2020)

Course Code	Course	Course Type	Teaching Scheme		Examination Scheme					Total	Credits
			L	P	CIE	ISE	SCE	ESE	TW/OR		
CVPB11201	Theory of Elasticity	TH	3	-	20	30	20	30	-	100	3
CVPB11202	Dynamics and Earthquake Engineering	TH	3	-	20	30	20	30	-	100	3
CVPB11203	Finite Element Analysis	TH	3	-	20	30	20	30	-	100	3
CVPB11204	Program Elective I	TH	3	-	20	30	20	30	-	100	3
CVPB11205	Program Elective II	TH	3	-	20	30	20	30	-	100	3
CVPB11206	Open Elective I	CE	2	-	-	-	-	-	50	50	2
CVPB11207	Research Methodology	CE	2	-	-	-	-	-	50	50	2
CVPB11208	Laboratory I *	CE-OR	-	4	-	-		-	50	50	2
AP1	Audit Course I	-	-	-	-	-		-	-	-	-
	Total		19	4	100	150	100	150	150	650	21

L: 1Hr. = 1 Credit, P: 2 Hrs. = 1 Credit, T: 1hr. = 1 Credit, AP: No Credits
***** Course have oral examination
Laboratory I (CVPB11208) will be based on Program Core Courses: Theory of Elasticity, Dynamics and Earthquake Engineering and Finite Element Analysis.

Course Code	**Program Elective I**
CVPB11204A	Plastic Analysis of Steel Structures
CVPB11204B	Numerical Methods in Structural Engineering
CVPB11204C	Advanced Analysis of Steel Frames

Course Code	**Program Elective II**
CVPB11205A	Soil Structure Interaction
CVPB11205B	Advanced Earthquake Engineering
CVPB11205C	Theory of Plates and Shells

Course Code	**Open Elective I**
IOEP11206A	Soft Computing Techniques
IOEP11206B	Ethical Hacking
IOEP11206C	Product Design Engineering

Audit Courses	
1. English for Research Paper Writing	5. Constitution of India
2. Disaster Management	6. Pedagogy Studies
3. Sanskrit for Technical Education	7. Stress Management by Yoga
4. Value Education	8. Personality Development through Life Enlightenment Skills

BOS Chairman **Dean Academics** **Director**

Department of Civil Engineering

First Year M. Tech. (FYMT) Structures (Civil Engineering)
Semester II (Pattern 2020)

Course Code	Course	Course Type	Teaching Scheme		Examination Scheme					Total	Credits
			L	P	CIE	ISE	SCE	ESE	TW/OR		
CVPB12201	Advanced Design of Concrete Structures	TH	3	-	20	30	20	30	-	100	3
CVPB12202	Advanced Design of Steel Structures	TH	3	-	20	30	20	30	-	100	3
CVPB12203	Design of Prestressed Concrete Structures	TH	3	-	20	30	20	30	-	100	3
CVPB12204	Program Elective III	TH	3	-	20	30	20	30	-	100	3
CVPB12205	Program Elective IV	TH	3	-	20	30	20	30	-	100	3
CVPB12206	Open Elective II	CE	2	-	-	-	-	-	50	50	2
CVPB12207	Intellectual Property Rights	CE	2	-	-	-	-	-	50	50	2
CVPB12208	Laboratory II *	CE-OR	-	4	-	-	-	-	50	50	2
AP2	Audit Course II	-	-	-	-	-					
	Total		19	4	100	150	100	150	150	650	21

L: 1Hr. = 1 Credit, P: 2 Hrs. = 1 Credit, T: 1hr. = 1 Credit, AP: No Credits
***** Course have oral examination
Laboratory II (CVPB12208) will be based on Program Core Courses namely Advanced Design of Concrete Structures, Advanced Design of Steel Structures and Design of Prestressed Concrete Structures.

Course Code	**Program Elective III**
CVPB12204A	Design of Foundations
CVPB12204B	Design of Earthquake Resistant Structures
CVPB12204C	Design of Industrial Structures

Course Code	**Program Elective IV**
CVPB12205A	Design of RCC Bridges
CVPB12205B	Design of Composite Structure
CVPB12205C	Retrofitting and Strengthening of RC Structures

Course Code	**Open Elective II**
IOEP12206A	Project Planning and Management
IOEP12206B	Blockchain Technologies
IOEP12206C	Data Science for Engineers

Audit Courses	
1. English for Research Paper Writing	5. Constitution of India
2. Disaster Management	6. Pedagogy Studies
3. Sanskrit for Technical Education	7. Stress Management by Yoga
4. Value Education	8. Personality Development through Life Enlightenment Skills

BOS Chairman **Dean Academics** **Director**

Semester I

Department of Civil Engineering

Theory of Elasticity (CVPB11201)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite course (s): Strength of Materials, Engineering Mathematics, Structural Analysis

Course Objectives: The course will help students

- To **analyze** representative problems and to formulate the conditions of theory of elasticity application
- To **execute** a reasonable choice of parameters of the model (geometry, material properties, boundary conditions)

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

1. **Apply** equilibrium equations, stress compatibility and strain compatibility equations
2. **Analyse** two dimensional problems using equilibrium and compatibility equations in Cartesian coordinate systems
3. **Analyze** two dimensional problems using equilibrium and compatibility equations in Polar coordinate systems
4. **Analyse** the stress concentration problems in plates
5. **Apply** differential equations for rectangular plates using pure bending theory
6. **Analyse** rectangular plates using Navier solution

Unit I: Analysis of Stresses and Strain **(6 Hrs.)**

Concept of stress at a point, stress tensor, stress on inclined plane, stress components on a Rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, transformation of stresses, stress invariants. The state of strain at a point, strain displacement relations, strain compatibility condition and stress compatibility conditions.

Unit II: Stress-Strain Relationship **(6 Hrs.)**

Relations between Elastic Constants, Problems on Navier Lame's Equilibrium Equations, Problems on Beltrami-Michell compatibility equations, Boundary value problems in Elasticity. Generalized Hook's law for Isotropic, Orthotropic, plane stress, plane strain and axisymmetric problems, Problems in 2D and 3D Cartesian coordinate system, Airy's stress function, bending of beams.

Unit III: Polar Coordinate System **(6 Hrs.)**

Relationship between Cartesian and Polar coordinate system, Equilibrium equations, Strain displacement relations, Stress-strain relationship, Strain-displacement relationship for plane stress and plane strain conditions.

Unit IV: Stress Concentration Problems **(6 Hrs.)**

Stress concentration problems such as stress concentration due to circular hole in stressed plate (Kirsch's Problem), failure criterion- von mises.

Unit V: Plates **(6 Hrs.)**

Introduction: Thin and thick plates, small and large deflections. Small deflection theory of thin plates: Assumptions, Moment Curvature relations. Stress resultants. Governing differential equation in Cartesian co-ordinates, various boundary conditions. Pure bending of Plates.

Unit VI: Analysis of Rectangular Plates **(6 Hrs.)**

Analysis of Rectangular Plates: Navier solution for plates with all edges simply supported.

Text books:

1. Irving Shames, Mechanics of deformable solids, Prentice Hall
2. Sadhu Singh – Theory of Elasticity, Khanna Publishers
3. L.S. Sreenath – Advanced Mechanics of Solids, Tata McGraw-Hill Publications
4. N. K. Bairagi- Advanced Solid Mechanics- Khanna Publishers, New Delhi
5. S. Crandall, N. Dahl and T. Lardner – Mechanics of Solids, McGraw Hill Publications

Reference books:

1. Timoshenko and Goodier – Theory of Elasticity, McGraw-Hill Publications
2. Wang – Applied Elasticity, Dover Publications
3. Enrico Volterra and J. H. Gaines – Advanced Strength of Materials, Prentice Hall
4. S M A Kazimi – Solid Mechanics, Tata McGraw-Hill Publications

Dynamics and Earthquake Engineering (CVPB11202)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite course (s): Engineering Mechanics, Theory of Structures, Engineering Mathematics III, Structural Design II

Course Objectives: The course will help students

- To **introduce** students to the fundamentals of dynamics and it application
- To **introduce** students to analyse building structure under earthquake loads

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

1) **Analyse** Single Degree of Freedom system subjected to free vibrations
2) **Analyse** Single Degree of Freedom system subjected to forced vibrations using Duhamel Integral, Fourier series and determine the repose of SDOF systems for ground motion
3) **Compute** the natural frequencies and mode shapes for Multi Degree of Freedom Systems
4) **Comprehend** the basics of earthquake inputs
5) **Comprehend** the provisions for analysis of multi-storey buildings in IS 1893:Part 1
6) **Compute** the base shear and lateral forces on multi storey buildings.

Unit I: Introduction to Vibration analysis and Response of Single Degree of Systems –I (6 Hrs.)

Vibrations and the nature of time dependent phenomena, inertia, dynamic equilibrium and mathematical models of physical systems. Introduction to structural dynamics, definition of basic problem in dynamics, static versus dynamic loads, different types of dynamic loads.
Introduction to single degree of Freedom (SDOF) systems- Un-damped vibration of SDOF system, natural frequency and period of vibration, damping in structures, viscous damping and coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, logarithmic decrement, forced vibration. Resonance.

Unit II: Response of Single Degree of Freedom Systems-II (6 Hrs.)

Duhamel's integral, response of structure subjected to general dynamic load, numerical evaluation of dynamics response of SDOF systems, response of structure in frequency domain subjected to general periodic and non-periodic/impulsive forces of short duration, use of Fourier Series for periodic forces, response of SDOF system subjected to ground motion.

Unit III: Multi – Degree of Freedom Systems (6 Hrs.)

Lumped mass multi degree of freedom (MDOF) system- Coupled and uncoupled systems, direct determination of frequencies of vibration and mode shapes, orthogonality principle, vibration of MDOF systems with initial conditions, approximate methods of determination of natural frequencies of vibration and mode shapes-vector iteration methods.

Unit IV: Earthquake Inputs (6 Hrs.)

Time History Records and Frequency Contents of Ground Motion; Power Spectral Density Function of Ground Motion; Concept of Response Spectrums of Earthquake; Combined D - V- A Spectrum and Construction of Design Spectrum; Site Specific, Probabilistic and Uniform Hazard spectrums; Predictive Relationships for earthquake parameters.

Unit V: Analysis of Multi-storeyed Buildings for Lateral Loads (6 Hrs.)

Deterministic earthquake response: types of earthquake excitation, lumped SDOF elastic systems, translational excitation, lumped MDOF elastic systems, distributed-parameter elastic systems, translational excitation, combining maximum modal responses using mean square response of a single mode, SRSS and CQCC combination of modal responses. Provisions in IS 1893 (Part1):2016.

Unit VI: Computation of Lateral Forces on Multi-storeyed Buildings (6 Hrs.)

Numerical Examples on computation of base shear and lateral forces on the buildings using:
Equivalent Lateral Load Method of analysis and Response Spectrum Method of analysis. Maximum three storey building for Response Spectrum Method.

Text books:

1. A.K. Chopra, Dynamics of Structures , Theory and Application to Earthquake Engineering, Prentice Hall
2. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, PHI, 2008
3. Dr. Vinod Hosur, Earthquke Resistant Design of Building Structures, Wiley India
4. Mario Paz and William Leigh, Structural Dynamics- Theory and Computations, Kluwer Academic Publishers

Reference books:

1. Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition, 1992
2. T. Paulay and M.J.N. Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, Wiley India

IS Codes:

1. IS 1893 (Part1):2016, "Criteria for Earthquake Resistant Design of Structures" Part1 General Provisions and Buildings

Finite Element Analysis (CVPB11203)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite course (s): Mechanics of structures I, Mechanics of structures II, Engineering Mathematics I, Engineering Mathematics II, Engineering Mathematics III

Course Objectives: The course will help students to

- To **analyse** some real problem and to formulate the conditions of FEA application
- To **execute** a reasonable choice of parameters and variables of the FEA model (geometry, material properties, boundary conditions)
- To **analyse** the result FEA model solution by standard computational programs

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

1. **Recognize** the importance and limitations of FEA
2. **Execute** the generalized stiffness matrix for bar and beam element for boundary conditions to get stress and reactions in elements
3. **Execute** the generalized stiffness matrix for plane truss for boundary conditions to get stress and reactions in elements
4. **Understand** the displacement function and its synthesis with type of elements
5. **Identify** different types of elements for Two and Three Dimensional solids
6. **Comprehend** the use of FEM software

Unit I: Introduction **(6 Hrs.)**

Theory of elasticity: Strain-displacement relations, compatibility conditions in terms of strain, plane stress and plane strain problems, differential equations of equilibrium, compatibility condition in terms of stresses, stress-strain relations in 2D and 3D problems. General steps of the finite element method, Applications and advantages of FEM, concept of finite element for continuum problems, discretization of continuum, use of polynomial displacement function, Pascal's triangle, convergence criteria.

Unit II: Stiffness Matrix and Boundary Conditions for bar and beam **(6 Hrs.)**

Bar element: stiffness matrix, load vector, assembly of element matrices implementing boundary conditions, stress calculations, support reactions.
Beam element: Introduction, Derivation of Element Stiffness Matrix, Generalized Stiffness Matrix of a Beam Member, stress calculations, support reactions.

Unit III: Stiffness Matrix and Boundary Conditions for Truss **(6 Hrs.)**

Introduction, Element Stiffness of a Truss Member, Member Stiffness with Varying Cross Section, Generalized Stiffness Matrix of a Plane Truss Member: Analysis of Truss, Element Stiffness of a 3 Node Truss Member.

Unit IV: Finite Element Formulation Techniques **(6 Hrs.)**

Choice of Displacement Function: Convergence criteria, Compatibility, Geometric invariance, Shape Function, Degree of Continuity, Isoparametric Elements, Various Elements.

Unit V: Two and Three Dimensional elements **(6 Hrs.)**

Two dimensional element : Constant Strain Triangle: Element Stiffness Matrix for CST, Nodal Load Vector for CST, Linear Strain Triangle: Element Stiffness Matrix for LST, Nodal Load Vector for LST, Numerical Example using CST Three dimensional element : Tetrahedron element, shape function ,element matrices.

Unit VI: FEM Software **(6 Hrs.)**

Working of FEM, Steps, algorithm flow charts, sequence of procedure followed in software, description of various software, common mistakes, validation study.

Text books:

1. S.S. Bhavikatti –Finite Element Analysis –New Age International Publishers, Delhi
2. Thompson---Introduction to the Finite Element, Method: Theory, Programming and Applications, Wiley, India
3. S.S. Rao –The Finite Element Method in Engineering 4th Edition –Elsevier Publication
4. G.R. Buchanan –Finite Element Analysis Schaum's outlines –Tata McGraw Hill Publishing Co. Ltd
5. Iriving Shames & Clive Dym, Energy & Finite Element Methods in Structural Mechanics, New Age International Publishers, Delhi
6. NPTEL Notes

Reference Books:

1. Zienkiewiczand Taylor –The Finite Element Method 4th Edition –Vol –I & II –McGraw Hill International Edition
2. Robert D. Cook, D.S. Malkus, M.E. Plesha –Concepts & Applications of Finite Element Analysis –Wiley,India.
3. J.N. Reddy –An Introduction to the finite element method –Tata McGraw Hill Publishing Co. Ltd
4. Segerlind L.J. –Applied Finite Element Analysis –John Wiley & Sons.
5. C.S. Krishnamoorthy –Finite Element Analysis –Theory & Programming –Tata McGraw Hill Publishing Co. Ltd

Program Elective I
Plastic Analysis of Steel Structures (CVPB11204A)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Structural Analysis-I, Structural Analysis-II

Course Objectives: The course will help students

- To **recognize** the concept of plastic analysis of steel frames.
- To **identify** the effect of additional stresses interacting with bending stresses in steel members.

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

1) **Demonstrate** the behavior of steel structures in plastic state of deformation.
2) **Analyze** single bay – single storey rectangular steel frames using plastic analysis method.
3) **Analyze** multi bay – multi storey rectangular steel frames using plastic analysis method.
4) **Analyze** gable portal frames using plastic analysis method.
5) **Understand** effect of additional stresses interacting with bending stresses in steel beams and **design** the beams as per the guidelines of Indian standard code.
6) **Design** beam to column connections as per the guidelines of Indian standard code.

Unit I: Introduction of Plastic Theory **(6 Hrs.)**

Plasticity in ductile materials, actual and idealized stress-strain graph for mild steel, elastoplastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge.

Unit II: Rectangular portal frames **(6 Hrs.)**

Plastic collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames Various mechanisms, Analysis of single bay – single storey rectangular frames

Unit III: Plastic Analysis of multi bay rectangular frames **(6 Hrs.)**

Analysis of Multi Bay- Multi Storey rectangular portal frame, Joint & Various mechanisms
(Two bays – Three storeys)

Unit IV: Gables portal frames **(6 Hrs.)**

Plastic collapse loads of gable portal frames, various mechanisms.

Unit V: Secondary design considerations **(6 Hrs.)**

Effect of axial force, shear, residual stresses and brittle fracture on moment capacity. Design of beams with high shear, interaction of bending & axial force: section and member strength.

Unit VI: Design of beam to column connections **(6 Hrs.)**

Design of beam to column Moment resisting connections. End plate: Flush & extended, T Stub connections. Combined tension & shear considerations in welded & bolted connection.

Text books:

1. "Limit state Design of Steel Structures", S K Duggal , McGraw Hill education, 2010
2. "Limit State Design of Steel Structures", Dr. M R Shiyekar, PHI Publication, 3rd Print

Reference books:

1. B.G. Neal – Plastic Method of Structural Analysis, Chapman & Hall **2.** L.S. Beedle – Plastic Design of Steel Frames, John Willey & Sons
IS Codes:
IS: 800 - 2007, Code of Practice for General Construction in Steel, BIS, New Delhi.

Program Elective I
Numerical Methods in Structural Engineering (CVPB11204B)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Matrices, linear equations, differential equations.

Course Objectives: The course will help students

- To **use** different numerical methods to solve structural engineering problems

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

1. **Analyse** beams, frames, trusses using linear equations
2. **Analyse** beams, frames, trusses using matrix operations
3. **Solve** structural engineering problems using differential equations
4. **Solve** structural engineering problems using numerical integration methods
5. **Apply** finite difference methods to analyze intermediate beams, columns and plates
6. **Solve** structural engineering problems using regression analysis

Unit I: Solution to Linear equations **(6 Hrs.)**

Gauss elimination method, Gauss – Jordan method, Choleski's factorization method, Jacobi's method and Gauss – Seidel method. Solutions to the problems of analysis of beams, frames, trusses using stiffness matrix methods.

Unit II: Matrix operations **(6 Hrs.)**

Flexibility and stiffness matrices, numerical examples of application of stiffness method to beams and plane trusses, concept of transformation matrix, stiffness matrix for plane frame and space frame.

Unit III: Solution to Differential equations **(6 Hrs.)**

Review of Taylor's series and Euler's method. Runge – Kutta fourth order method, predictor – corrector method. Solution of Eigen value problems by Power method.

Unit IV: Numerical integration **(6 Hrs.)**

Trapezoidal and Simpson's methods, Gauss quadrature method, Newton's – Cotes method.

Unit V: Finite difference method **(6 Hrs.)**

Forward, backward and centered finite difference approximations to the derivatives. Applications to indeterminate beams, columns and plates.

Unit VI: Regression analysis **(6 Hrs.)**

Least square method, polynomial functions, curve fitting. Interpolation – Polynomial approximation, Lagrange's method, spline interpolation.

Text books:

1. S. C. Chapra & R. P. Canale, Numerical Methods for Engineering, TMH Publications
2. Krishna Raju, Numerical Methods in Civil Engineering, CBS

Reference books:

1. E. Ward Cheney, David R. Kincaid, Numerical Methods and Applications, Brooks Cole / Cengage Learning India
2. E. Balgurusamy, Numerical Methods, TMH Publications

Program Elective I
Advanced Analysis of Steel Frames (CVPB11204C)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Strength of Materials, Structural Analysis-I, Structural Analysis-II

Course Objectives: The course will help students

- To **identify** the application of basic concepts of stability of structures.
- To **recognize** the purpose of specific steel structure and **interpret** its behavior under various loads based on its applications.

Course Outcomes: By the end of the course, Students will be able to

1. **Understand** stability of structures.
2. **Understand** first order elastic and inelastic analysis of rectangular and gable portal steel frames.
3. **Understand** second order elastic analysis of steel frames.
4. **Understand** second order inelastic analysis of steel frames.
5. **Analyze and design** Pre-engineered buildings.
6. **Demonstrate** advanced analysis of steel frames and Pre-engineered buildings using suitable software.

Unit I: Stability of structures **(6 Hrs.)**

Elastic stability & structural Instability, Review of critical loads of long columns for various boundary conditions; beam-columns, critical load of simple rectangular frames. Columns with initial imperfection.

Unit II: First order elastic and inelastic analysis **(6 Hrs.)**

First order elastic (FOE) & first order inelastic (FOIE) (Plastic) analysis of rectangular and gable portal frames. Elastic & limit state of strength of frame.

Unit III: Second order elastic analysis **(6 Hrs.)**

Second order considerations in elastic analysis of frames P-δ & P-Δ effect. Critical load of single bay, single storey portal frame using P-δ & P-Δ effect; classical & semi geometrical approach. Direct second order elastic analysis (SOE), international codal provisions, application for simple frame.

Unit IV: Second order inelastic analysis **(6 Hrs.)**

Second order inelastic (SOIE) analysis of frames, elastic plastic hinge analysis, plastic zone method, use of finite element method Refined plastic hinge analysis, reduction in stiffness of member due to plasticity at hinge. Advantages of advanced analysis.

Unit V: Pre-Engineered Buildings **(6 Hrs)**

Introduction, basic concept of pre-engineered building, advantages and disadvantages, analysis and design of purlins and structural frame.

Unit VI: Software application **(6 Hrs.)**

Design of frame using advanced analysis. Use of suitable software illustrating difference in analytical results among all methods such as FOE, FOIE, SOE, SOIE. Software application for pre-engineered building.

Text books:

1. "Stability Analysis & design of Structures" M.L. Gambhir, Springer, SIE.
2. "Limit State Design in Structural Steel" M. R. Shiyekar, PHI publication.

Reference books:

1. "Advanced Analysis of steel frames, Theory Software and application", W F Chen, S.Toma, CRC press, Tokyo.
2. "LRFD steel design using Advanced Analysis", W F Chen, S. Kim, CRC press.

IS Codes:

IS: 800 - 2007, Code of Practice for General Construction in Steel, BIS, New Delhi.

Program Elective II
Soil Structure Interaction (CVPB11205A)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Geotechnical Engineering, Foundation Engineering, Mechanics of Structures

Course Objectives: The course will help students

1. To **introduce** and **analyse** SSI problem
2. To **introduce** knowledge in principles for design of soil structure interaction.

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

1. **Analyse** Contact pressure and settlement under foundations
2. **Understand** the various theories applicable for SSI
3. **Understand** the soil behavior
4. **Understand** the soil structure interaction problem in axially an laterally loaded pile
5. **Analyse** earth pressure on different retaining structures
6. **Understand** the Soil-Structure Interaction under dynamic loads

Unit I: Contact Pressure and settlement under foundations **(6 Hrs.)**

Introduction, critical study of conventional methods of shallow foundation design: bearing capacity and settlement calculation. Contact pressure and soil-structure interaction for shallow foundation. Determination of subgrade modulus and parameters influencing subgrade modulus.

Unit II: Soil – Foundation Interaction **(6 Hrs.)**

Introduction, Importance and Applications of Soil Structure Interaction **(**SSI), Effects of structure roughness/smoothness on soil behavior, General soil-structure interaction problems – Shallow Foundations, Sheet piles, Mat/Raft foundations etc., Contact pressures and soil-structure interaction for shallow Foundations, Fixed/Flexible Base.

Unit III: Soil Structure Interaction – Parameters **(6 Hrs.)**

Concept of sub grade modulus, effects/parameters influencing sub grade modulus, Flexible and Rigid Foundations – Rigidity calculations, Static and Dynamic Spring Constants – Winkler Model, Estimation of soil spring constants/stiffness for foundations design. Elastic Continuum, Winkler Model, Multi-Parameter Models, Hybrid Model. Structure Contact Interface.

Unit IV: Soil Behavior **(6 Hrs.)**

Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits/pipes in soils. Beams on elastic foundation concept, introduction to the solution of beam problems. Arching in soils.

Unit V: Soil-Pile Behavior **(6 Hrs.)**

Introduction, axial and laterally loaded piles, load-displacement behavior, Modified Ramberg Osgood Model, pile group, interaction effect in pile group, soil-pile modeling in FEM.

Unit VI: Soil Structure Interaction in Retaining Structures **(6 Hrs.)**

SSI in Retaining Structures: Mohr-Coulomb envelope and circle of stresses. Earth pressure computations by friction circle method. Earth pressure distribution on walls with limited/restrained deformations, Earth pressures on sheet piles, braced excavations. Design of supporting system for excavations.

Text books:

1. Selvadurai, A. P. S. – Elastic Analysis of Soil-Foundation, Elsevier Scientific Publishing Company, Interaction, 1979
2. Rolando P. Orense, Nawawi Chouw, Michael J. Pender, Soil-Foundation-Structure Interaction, CRC Press, 2010 Taylor & Francis Group, London, UK

Reference books:

1. Bowels J.E., "Analytical and Computer Methods in Foundation", McGraw Hill Book Co.
2. Desai C.S. and Christian J.T., "Numerical Methods in Geotechnical Engineering" McGraw Hill Book Co. New York.
3. Das, B. M. – Principles of Foundation Engineering 5th Edition Nelson Engineering
4. Scott, R.F. Foundation Analysis, Prentice Hall, 1981
5. Structure Soil Interaction – State of Art Report, Institution of structural Engineers, 1978
6. Soil Structure Interaction, the real behavior of structures, Institution of Structural Engineers

Program Elective II
Advanced Earthquake Engineering (CVPB11205B)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite course (s): Dynamics and Earthquake Engineering, Theory of Structures, Engineering Mathematics III

Course Objectives: The course will help students

- To **introduce** Response Spectrum and Time History Analysis for earthquake induced loads
- To **introduce** seismic soil structure interaction
- To **introduce** base isolation techniques

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

1. **Comprehend** the basics of earthquake inputs
2. **Comprehend** the concepts of Response Spectrum Analysis
3. **Analyse** the symmetric and un-symmetric multi-storey buildings for lateral loads
4. **Design** R.C. structures with Shear Wall using IS 13920
5. **Comprehend** the basics of retrofitting structures.

Unit I: Earthquake Inputs **(6 Hrs.)**

Time History Records and Frequency Contents of Ground Motion; Power Spectral Density Function of Ground Motion; Concept of Response Spectrums of Earthquake;
Combined D-V-A Spectrum and Construction of Design Spectrum; Site Specific, Probabilistic and Uniform Hazard spectrums; Predictive Relationships for earthquake parameters.

Unit II: Response Spectrum Analysis Method **(6 Hrs.)**

Characterization of ground motion: earthquake response spectra, factors influencing response spectra, design response spectra for elastic systems, peak ground acceleration, response spectrum shapes, deformation, pseudo-velocity, pseudo-acceleration response spectra, peak structural response from the response spectrum, response spectrum characteristics.

Unit III: Analysis of Multi-storied Buildings **(6 Hrs.)**

Deterministic earthquake response: types of earthquake excitation, lumped SDOF elastic systems, translational excitation, lumped MDOF elastic systems, multistoried buildings with symmetric plans, multistoried buildings with unsymmetric plans, torsional response of symmetric plan building, distributed-parameter elastic systems.

Unit IV: RC building with Shear Walls **(6 Hrs.)**

Design of RC building with Shear Walls. Ductile detailing as per latest IS: 13920.

Unit V: Retrofitting of structures **(6 Hrs.)**

Retrofitting of Structures, Sources of weakness in framed buildings, Classification of retrofitting techniques, Conventional and non-conventional methods, Comparative study of various methods and case studies.

Unit VI: Base Isolation Techniques (6 Hrs.)

Base isolation concept, isolation systems and their modeling; linear theory of base isolation; stability of elastomeric bearings; codal provisions for seismic isolation, practical applications.

Text books:

1. A.K. Chopra, Dynamics of Structures , Theory and Application to Earthquake Engineering, Prentice Hall
2. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, PHI, 2008
3. Dr. Vinod Hosur, Earthquke Resistant Design of Building Structures, Wiley India
4. Mario Paz and William Leigh, Structural Dynamics- Theory and Computations, Kluwer Academic Publishers.

Reference books:

1. Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition, 1992
2. T. Paulay and M.J.N. Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, Wiley India

IS Codes:

1. IS 1893 (Part1):2016, "Criteria for Earthquake Resistant Design of Structures" Part1 General Provisions and Buildings.

Program Elective II
Theory of Plates and Shells (CVPB11205C)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Theory of Elasticity, Advanced Solid Mechanics

Course Objectives: The course will help students

- To **identify** the application of basic concepts of analysis of 2-D plates and shells.
- To **interpret** the behavior of plate and shell structure under various loads.
- To **understand** and **compare** various analysis methods for plates and shells.

Course Outcomes: By the end of the course, Students will be able to

1. **Demonstrate** the basic concept of thin plates and to analyse thin rectangular plates.
2. **Analyze** rectangular plates using shear deformation theory.
3. **Analyze** circular plates with and without central hole subjected to distributed and ring loads.
4. **Demonstrate** the basic concept of thin shells and to analyse thin shells using membrane theory.
5. **Analyze** cylindrical shells using bending and beam theory.
6. **Analyze** circular cylindrical shells using membrane theory.

Unit I: Thin plates **(6 Hrs.)**

Introduction: Theory of thin plates: Assumptions, Moment Curvature relations. Navier and Levy's solution for plates with distributed loads. Raleigh- Ritz approach for simple cases in rectangular plates.

Unit II: Shear deformation theories **(6 Hrs.)**

Introduction to shear deformation theories. Reissener – Mindlin Theory, Moment curvature relationship for First order shear deformation theory.

Unit III: Circular Plates **(6 Hrs.)**

Circular Plates: Analysis of circular plates under axi-symmetric loading. Moment Curvature relations. Governing differential equation in polar co-ordinates. Simply supported and fixed edges. Distributed load, ring load, a plate with a central hole.

Unit IV: Thin Shells **(6 Hrs.)**

Shells of Revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells.

Unit V: Shell bending and beam theory **(6 Hrs.)**

Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions. Application to pipes and pressure vessels. Beam theory of cylindrical shells: Principles of Lundgren's beam theory, beam analysis, arch analysis, applications to cylindrical roof shells.

Unit VI: Circular cylindrical Shells **(6 Hrs.)**

Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions.

Text books:

1. Chandrashekhara K., Analysis of Concrete Shells, New Age International Edition
2. Chandrashekhara K., Analysis of Plates, New Age International Edition

Reference books:

1. S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Graw Hill.
2. Ansel C. Ugural Stresses in Plates and Shells, Mc Graw Hill

Open Elective I
Soft Computing Techniques (CVPB11206A)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Prerequisite: UG level mathematics

Course Objectives: The course will help students

- To make students aware about soft computing techniques /AI techniques
- To impart knowledge about working of ANN, applications of ANN
- To impart knowledge about working of Genetic programming, applications of GP
- To impart knowledge about working of Support vector Regression and Model Tree, applications of SVR and MT

Course Outcomes: By the end of the course, Students will be able to

1. **Understand** working of ANN and design temporal and cause effect ANN models
2. **Understand** working of Genetic programming and design temporal and cause effect GP models
3. **Understand** working of Support Vector Regression and design temporal and cause effect SVRmodels
4. **Understand** working of Model Tree and design temporal and cause effect MT models.

Unit I: Artificial Neural Networks **(8 Hrs.)**

Introduction to computing, hard computing-soft computing, AI and Soft computing, ANN as a soft computing technique, Biological neural network, artificial neuron, working of an artificial neural network, network training, validation and testing, standard Back propagation algorithm, introduction of first order, second order and global training algorithms

Unit II: Neural network design and applications **(8 Hrs.)**

Important aspects of artificial network design, types of neural networks, Applications of ANN in temporal and cause effect modeling

Unit III: Genetic programming **(4 Hrs.)**

Introduction to Genetic programming, genetic operators, variants in GP, Algorithm of GP, GP parameters Application of GP in temporal and cause effect modeling

Unit IV: Support Vector Regression and Model Tree **(6 Hrs.)**

Introduction to Support vector machines, Support Vector Regression, basics of SVR, Application of MT in temporal and cause effect modeling. Introduction to Model Tree, M5 Algorithm, Application of MT in temporal and cause effect modeling

Term Work:

Design cause effect model using ANN, GP, SVR and MT for the same problem and comparetheir results. Students will prepare a single report of these four applications.

Text books:

1. Bose, N. K., Liang, P. (1998), "Neural Network Fundamentals with Graphs, Algorithms andApplications", Tata McGraw-Hill Publication.
2. Kosko, B., (1992), "Neural Networks and Fuzzy systems", Prentice Hall, Englewood Cliffs, NJ
3. Wasserman, P.D., (1993), "Advanced methods in neural computing", Van Nostrand Reinhold,New York.

Reference books:

1. Publications in ASCE, Science Direct, Springer, Wiley, IEEE journals and/or similar peer reviewedinternational unpaid journals

Open Elective I
Ethical Hacking (CVPB11206B)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Course Objectives: The course will help students

- To aware legal perspective of cybercrime including Indian IT ACT 2008
- To learn techniques of gathering network information
- To identify security tools including, but not limited to intrusion detection and firewall software
- To learn to perform different kind of attacks

Course Outcomes: By the end of the course, Students will be able to

1. **Use** basics knowledge of network security and hacking
2. **Understand** and **use** the IT Laws as and when required
3. **Gather** required information to perform an attack
4. **Use** various tools and methods for Vulnerability Assessment

Unit I: Introduction to Network and security **(6 Hrs.)**

Basics of Computer Networks: OSI Model, TCP/IP Model, Network topology (Physical & logical), Network Hardware Components: Connectors, Repeaters, hubs, NICs, Bridges and Switches. Basics of Computer Networks Security: Essential Terminology, Elements of Information Security, Types of Hackers, Steps for Ethical hacking, Types of Attacks.

Unit II: Legal Perspective **(6 Hrs.)**

The Indian IT Act, Challenges to Indian law, Cybercrime scenario in India, 2008 amendments to Indian IT Act, Intellectual property in the cyberspace.

Unit III: Information Gathering Techniques **(6 Hrs.)**

Active information gathering, passive information gathering, Trace route, Interacting with DNS Servers, SNMP and SMTP attacks.

Unit IV: Port Scanning and Vulnerability Assessment **(6 Hrs.)**

Target Enumeration and Port Scanning Techniques: Scanning for Open Ports and Services, Typesof Port Scanning, Firewall/IDS Evading Techniques

Vulnerability Assessment: Vulnerability Scanners and How Do They Work, Pros and Cons of a Vulnerability Scanner, Vulnerability Assessment with Nmap, Nessus

Term Work:

Assignments on each unit

Text books:

1. Rafay baloch, "Ethical hacking and Penetration Testing guide", CRC press, 2015, ISBN: 13:978-1-4822-3162-5 (eBook – PDF).
2. Nina Godbole, SunitBelapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY Publications, 2015, ISBN:978-81-265-2179-1

Reference books:

1. Behrouz Fourzon, " Data Communication and Computer Networks", Pearson Education,5th edition ISBN : 978-0070634145.
2. Andrew S. Tanenbaum, " *Computer Networks",* International Economy Edition, 5th edition ISBN: 10:9332518742

Open Elective I
Product Design Engineering (CVPB11206C)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Course Objectives: The course will help students

- To understand basic techniques for particular phases of product development
- To make and manage design teams for product development in a company.

Course Outcomes: By the end of the course, Students will be able to

1. **Describe** an engineering design and development process
2. **Employ** engineering, scientific, and mathematical principles to execute a design from conceptto finished product
3. **Create** 3D solid models of mechanical components from the perspective of aesthetic, ergonomicand functional requirement using CAD software
4. **Work** collaboratively on a team.
5. **Create** new product based on mechanical design engineering.
6. **Investigate** contemporary issues and their impact on provided solution.

Unit I: Introduction to Product Design **(6 Hrs.)**

Characteristics of Successful Product Development, Innovative Thinking, Challenges to Product Development, Product Development Process, Concept Development, Economics – Cost Vs Performance, Design Considerations

Unit II: Product Development Process **(6 Hrs.)**

Product development process- Identification of customer needs- customer requirements, product development process flows. Product specifications and concept generation, concept selection, concept screening, concept testing, reverse engineering, product architecture

Unit III: Product Design Tools **(6 Hrs.)**

Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving (TRIZ), Product function tree, Life cycle analysis, Quality Function Deployment, Competing Product Analysis, SWOT analysis, Failure Mode Effect Analysis.

Unit IV: Design for Manufacture and Assembly **(6 Hrs.)**

Design for assembly, design for disassembly, design for environment, design for graphics and packaging

Term work:

1. Case study on concept development
2. Case study on life cycle analysis
3. Case study on DFMA

Text books:

1. Product Design-Techniques in Reverse Engineering and New Product Development, Kevin Otto, Kristion Wood, Pearson Education, ISBN 978-81-7758-821-7.
2. Karl T.U. And Steven D.E., Product Design and Development, McGraw Hill, Ed 2000.

Reference books:

1. Dieter GE, Engineering Design-Material and Processing Approach, McGraw Hill, Ed 2000

Research Methodology (CVPB11207)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Prerequisite: Basic statistical tools

Course Objectives: The course will help students

- To introduce to the concept of research and research problem
- To understand research ethics
- To get introduced to the concept of Intellectual property rights.
- To understand developments in IPR

Course Outcomes: By the end of the course, Students will be able to

1. **Define** research and **formulate** a research problem
2. **Discuss** the importance of Research Design and Literature Review
3. **Discuss** classification of data and preliminary data analysis
4. **Write** a research proposal to a suitable funding agency

Unit I: Introduction to Research and Research problem **(6 Hrs.)**

Meaning of research, types of research, process of research, Objectives of research, Research and Scientific Method, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, defining a research problem (Real life example or case study), formulation of research hypotheses, Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing -Logic & Importance

Unit II: Research Design and Literature Review **(6 Hrs.)**

Research Design- Concept and Importance in Research, different research designs in research studies, Literature survey- Definition of literature and literature survey, need of literature survey, elements and objectives of literature survey, sources of literature-monographs-patents – web as a source, Critical literature review – Identifying gap areas from literature review and strategies of literature survey, Errors in research.

Unit III: Data and Data Analysis **(6 Hrs.)**

Classification of data, benefits and drawbacks of data, qualitative methods of data collection, types of data analysis, Sampling, sample size, sample design, Testing of hypothesis and Goodness of Fit: Definition of null and alternative hypothesis, student's 't' distribution, Chi-square distribution, F-test, analysis of variance techniques, introduction to non-parametric tests. Regression Analysis – Simple Linear Regression, Multiple linear Regression

Unit IV: Report, Research Proposal and Funding Agencies **(6 Hrs.)**

Need of effective documentation, types of reports and their format. Essentials of a research proposal. Different funding agencies for research. Research briefing, presentation styles, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure, ethical issues.

Term work:

Assignment on each unit.

Text books:

1. Dr. C. R. Kothari, Research Methodology: Methods and Trends', New Age InternationalPublishers.
2. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction
3. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners

Reference books:

1. Deepak Chawla and Neena Sondhi, Research Methodology**:** concepts and cases, Vikas Publishing House Pvt. Ltd. (ISBN 978-81-259-5205-3)
2. Louis Cohen, Manion, Morrison , Research Methods in Education, Routledge (Taylor& Francis Group) /Cambridge University Press India Pvt. Ltd.-ISBN-978-0-415-58336-7
3. Sekaran Uma and Roger Bougie, Research Methods for Business, Wiley, India.

Laboratory I (CVPB11208)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): NA Tutorial (T): NA Practical (P): 4 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	50	NA	50

Course Objectives: The course will help students

- To introduce students independent thinking and exposure to practical considerations.
- To demonstrate course contents by software applications.

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

1. **Analyse** two dimensional problem in Cartesian coordinate system and polar coordinate systems
2. **Analyse** the rectangular plates using Navier solution
3. **Analyse** SDOF system and MDOF system and obtain the response of the system
4. **Compute** the base shear and lateral forces on multi storey buildings
5. **Understand** the philosophy and applications of finite element method in civil engineering.
6. **Solve** engineering problems using Finite Element Analysis

Laboratory I
The oral exam for Laboratory - I should be based on completion of assignments / experimental work / demonstration / review of technical documentaries/review of case studies / research paper review / failure case studies / observations and group discussion on case studies / applications confined to the program core courses: Theory of Elasticity, Dynamics and Earthquake Engineering and Finite Element Analysis.
The file will consist of:
One assignment on each unit; total six assignments based on the content of each of the following courses: Theory of Elasticity, Dynamics and Earthquake Engineering and Finite Element Analysis.

Semester II

F. Y. M. Tech. Semester II
Advanced Design of Concrete Structures (CVPB12201)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Strength of Materials, Analysis of Structures, Design of Structures.

Course Objectives: The course will help students

- To **analyze** and **design** reinforced concrete structural members under specific loading conditions.
- To **analyze** and **design** special concrete structures.

Course Outcomes: By the end of the course, Students will be able to

1. **Design** RC beams subjected to torsion
2. **Design** RC continuous beams with redistribution of moments
3. **Design** RC grid slab and flat slab
4. **Design** RC retaining wall
5. **Design** RC water tank resting on ground
6. **Design** RC bunkers and silos.

Unit I: Design of RC beams subjected to torsion **(6 Hrs.)**

Behavior of R.C. rectangular sections subjected to torsion, Design of sections subjected to combined bending and torsion, combined shear and torsion.

Unit II: Design of RC continuous beams with redistribution of moments **(6 Hrs.)**

Introduction to the concept of redistribution of moments. Provisions in IS code. Design of RC continuous beams with redistribution of moments.

Unit III: Design of floor systems **(6 Hrs.)**

Serviceability criteria: Deflection and crack width. Design of grid slab and flat slabs

Unit IV: Design of earth retaining structures **(6 Hrs.)**

Introduction, functions and types of retaining walls. Analysis and design of RC cantilever type of retaining wall for various types of backfill conditions.

Unit V: Design of water retaining structures **(6 Hrs.)**

Introduction, types, functions of water tank. IS codal provisions, Analysis and design of circular and rectangular water tanks resting on ground.

Unit VI: Design of Bunkers and Silos **(6 Hrs.)**

Design of reinforced concrete bunkers and silos.

Text books:

1. Limit state theory and design of reinforced - Dr. V. L. Shah and Dr S. R. Karve - Structures Publications, Pune

Reference books:

1. Reinforced Concrete Design (Limit State) -A.K. Jain
2. Advanced Reinforced Concrete, Varghese A. V. , Prentice Hall of India
3. Design of design of reinforced Concrete structures- M. L. Gambhir–PHI
4. Advanced Design of Concrete Structures, Krishana Raju N. Tata Mc-Graw Hill, Delhi
5. Limit State Design of Reinforced Concrete, Jain A. K., Nemchand& Bros., Roorkee

IS codes:

1. IS: 456-2000: Indian Standard code of practice for plain and reinforced concrete, BIS, New Delhi.
2. IS: 3370-2016: Indian Standard code of practice for concrete structures for storage of liquids, BIS, New Delhi.

Advanced Design of Steel Structures (CVPB12202)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Structural Analysis-I, Structural Design - I

Course Objectives: The course will help students

1. To **understand** the basic concepts of design of steel structures.
2. To **recognize** the purpose of specific steel structure and **interpret** its behavior under various loads.
3. To **recognize** the behavior of light gauge sections and **design** the same subjected to various loads.
4. To **analyze** and **design** steel structures subjected to various loads based on its application.

Course Outcomes: By the end of the course, Students will be able to

1. **Analyze** and **design** hording structures based on the provisions of Indian Standard Codes.
2. **Analyze** and **design** castellated beams based on the provisions of Indian Standard Codes.
3. **Analyze** and **design** microwave and transmission towers based on the provisions of Indian Standard Codes.
4. **Analyze** and **design** tubular structures based on the provisions of Indian Standard Codes.
5. **Analyze** and **design** cold formed sections based on the provisions of Indian Standard Codes.
6. **Analyze** and **design** gantry girders based on the provisions of Indian Standard Codes.

Unit I: Hoarding Structures **(6 Hrs.)**

Analysis and design of hoarding structures under dead, live and wind load conditions as per codal provisions by limit state method, introduction to fatigue failure.

Unit II: Castellated beams **(6 Hrs.)**

Concept, fabrication of the castellated beam from rolled steel section, design of castellated beam for bending and shear as per codal provisions by limit state method.

Unit III: Microwave and Transmission Towers **(6 Hrs.)**

Introduction, structural configuration, function, analysis and design.

Unit IV: Tubular Structures **(6 Hrs.)**

Design of tubular Trusses and scaffoldings using circular hollow, rectangular hollow sections as per codal provisions, detailing of joints.

Unit V: Cold form light gauge section **(6 Hrs.)**

Type of cross section, stiffened, multiple stiffened and un-stiffened element, flat-width ratio, effective design width, design of light gauge compression, tension and flexural members as per codal provisions.

Unit VI: Design of gantry girder **(6 Hrs.)**

Selection of gantry girder, design of cross section, check for moment capacity, buckling resistance, bi-axial bending, deflection at working load and fatigue strength.

Text books:

1. S K Duggal, Limit state design of steel structures, Tata McGraw Hill Education.
2. Punmia and Jain, Comprehensive Design of steel structure, Laxmi Publication, Delhi.

Reference books:

1. N Subramanian, Design of steel structures, Oxford University Press.
2. Sarwar Alam Raz—Structural Design in Steel---New Age International Publishers

IS Codes:

1. IS: 800 - 2007, Code of Practice for General Construction in Steel, BIS, New Delhi.
2. IS: 800 - 1984, Code of Practice for General Construction in Steel, BIS, New Delhi.
3. IS: 801 - 1975, Code of Practice for use of cold formed light gauge steel structural members in general building construction, BIS, New Delhi.
4. IS 811-1987, Specifications for cold formed light gauge structural steel sections
5. IS 875 (Part 1) – 1987 Code of practice for design loads (other than earthquake) for buildings and structures, Part 1 Dead Load.
6. IS 875 (Part 2) – 1987 Code of practice for design loads (other than earthquake) for buildings and structures, Part 2 Imposed Loads.
7. IS 875 (Part 3) – 2015 Code of practice for design loads (other than earthquake) for buildings and structures, Part 3 Wind Load.

Design of Prestressed Concrete Structures (CVPB12203)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Strength of Materials, Analysis of structures, Design of structures (Basic Concepts).

Course Objectives: The course will help students

- To understand basic concepts, analysis, design, maintenance and rehabilitation of prestressed concrete structures

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

1) **Understand** basic concepts and losses in prestressed concrete
2) **Analyze** and **design** prestressed concrete sections for flexure and shear
3) **Design** pre-tensioned beams with rectangular sections
4) **Design** post tensioned beams of T and I section
5) **Design** pre and post tensioned one way and two way slabs
6) **Understand** maintenance and rehabilitation of prestressed concrete structures

Unit I: Introduction to prestressed concrete **(6 Hrs.)**

Introduction, basic concepts and general principle, materials used, prestressing systems, losses of prestress, Concept of cable profile and cable zone.

Unit II: Analysis and design of prestressed concrete section **(6 Hrs.)**

Concepts of prestressing. Analysis of prestress and bending stresses using stress concept. Resultant stress at a section. Permissible stresses in concrete and steel. Philosophy of limit state design for prestressed concrete members. Flexural and shear strength of a prestressed concrete section.

Unit III: Design of pre-tensioned flexural members **(6 Hrs.)**

Deflections in prestressed concrete members. Design of rectangular pre tensioned beams

Unit IV: Design of post tensioned flexural members **(6 Hrs.)**

Design of T or I section post tensioned simply supported beam for flexure, shear and bearing including end block.

Unit V: Design of prestressed concrete slabs **(6 Hrs.)**

Design of pre-tensioned and post tensioned one way and two way slabs

Unit VI: Maintenance and rehabilitation of prestressed concrete structures **(6 Hrs.)**

General aspects of maintenance and rehabilitation. Inspection of structures. Use of NDT equipment's in the inspection. Cracks in prestressed concrete structures- remedy and repair. Repair and rehabilitation of prestressed concrete structures. Strengthening of prestressed concrete structures.

Text books:

1. Design of Prestressed concrete structures - T. Y. Lin, John Wiley Publishers.
2. Prestressed Concrete- N. Krishna Raju – Tata Mc Graw Hill Publication Co.
3. Prestressed Concrete, S. Ramamrutham, Dhanpat Rai & Sons.

Reference books:

1. Prestressed Concrete, Y.Guyon, Contractors Record Ltd.
2. Prestressed Concrete, R.H.Evans & E.W.Bennette, McGraw Hill Book Co.

IS Codes:

1. IS: 1343-2012: Indian Standard code of practice for Prestressed concrete, BIS, New Delhi.

Program Elective III
Design of Foundation (CVPB12204A)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Geotechnical Engineering, Foundation Engineering, Mechanics of Structures I

Course Objectives: The course will help students

- To analyze and design various foundations
- To introduce knowledge in principles for design of retaining wall.

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

1. **Identify** a suitable foundation system for a structure
2. **Evaluate** the importance of raft foundation and principles of design
3. **Comprehend** the parameters associated with the pile foundation design including lateral loads
4. **Demonstrate** the use of Indian Codes for design of RC cast-in-situ and precast pile and pile cap
5. **Analyse** and design sheet pile system
6. **Analyse** the laterally loaded pile, raft foundation and sheet pile using software tool

Unit I: Soil – Foundation Interaction **(6 Hrs.)**

Foundation objectives and their importance, Classification of foundations, Soil classification. Geotechnical design parameters, bearing capacity, settlements and factors affecting settlement. Loads for design, depth of foundation and depth of soil exploration. Parameters for design of foundation on various types of soil, soil structure interaction.

Unit II: Design of Raft Foundations **(6 Hrs.)**

Types of rafts, Design of Flat slab raft foundation .Design of beam and slab raft foundation.

Unit III: Pile Foundation –I **(6 Hrs.)**

Function and Classification of piles, Concrete piles, Precast and cast-in-situ piles. Static point and skin resistance capacity of a Pile, Pile settlements. Laterally loaded Piles. Various pile group patterns, Efficiency of Pile in group, Negative skin friction.

Unit IV: Pile Foundation –II **(6 Hrs.)**

IS code recommendations for structural design for various piles. Design of RC cast-in-situ and precast pile by IS code method. Pile group analysis by rigid and flexible methods, Design of pile cap.

Unit V: Design of Sheet Pile **(6 Hrs.)**

Earth pressure diagram, determination of depth of embedment in sands and clays, timbering of trenches, Earth pressure diagrams, forces in struts

Unit VI: Software application **(6 Hrs.)**

Software application on laterally loaded pile, raft foundation and sheet pile.

Text books:

1. Kurain N.P, Modern Foundations: Introduction to Advance Techniques: TataMcGraw
2. Kurain N. P, Design of foundation systems Principles and Practice, Narosa Publishing house,New Delhi, 2005
3. Dr. H.J.Shah, Reinforced Concrete, Vol II, Charotar Publishing House
4. Winterkorn H.F. and Fang H.Y. Ed., Foundation Engineering Hand Book, Van-

Reference books:

1. Bowles J.E., Foundation Analysis and Design (4th Ed.), Mc.Graw –Hill, NY, 1996
2. Poulose H.G. and Davis E.H., Pile foundation Analysis and Design, John-Wiley Sons, NY
3. Leonards G. Ed., Foundation Engineering, Mc.Graw-Hill, NY, 1962
4. ShamsherPrakash, Soil Dynamics, McGraw Hill
5. Sreenivasalu and Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill

IS Codes:

1. IS 1904: 1986 Code of practice for design and construction of foundations in soils: generalrequirements (Third Revision)
2. IS 2911: Part 1 : Sec 1 to3 : 1979 Code of practice for design and construction of pilefoundations: Part 1 Concrete piles
3. IS 2911: Part 1: Sec 4 : 1984 Code of practice for design and construction of pile foundations:Part 1 Concrete piles
4. IS 2911: Part 3: 1980 Code of practice for design and construction of pile foundations: Part 3Under-reamed piles
5. IS 2950: Part 1: 1981 Code of Practice for design and construction of raft foundations: Part 1:Design
6. IS 2974: Part 1to 5: 1982 Code of practice for design and construction of machine foundations

Program Elective III
Design of Earthquake Resistant Structures (CVPB12204B)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Structural Dynamics, Earthquake Engineering, Engineering Geology

Course Objectives: The course will help students

- To prepare the students to analyze and design earthquake resistant RCC building

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

1) **Comprehend** characterization of ground motion
2) **Comprehend** the aspects of earthquake resistant building
3) **Compare** the seismic demand and seismic capacity of the structure
4) **Compute** the seismic force using equivalent lateral force method and response spectrum method
5) **Explain** the ductile detailing of RCC beam, column and shear wall
6) **Design** (G+3) RCC building for gravity loads and lateral loads including ductile detailing

Unit I: Engineering Seismology **(6 Hrs.)**

Origin of earthquakes, Classification of earthquakes, Strong motion characteristics, Magnitude and intensity of earthquakes, Characterization of ground motion, Generation of seismic forces and Evaluation of seismic risk

Unit II: Earthquake-Resistant Buildings **(6 Hrs.)**

Basics of Earthquake-Resistant Design and Construction , Basic Aspects of Seismic Design, The Four Virtues of Earthquake Resistant Buildings, Earthquake Demand versus Earthquake Capacity, Force-based Design to Displacement-based Design

Unit III: Structural Systems for Seismic Resistance **(6 Hrs.)**

Lateral force path, Structural behaviour under gravity loads and seismic loads, Requirement of an efficient earthquake resistant structural systems, Estimation of seismic demand and measures to reduce the seismic demand, Estimates of capacity and measures to improve seismic capacity

Unit IV: Computation of Seismic Forces **(6 Hrs.)**

Principal steps involved in the earthquake resistant design of RCC structures as per IS code, Equivalent lateral force procedure, Dynamic analysis procedure, Lateral drift and P-Δ analysis, Load combinations, Effect of soil structure interaction and masonry infill, Irregularities in the building structures

Unit V: Design and Detailing of Reinforced Concrete Building **(6 Hrs.)**

Ductility in R.C. structures, Ductile detailing of Flexure Member, Ductile detailing of column and flexural member subject to Combined Bending and Axial Load, R.C. Shear Walls-Structural behaviour, failure pattern, design and detailing of shear wall

Unit VI: Earthquake Resistant Design of RC buildings **(6 Hrs.)**

Earthquake resistant design of RC buildings – Preliminary data, loading data, analysis of sub-frames, load combinations, design of sub-frames (maximum of 3 storeys).

Text books:

1. "Earthquake Resistant Design of Building Structures", Dr. Vinod Hosur, Wiley Publications
2. "Earthquake Resistant Design of Structures", Agrawal Pankaj & Shrinkhande Manish, Prentice Hall of India Pvt Ltd, New Delhi

Reference books:

1. "Earthquake Tips - Learning Earthquake Design and Construction", Murty, C.V.R., IITK-BMTPC, National Information Center of Earthquake Engineering, IIT Kanpur, India
2. "Dynamics of Structures", Anil K. Chopra, Prentice Hall, India.

IS Codes:

1. IS 1893 (Part1):2016, "Criteria for Earthquake Resistant Design of Structures" Part1 General Provisions and Buildings
2. IS 13920:2016, " Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces-Code of Practice"

Program Elective III
Design of Industrial Structures (CVPB12204C)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Strength of Materials, Structural Analysis, Structural Design

Course Objectives: The course will help students

- To identify the application of basic concepts of design of steel structures.
- To recognize the purpose of specific steel structure and interpret its behavior under various loads.
- To design various steel structures having specific application.

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

1) **Design** welded plate girders.
2) **Design** steel portal, gable frames.
3) **Design** steel bunkers and silos.
4) **Design** chimneys.
5) **Design** water tanks.
6) **Design** pressed steel water tanks.

Unit I: Welded Plate Girder **(6 Hrs.)**

Design of welded plate girder: design of cross section, curtailment of flange plates, stiffeners and connections.

Unit II: Portal Frames **(6 Hrs.)**

Design of portal frame with hinge base, design of portal frame with fixed base - Gable Structures

Unit III: Steel Bunkers and Silos **(6 Hrs.)**

Design of square bunker , Jansen's and Airy's theories, IS Code provisions, Design of side plates, Stiffeners, Hooper, Longitudinal beams, Design of cylindrical silo, Side plates, Ring girder, stiffeners.

Unit IV: Chimneys **(6 Hrs.)**

Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.

Unit V: Water Tanks **(6 Hrs.)**

Design of rectangular riveted steel water tank , Tee covers, Plates, Stays, Longitudinal and transverse beams, Design of staging, Base plates, Foundation and anchor bolts.

Unit VI: Design of pressed steel water tank **(6 Hrs.)**

Design of stays, Joints, Design of hemispherical bottom, water tank, side plates, Bottom plates, joints, Ring girder, Design of staging and foundation.

Reference books:

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
2. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009.

3. Design of Steel Structures, N. Subramaniyan, Oxford University Press, New Delhi.
4. Limit state design of steel structures by S K Duggal, Tata McGraw Hill Education, New Delhi.

IS Codes:

1. IS: 800 - 2007, Code of Practice for General Construction in Steel, BIS, New Delhi.
2. IS: 800 - 1984, Code of Practice for General Construction in Steel, BIS, New Delhi.

Program Elective IV
Design of RCC Bridges (CVPB12205A)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Strength of Materials, Structural Analysis, Structural Design

Course Objectives: The course will help students

- To recognize the purpose of specific type of RC Bridge structure and interpret its behavior under various loads.
- To understand the various types of vehicles and its application on various types of road bridges.

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

1. **Demonstrate** the use of IRC Codes and standards related to design of slab culvert, box culvert and skew bridge
2. **Analyze** and **design** of T-beam bridge using Courbon's method
3. **Analyze** and **design** rigid frame bridge
4. **Understand** the use of bearings and evaluate the forces acting on the abutments and piers
5. **Analyze** and **design** the wing walls of the RC bridges
6. **Recognize** the suitability of the various types of bridge foundations.

Unit I: Introduction to Bridge Engineering **(6 Hrs.)**

Classification and components of bridges, layout, planning. Structural forms of bridge decks, beam and slab decks, cellular decks. Design of slab culvert, box culvert and skew bridge.

Unit II: Design of T-Beam Bridge **(6 Hrs.)**

Introduction to Courbon's method, Henry-Jaegar method and Guyon - Massonet method. Design of T-beam bridge using Courbon's method.

Unit III: Design of Rigid Frame Bridge **(6 Hrs.)**

Structural classification of Rigid Frame bridge, analysis and design of Rigid Frame bridge.

Unit IV: Bearings **(6 Hrs.)**

Classification and design of bearings. Expansion joints. Forces acting on abutments and piers.

Unit V: Wing walls **(6 Hrs.)**

Analysis and design, types and design of wing walls.

Unit VI: Design of Bridge Foundations **(6 Hrs.)**

Bridge foundations introduction, design of open well, pile and caisson foundation.

Text books:

1. T.R. Jagadeesh, M.A. Jayaram - Design of Bridge Structures, Prentice-Hall of India
2. N. Krishna Raju - Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
3. David Lee – Bridge Bearings and Expansion Joints,E & FN Spon
4. Nainan P. Kurian – Design of Foundation Systems, Narosa Publishing House

Reference books:

1. D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
2. V.K. Raina – Concrete Bridge Practice Analysis, design and Economics, Tata McGraw Hill
3. Joseph E. Bowles – Foundation Analysis and Design, McGraw-Hill International Edition

IS Codes:

1. IRC Codes – IRC: 5, IRC: 6, IRC -21, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83

Program Elective IV
Design of Composite Structures (CVPB12205B)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Strength of Materials, Theory of Elasticity

Course Objectives: The course will help students

- To **understand** the basic concepts of composite constructions.
- To **interpret** behavior composite structures under various loads.
- To **analyse** various composite structural components subjected to various loads using different codal provisions.
- To **design** various composite structural elements having specific application.

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

1) **Understand** composite constructions **and demonstrate** the use of different Codes and standards related to design of composite structures.
2) **Design** of composite beams as per Indian Standard provisions.
3) **Design** of composite floors as per Indian Standard provisions.
4) **Design** of composite columns as per Indian Standard provisions.
5) **Design** of multistoried commercial and residential composite buildings.
6) **Demonstrate** software applications for the design of composite structures.

Unit I: Concept of composite construction **(6 Hrs.)**

Introduction of Composite Constructions. Benefits of Composite Construction, Introduction to IS, BS and Euro codal provisions.

Unit II: : Composite Beams **(6 Hrs.)**

Composite beams, elastic behaviour of composite beams, No and Full Interaction cases, Shear Connectors, Ultimate load behaviour, Serviceability limits, Effective breadth of flange, Interaction between shear and moment.

Unit III: Composite Floors **(6 Hrs.)**

Basic design consideration and design of composite beams. Composite floors, Structural elements, Profiled sheet decking, Bending resistance, Serviceability criterion, Analysis for internal forces and moments.

Unit IV: Composite Columns **(6 Hrs.)**

Composite Columns, Materials, Concrete filled circular tubular sections, Non-dimensional slenderness, local buckling of steel sections, Effective elastic flexible stiffness, resistance of members to axial compressions, Composite Column design, Fire Resistance.

Unit V: Multi-storeyed commercial and residential composite building **(6 Hrs.)**

Design of Multi-storeyed commercial and residential composite building, Design basis, load calculations, Design of composite slabs with profile decks, composite beam design, design for compression members, vertical cross bracings, design of foundation.

Unit VI: Software application **(6 Hrs.)**

Use of suitable software illustrating design of various composite structural components using different codes.

Text books:

1. Composite Structures of Steel and Concrete: Beams, Slabs Columns and Frames for Buildings, 3ed Johnson, -Wiley India.
2. INSDAG teaching resources for structural steel design Vol – 2, Institute for Steel Development and Growth Publishers, Calcutta

Reference books:

1. Johnson R. P. – Composite Structures of Steel and Concrete, Vol I, Beams, Columns and Frames in Buildings, Oxford Blackwell Scientific Publications.
2. INSDAG Handbook on Composite Construction – Multi-Storey Buildings, Institute for Steel Development and Growth Publishers, Calcutta.

Reference books:

IS: 11384, 1985 Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi.

Program Elective IV
Retrofitting and Strengthening of RC Structures (CVPB12205C)

Teaching Scheme	**Examination Scheme**						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course Objectives: The course will help students

- To **understand** causes of deterioration, and evaluation, repair, retrofitting, strengthening and maintenance of RC structures

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

1) **Understand** causes of deterioration and need for repair, rehabilitation and strengthening of RC structures
2) **Evaluate** condition of existing RC structures using in situ and NDT methods
3) **Study** materials used and their compatibility with old surfaces in repair, rehabilitation and strengthening of RC structures
4) **Study** different techniques used in strengthening of RC members
5) **Understand** design process of strengthening of degraded beams, slabs, columns, footings.
6) **Understand** maintenance of RC structures

Unit I: Introduction to rehabilitation and strengthening of RC structures (6 Hrs.)

Needs for repair, rehabilitation and strengthening of RC structures; Degradation of RC structures: major causes and signs; cracking type, causes and characteristics

Unit II: Evaluation of existing RC Structures (6 Hrs.)

Preliminary investigation: scope, methodology and output; Detailed investigation-scope and methodology, In situ and laboratory testing such as nondestructive, semi destructive, corrosion test, chemical test and NDT for cracks, flaws and voids in concrete.

Unit III: Materials for retrofitting and strengthening (6 Hrs.)

Materials, their physical and chemical properties, used in retrofitting and strengthening of RC structures: cement base, polymer modified, resin base, micro concrete and composites; compatibility of old and new materials

Unit IV: Strengthening techniques (6 Hrs.)

Strengthening techniques-section enlargement, composite construction, post tensioning, stress reduction, strengthening by reinforcement, is strengthening using composites.

Unit V: Design of strengthening of RC members (6 Hrs.)

Strengthening of RC elements such as beams, slabs, columns, footings due to degradation: degradation due to aging, corrosion, earthquake, fire, blast; and change in use.

Unit VI: Maintenance of RC structures (6 Hrs.)

Quality control in concrete construction, maintenance, water leakage-detection and mitigation, fire damage-detection and reparation, corrosion-detection and mitigation, demolition of concrete structures and structural health monitoring.

Text books:

1. Concrete Repair and Maintenance, P. H. Emmons and G M Sabnis, Galgotia Publication.
2. Maintenance, Repair & Rehabilitation & Minor Works of Building, by P C Varghese, PHI
3. Concrete Repair and Maintenance, P. H. Emmons and G M Sabnis, Galgotia Publication.

Reference books:

1. Repairs and Rehabilitation – Compilation from Indian Concrete Journals
2. Management of Deteriorating Concrete Structures, George Somerville, Taylor and Francis, Publication.
3. ACI 440.2R-08, Guide for the design and construction of externally bonded FRP systems for strengthening concrete structures, American Concrete Institute.
4. Strengthening and Rehabilitation of Civil Infrastructures Using Fibre-Reinforced Polymer (FRP) Composites, L. C. Hollaway and J.G. Teng, Woodhead Publishing Series in Civil and Structural Engineering
5. Xilin lu (2010), Retrofitting design of building structures, Science Press, New York.
6. Durability of Cement and Cement Composites, C. L. Page, M M Page, Wood Head, Publishing.

Open Elective II
Project Planning and Management (IOEP12206A)

Teaching Scheme	Examination Scheme						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Prerequisite: Basic understanding of Project Management at UG level

Course Objectives: The course will help students

- To impart knowledge of project life cycle.
- To introduce students to Project Identification Process, Project Initiation, Pre-Feasibility Studyand Project feasibility Studies,
- To construct CPM, PERT network for a project.
- To introduce students to Steps in Risk Management, Risk Identification, Risk Analysis andReducing Risks
- To introduce students to process of project Performance Measurement, Evaluation and closeout.

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

1. **Understand** principles of Project Management and phases of project life
2. **Understand** the Project Identification Process, Project Initiation, Pre-Feasibility Study and Projectfeasibility Studies,
3. **Construct** CPM, PERT network for a project.
4. **Understand** the process of project Performance Measurement, Evaluation and closeout.

Unit I: Basics of Project Management **(6 Hrs.)**

Introduction, Need, Project Management Knowledge Areas and Processes, Concept of OrganizationalStructure and types, The Project Life Cycle (preferably with case study), Essentials Project Management Principles.

Unit II: Project Identification and Selection **(6 Hrs.)**

Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. Case study is preferred.

Unit III: Project Planning **(6 Hrs.)**

Introduction, Need for Project Planning, Work Breakdown Structure (WBS), LOB, CPM and PERT,Network Cost System, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, concept of Project Risk Management

Unit IV: Project Performance Measurement, Evaluation and closeout **(6 Hrs.)**

Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects. Project Close-out, Steps for Closing the Project, Project Termination, and Project Follow-up. Case study is preferred.

Students are encouraged to register for On-line course in the relevant above course approved by authority.

Term Work:

Assignments for all units

Text books:

1. Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014)
2. Project Management – K Nagrajan – New age International Ltd.
3. Project Management – Ahuja H.N. – John Wiely, New York.
4. Project Management-Planning and Control---Rory Burkey 4th ed.—Wiley,India.

Open Elective II

Blockchain Technologies (IOEP12206B)

Teaching Scheme	Examination Scheme						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Prerequisite: Knowledge of programming language and script language

Course Objectives: The course will help students

- To introduce fundamentals of Blockchain
- To explain Bitcoin Blockchain
- To explain Ethereum Architecture & Components
- To discuss Emerging Trends in Blockchain and Use cases

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

1. **Explain** fundamental knowledge of Blockchain (Understand)
2. **Illustrate** Bitcoin Blockchain (Understand)
3. **Summarize** Ethereum Architecture & Components (Understand)
4. **Explore** emerging trends in Blockchain and Use cases (Understand)

Unit I: Overview of Blockchain **(6 Hrs.)**

Introduction to Blockchain, History of Blockchain, Network and protocols, Smart Contract and Consensus
Algorithms, Blockchain users and adoption, Blockchain challenges

Unit II: Bitcoin Blockchain **(6 Hrs.)**

Blockchain TOC Bitcoin/Blockchain data structures, Keys as Identity, Digital Signatures, Hashes, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain transactions, Blockchain block structure

Unit III: Ethereum Architecture & Components **(6 Hrs.)**

Evolution of Ethereum, Ethereum Components, Ethereum Virtual Machine, Types of Transactions, Solidity language, Ethereum Smart Contracts, Tokenization, Dapps.

Unit IV: Emerging Trends in Blockchain and Use cases **(6 Hrs.)**

Introduction of Hyperledger, Corda, Ripple, R3. Blockchain and cloud computing, Blockchain and Artificial Intelligence, Blockchain use cases in Health Care, Banking, Government Sector, Supply Chain Management, Identity Management, etc.

Term work:

Case study on various Crypto currencies.
Case study on various Blockchain Platforms.

Text books:

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Mastering Ethereum Building Smart Contracts and DApps, Andreas M. Antonopoulos, Gavin Wood, O'Reilly
4. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric

Reference books:

1. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits
2. Etherium Yellow Paper : "Ethereum: A Secure Decentralised Generalised TransactionLedger Petersburg", Dr. Gavin Wood

Open Elective II
Data Science for Engineers (IOEP12206C)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Prerequisites: Basic mathematics

Course Objectives: The course will help students

- To introduce the mathematical foundation.
- To introduce data science algorithms and data analytics.
- To introduce a practical capstone case study.

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

1. **Describe** a flow process for data science problems.
2. **Classify** data science problems.
3. **Correlate** results to the solutions.
4. **Construct** use cases to validate approach.

Unit I: Linear Algebra Basics **(6 Hrs.)**

Linear algebra for data science, Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse), Geometric view - vectors, distance, projections, eigenvalue decomposition.

Unit II: Statistics and Optimization **(6 Hrs.)**

Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates) and Optimization.

Unit III: Linear regression **(6 Hrs.)**

Typology of data science problems and a solution framework, Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection.

Unit IV: Classification techniques **(6 Hrs.)**

Classification using logistic regression, Classification using kNN and k-means clustering.

Term work: Assignment on each unit will be given by the course teacher.

Text books:

1. Gilbert Strang, "Introduction to Linear Algebra," 2nd Ed., Wellesley-Cambridge Press.

Reference books:

1. Douglas Montgomery and George Runger "Applied Statistic and Probability for engineers," 6th Ed., Wiley.

Open Elective II
Intellectual Property Rights (CVPB12207)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): 2 hrs./week Tutorial (T): NA Practical (P): NA	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	NA	50	50

Prerequisite: NA

Course Objectives: The course will help students to

- Explain the importance of ideas, concept and creativity
- Transfer the knowledge about the IPR required for Engineer's
- Describe the how IPR creates National wealth
- Teach National and International IP System

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

1. **Explain** property and Intellectual property their nature, importance and objectives. (Understand)
2. **Discuss** types of IPR: Patents, Designs, Trademarks (Registered and unregistered trademarks),Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting
3. **Understand** the process of patenting, development and International scenario: WIPO, TRIPs
4. **Explain** administration of patent system.

Unit I: Introduction to the concepts Property and Intellectual Property **(6 Hrs.)**

Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives of understanding Intellectual Property Rights, IPR and IITs

Unit II: Intellectual Property Rights **(6 Hrs.)**

Understanding the types of Intellectual Property: - Patents, Designs, Trademarks (Registered and unregistered trademarks), Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting, (Case Studies)

Unit III: New Developments in IPR **(6 Hrs.)**

New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development, understanding of IPR issues in cyber world, International Scenario: WIPO, TRIPs, Indian Patent Office

Unit IV: Administration of Patent System **(6 Hrs.)**

Administration of Patent System – Patenting under Indian Patent Act, Patenting under PCT, Patent Rightsand its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non-Provisional Patent Application and Specification.

Term work:

Assignment on each unit.

Text books:

1. Resisting Intellectual Property by Halbert, Taylor & Francis Ltd ,2007
2. Industrial Design by Mayall, Mc Graw Hill

3. Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley
Reference books:
1. Intellectual Property Rights under WTO by T. Ramappa, S. Chand Introduction to Design by Asimov, Prentice Hall

Laboratory II (CVPB12208)

Teaching Scheme	**Examination Scheme**						
Credits: 2 Lecture (L): NA Tutorial (T): NA Practical (P): 4 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	NA	NA	NA	NA	50	NA	50

Course Objectives: The course will help students

- To introduce students independent thinking and exposure to practical considerations.
- To demonstrate course contents by software applications.

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

1. **Analyse** and **design** reinforced concrete structural members under specific loading conditions.
2. **Analyse** and **design** special concrete structures.
3. **Demonstrate** use of suitable software for analysis and design of hoarding structure, tower structure.
4. **Design** hoarding structures, castellated beams, tubular structures, tower structures and gantry girders
5. **Analyse** and **design** prestressed concrete slabs and beams.
6. **Understand** maintenance and rehabilitation of prestressed concrete structures.

Laboratory II
The oral exam for Laboratory - II should be based on completion of assignments / experimental work / demonstration / review of technical documentaries/review of case studies / research paper review / failure case studies / observations and group discussion on case studies / applications confined to the program core courses Advanced Design of Concrete Structures, Advanced Design of Steel Structures and Design of Prestressed Concrete Structures.
The file will consist of:
One assignment on each unit; total six assignments based on the content of each of the following courses: Advanced Design of Concrete Structures, Advanced Design of Steel Structures and Design of Prestressed Concrete Structures.