Annexure-II(b) Back

COURSE STRUCTURE PROPOSED FOR M.Tech (Structural Engineering)

(From 2021 – 2022 Admitted Batch) – V21 Regulation

I SEMESTER

S.No	Course Code	Course Name	L	T	P	C
1	V21STET01	Theory of Elasticity	3	0	0	3
2	V21STET02	Structural Dynamics	3	0	0	3
3	V21STET03 V21MAT01 V21STET04	Elective I 1. Matrix Analysis of Structures 2. Analytical & Numerical Methods for Structural Engineering (Bos of Maths) 3. Design of RCC Foundations	3	0	0	3
4	V21STET05 V21STET06 V21STET07	Elective II 1. Bridge Engineering 2. Repair and Rehabilitation of Structures 3. Structural Optimization	3	0	0	3
5	V21STET08	Advanced Concrete Technology	2	0	0	2
6	V21STEL01	Advanced Concrete Technology Laboratory	0	0	4	2
7	V21STEL02	Advanced Structural Engineering Laboratory	0	0	4	2
8		Audit Course -1	2	0	0	0
Total			16	0	8	18

Total Contact Hours : 24
Total Credits : 18

II SEMESTER

S.No	Course Code	Course Name	L	T	P	C
1	V21STET09	Finite Element Methods in Structural Engineering	3	0	0	3
2	V21STET10	Stability of Structures	3	0	0	3
3	V21STET11 V21STET12 V21STET13	Elective III 1. Theory of Plates and Shells 2. Advanced Steel Design 3. Analysis of Offshore Structures	3	0	0	3
4	V21STET14 V21STET15 V21STET16	Elective IV 1. Earthquake Resistant Design ofBuildings 2. Precast and Prefabricated Structures 3. Earth Retaining Structures	3	0	0	3
5	V21STET17	Advanced Reinforced Concrete Design	2	0	0	2
6	V21STEL03	Structural Design laboratory	0	0	4	2
7	V21STEP01	Mini Project With Seminar	0	0	4	2
8		Audit Course -2	2	0	0	0
Total			16	0	8	18

Total Contact Hours : 24
Total Credits : 18

Audit course 1 & 2

1. English for Research Paper Writing - V21PGENT54(BOS English)
2. Disaster Management (BOS of CIVIL) - V21STEAC1
3. Value Education (BOS English) - V21PGENT55
4. Constitution of India (BOS English) - V21PGENT56
5. Pedagogy Studies (BOS English) - V21PGENT51
6. Personality Development through Life Enlightenment Skills (BOS English) - V21PGENT52
7. Stress Management by Yoga - V21PGENT53

III SEMESTER

S.No	Course Code	Course Name	L	T	P	C
1	V21STET18 V21STET19 V21STET20	Elective III/ MOOCS*/NPTEL* 1. Design of Prestressed Concrete Structures 2. Structural Health Monitoring 3. Industrial Structures 4. MOOCS-1 through NPTEL/SWAYAM 12 Week Programme related to the programme which is not listed in the course structure	3	0	0	3
2	V21MAT02 V21MBT56	Open Elective / MOOCS*/NPTEL* 1. Operational Research (BOS of Maths) 2. Cost Management for Engineering Projects (BOS of MBA) 3. MOOCS-2 through NPTEL/SWAYAM 12 Week Programme related to the programme which is not listed in the course structure	3	0	0	3
3	V21STEP02	Project Phase I	0	0	20	1 0
Total			6	0	20	16

Total Contact Hours: 26
Total Credits : 16

IV SEMESTER

S.No	Course Code	Course Name	L	T	P	C
1	V21STEP03	Project Phase II	0	0	32	16
Total			0	0	32	16

Total Contact Hours: 32
Total Credits : 16

SYLLABI PROPOSED FOR M.Tech

(Structural Engineering)

I SEMESTER – SYLLABUS

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation / Year	V21 / 2021-2022	3	0	0	3	V21STET01
Name of the Course	THEORY OF ELASTICITY					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Relate the stress and deformation and how to determine the components of the stress and strain tensors (K3)
- Apply the conditions of compatibility and equations of equilibrium (K3)
- Employ the mechanical characteristics of materials, constitutive equations and generalized Hook law (K3)
- Use the equilibrium equations stated by the displacements and compatibility conditions stated by stresses (K3)
- Develop index notation of equations, tensor and matrix notation and define state of plane stress, state of plane strain (K3)

SYLLABUS

UNIT I

Elasticity – Notation for forces and stresses – components of stresses and strains – Hooke's Law - Plane Stress – Plane strain – Differential Equations of equilibrium – Boundary conditions – Compatibility equations Stress function – Boundary Conditions.

UNIT II

Two dimensional problems in rectangular co-ordinates – Solution by polynomials – Saint Venant's principle – Determination of displacements – Bending of simple beams – Application of Fourier series for two dimensional problems for gravity loading.

UNIT III

Two dimensional problems in polar coordinates - General equations in polar coordinates – Stress distribution for problems having symmetrical about an axis - Strain components in polar co-ordinates– Displacements for symmetrical stress distributions - Stresses for plates with circular holes subjected to far field tension – stress concentration factor.

UNIT IV

Analysis of stress and strain in three dimension - Principal stresses – Stress ellipsoid and stress director surface – Determination of principal stresses - Maximum shear stress – Homogeneous Deformation – General Theorems - Differential equations of equilibrium – Conditions of compatibility– Equations of equilibrium in terms of displacements – Principle of superposition – Uniqueness of solution –Reciprocal theorem.

UNIT V

Torsion of Prismatic bars – Bars with elliptical cross section – Other elementary solution – Membrane analogy – Torsion of rectangular bars – Solution of Torsional problems by energy method.

Text Books:

1. 1.Theory of Elasticity- Stephen Timoshenko & J. N. Goodier, Mc.Grawhill Publishers
2. Advanced Mechanics of Solids L.S. Srinath, McGraw Hill Publishers
3. Theory of Elasticity By A.I. Lurie

References:

1. Elasticity: Theory, Applications and Numeric Martin H. Sadd, Wiley Publishers
2. Theory of Elasticity -Sadhu Singh 3rd Edition, Khanna Publishers.
3. An Introduction to the Theory of Elasticity
4. By R. J. Atkin, N. Fox · 2005, Dover Publications

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET02

Name of the Course	STRUCTURAL DYNAMICS
Branch	STRUCTURAL ENGINEERING

Course Outcomes:

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

- Asses the behavior of structures subjected to dynamic loads Harmonic excitation and earthquake load(K3)
- Demonstrate the behavior and response of SDOF structures with various dynamic loading. (K3)
- Illustrate the response of structural systems to dynamic loads and Realize the behavior and response of linear and nonlinear SDOF and MDOF structures with various dynamic loading. (K3)
- Develop the ability to find out suitable solution for continuous system of various beams with different end conditions. (K3)
- Interpret the analysis of building subject to earthquake by various methods. (K3)

SYLLABUS

UNIT I

Theory of vibrations: Introduction - Elements of vibratory system - Degrees of Freedom - Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Victorian representation of S.H.M. - Free vibrations of single degree of freedom system - undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation - Vibration Isolation -Dynamic magnification factor – Phase angle.

UNIT II

Introduction to Structural Dynamics: Fundamental objectives of dynamic analysis -Types of prescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's Principle, Principle of virtual work and Hamilton principle.

Single Degree of Freedom Systems : Formulation and solution of the equation of motion – Free vibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

UNIT III

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

UNIT IV

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

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

UNIT V

Introduction to Earthquake Analysis: Deterministic Earthquake Response: Systems on Rigid Foundations -Types of Earthquake Excitations – Lumped SDOF Elastic Systems, Translational Excitations -Generalized coordinate - SDOF Elastic Systems, Translational Excitations, Linear Static Method – Analysis for obtaining response of multi storied RC Building.

Text Books:

1. Structural Dynamics Anil K Chopra, 4edition, Prentice Hall Publishers
2. Structural Dynamics Theory & Computation – Mario Paz, CBS Publishes and Distributors
3. Elementary Structural Dynamics- V.K. Manika Selvam, Dhanpat Rai Publishers

References:

1. Dynamics of Structures by Clough & Penzien 3e, Computers & Structures Inc.
2. Theory of Vibration -William T Thomson, Springer Science.
3. Mechanical Vibrations- S. S. Rao, 5e, Pearson Publications.
4. Structural Dynamics of Earthquake Engineering - Theory and Application using Mathematica and Matlab- S. Rajasekharan.

Year/Sem	**I Sem**	**L**	**T**	**P**	**C**	**COURSE CODE**
Regulation	V21	3	0	0	3	V21STET03
Name of the Course	**MATRIX ANALYSIS OF STRUCTURES**					

Branch	STRUCTURAL ENGINEERING

Course Outcomes:

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

- Assess the structural analysis of determinate and indeterminate structures using classical compatibility methods, such as method of consistent displacements, force and equilibrium Methods (K3)
- Solve multiple degree of freedom two- and three-dimensional problems involving trusses, beams, frames and plane stress (K3)
- Asses the analysis of grid element by stiffness method (K3)
- Discuss the band width, loads at joints and their support displacement (K2)
- Complete analysis of plane frames with and without side sway by various approaches. (K3)

SYLLABUS

UNIT I

Introduction of matrix methods of analysis – Static and kinematic indeterminacy – Degree of freedom– Structure idealization-stiffness and flexibility methods – Suitability: Element stiffness matrix for truss element, beam element and Torsional element- Element force -displacement equations.

UNIT II

Stiffness method – Element and global stiffness equation – coordinate transformation and global assembly – structure stiffness matrix equation – analysis of simple pin jointed trusses – continuous beams – rigid jointed plane frames

UNIT III

Stiffness method for Grid elements – development of stiffness matrix – coordinate transformation. Examples of grid problems – tapered and curved beams

UNIT IV

Additional topics in stiffness methods – discussion of band width – semi band width – static condensation – sub structuring –Loads between joints- Support displacements- inertial and thermal stresses-Beams on elastic foundation by stiffness method.

UNIT V

Analysis of plane frame - continuous beams with and without settlement - plane frame including side sway single storey, single – bay and gable frame by flexibility method using system approach.

Text Books:

1. Matrix analysis of structures, Robert E Sennet- Prentice Hall- Englewood cliffs,New Jercy.
2. Advanced structural analysis, P. Dayaratnam, Tata McGraw hill publishing company limited.
3. Structural Analysis Matrix Approach - Pandit and Gupta, Mc Graw Hill Education

References:

1. Indeterminate Structural analysis, C.K Wang, Amazon Publications
2. Analysis of Tall buildings by force – displacement – Method M. Smolira Mc. Graw Hill.
3. Foundation Analysis and design, J.E. Bowls, Amazon Publications.
4. Matrix Analysis of Framed Structures -William Weaver, Jr.James M. Gere, Van Nostrand Reinhold, Newyork.
5. Matrix Methods of Structural Analysis Madhu B.Kanchi, Wiley Publications.
6. Indeterminate Structural Analysis by K. U. Muthu, IK International Publishing house.

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21MAT01
Name of the Course	**ANALYTICAL& NUMERICAL METHODS FOR STRUCTURAL ENGINEERING**					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Calculate of Laplace transform methods on heat conduction problems (K3)
- Apply the principles and techniques of Elliptic Equations-Laplace equation (K3)
- Develop the principles and techniques of Integral Equations (K3)
- Adopt the principles and techniques of Finite Difference and their Applications (K3)
- Apply the principles and techniques of Numerical Integration (K3)

SYLLABUS

UNIT I

Transform Methods- Laplace transform methods for one-dimensional wave equation - Displacements in a long string - Longitudinal vibration of an elastic bar - Fourier transforms methods for one-dimensional heat conduction problems in infinite and semi-infinite rod

UNIT II

Elliptic Equations-Laplace equation - Properties of harmonic functions - Fourier transform methods for Laplace equation-Calculus Of Variations- Variation and its properties - Euler's equation - Functionals dependent on first and higher order derivatives - Functionals dependent on functions of several independent variables - Some applications - Direct methods - Ritz and Kantorovich methods

UNIT III

Integral Equations- Fredholm and Volterra integral equations - Relation between differential and integral equations - Green's function -Fredholm equation with separable kernel - Iterative method for solving equations of second kind

UNIT IV

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

UNIT V

Numerical Differentiation: Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation.

Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method – New Marks Method and Application to Beams – Calculations of Slopes & Deflections.

Textbooks:

1. Introduction to Partial Differential Equations, Sankar Rao. K, PHI, New Delhi, 1995
2. Numerical Methods For Scientific and Engineering Computations. M. K. Jain- S. R. K. Iyengar – R. K. Jain, New Age International (p) Ltd., Publishers.
3. Numerical Methods for Engineering Problems N. Krishna Raju, K.U. Muthu Macmillan Publishers

References:

1. Differential Equations and Calculus of Variations Elsgolts. L, Mir Publishers, Moscow, 1966
2. Fundamentals of Mathematical Statistics Gupta. S.C, & Kapoor. V.K, Sultan Chand & Sons, Reprint 1999.
3. Higher Engineering Maths for Engg. And Sciences Venkataraman. M. K, National Publishing Company, Chennai
4. Elements of Partial Differential Equations, Sneddon. I.N, Mc Graw Hill, 1986
5. Computer based numerical analysis by Dr. M. Shanta Kumar, Khanna Book publishers New Delhi

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET04
Name of the Course	DESIGN OF RCC FOUNDATIONS (Elective-I)					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Attain the perception of site investigation to select suitable type of foundation based on soil category (K3)
- Capable of ensuring design concepts of shallow foundation (K3)
- Can be efficient in selecting suitable type of pile for different soil stratum and in evaluation of group capacity by formulation (K3)
- Design different types of well foundation (K3)
- Explain the properties of soil and mechanism of suitable foundation (K3)

SYLLABUS

UNIT I

Foundation Structures & Design of Centrally Loaded Isolated Footings and Column Pedestals – Introduction, Rigid and Flexible Foundations, Loads and their Effects, Design Requirements, Geotechnical Design, Empirical and Exact Methods of Analysis of foundations, Design Loads for Foundations, Recommended Approach to Structural Design of Foundations**.**

Introduction, General Procedure for Design, Design of Square Footing of Uniform Depth (Pad Footing), Design of sloped Rectangular Footings, Design Procedure, Detailing of Steel, Design of Rectangular Pad Footings, Design of Plain Concrete Footings, Design of Pedestals, Design Calculation for Pedestals.

UNIT II

Wall Footings – Introduction Simple Plain Concrete Wall Footings, Reinforced Concrete Continuous Strip Wall Footings, Design of continuous Strip Wall Footings, Design for Longitudinal Steel, R.C. T Beam Footings in Shrinkable Soils, Foundations of Partition Wall in Ground Floors, Summary.

Strip Footings Under Several Columns – Introduction, Design Procedure for Equally loaded and Equally Spaced Columns, Analysis of Continuous Strip

Footing for Unsymmetrical Loading, Analysis of Strip Footing with Unsymmetrical Loads, Detailing of Members.

UNIT III

Raft Foundations – Introduction, Rigid and Flexible Foundations, common Types of Rafts, Deflection Requirements of Beams and Slabs in Rafts, General considerations in Design of Rigid Rafts, Types of Loadings and Choice of Rafts, Record of Contact Pressures Measured Under Rafts, Modern Theoretical Analysis.

Design of Flat Slab Rafts-Mat Foundations – Introduction, Components of Flat Slabs, Preliminary Planning of Flat Slab Rafts, Analysis of Flat Slab by Direct Design Method, Method of Analysis, Values for Longitudinal Distribution and Transverse, Redistribution, Shear in Flat Slabs, Bending of Columns in flat Slabs, Limitations of Direct Design Method for Mats, Detailing of Steel, Design of Edge Beam in Flat Slabs.

Beam and Slab Rafts – Introduction, Planning of the Raft, Action of the Raft, Approximate Dimensioning of the Raft, Design of the Beam and Slab Raft under Uniform Pressure, Structural Analysis for the Main Slab, Design of Secondary and Main Beams, Analysis by Winkler Model, Detailing of Steel.

UNIT IV

Combined Piled Raft Foundations (CPRF) – Introduction, Types and uses of Piled Rafts, , Interaction of Pile and Raft, Ultimate Capacity and Settlement of Piles, Estimation of Settlement of Raft in Soils, Allowable Maximum and Differential Settlement in Buildings, Design of CPRF System, conceptual Method of Design, Conceptual Method of Analysis, Distribution of Piles in the Rafts, Theoretical Methods of Analysis.

Circular and Annular Rafts – Introduction, Positioning of chimney Load on Annular Raft, Forces Acting on Annular Rafts, Pressures Under Dead Load and Moment, Methods of Analysis, Conventional Analysis of Annular Rafts, Analysis of Ring Beams Under circular Layout of Columns, Analysis of Ring Beam Transmitting Column Load to Annular Rafts, Detailing of Annular Raft Under Columns of a Circular Water Tank.

UNIT V

Under-reamed Pile Foundations – Introduction, Safe Loads on Under-reamed Piles, Design of Under-reamed Pile Foundation for Load Bearing Walls of Buildings, Design of Grade Beams, Design of Under-reamed Piles Under Columns of Buildings, Use of Under-reamed Piles for Expansive Soils.

Design of cantilever and Basement Retaining Walls – Introduction, Earth Pressure and Rigid Walls, Calculation of Earth Pressure on Retaining Walls, Design of Rigid Walls, Design of Ordinary R.C. cantilever Walls, Design of cantilever Walls without Toe, Design of Basement Walls, Calculation of Earth Pressures in Clays, Design of Free Standing Basement Walls.

Text Books:

1. Design of Reinforced Concrete Foundations by P. C Varghese, PHI Learning Private Limited., New Delhi.
2. Krishnaraju.N " Design of Reinforced Concrete Structurres", CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3. Design of Reinforced Concrete Structures by N. Subramaniam- Oxford University.

References:

1. Reinforced Concrete Design by Unnikrishna Pillai and Devdas Menon, Tata Mc Graw Hill.
2. Ramachandra, "Limit state Design of Concrete Structures" Standard Book House, New Delhi.
3. IS 456 (2000): Plain and Reinforced Concrete - Code of Practice.

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET05
Name of the Course	**BRIDGE ENGINEERING**					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Illustrate the different types of loads and stresses acting on various bridges (K3)
- Asses the various methodologies to analyses the bridges and also interpret the specifications of bridge super structure (K3)
- Demonstrate the box culverts and its design (K3)
- Develop the knowledge on design of plate girder bridges (K3)
- Illustrate the different types of bearings, abutments, piers and various types of foundations for Bridges (K3)

SYLLABUS

UNIT I

Concrete Bridges: Introduction-Types of Bridges-Economic span length-Types of loading-Dead load-live load-Impact Effect-Centrifugal force-wind loads-Lateral loads-Longitudinal forces- Seismic loads- Frictional resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Width of roadway and footway-General Design Requirements.

UNIT II

Design of Girders & Slabs: Pigeaud's Method Design of longitudinal girders-Guyon-Messonet method- Hendry Jaegar method- Courbon's theory. (Ref: IRC-21), voided slabs.

Super Structure: Slab bridge- Wheel load on slab- effective width method-slabs supported on two edges- cantilever slabs- dispersion length- Design of interior panel of slab- T-Beam bridges.

UNIT III

Box Culverts: Single Cell Box Culvert – Design Loads, Design Moments, Shears and Thrusts. Design of Critical sections.

UNIT IV

Plate Girder Bridges: Elements of plate girder and their design-web-flange-intermediate stiffener- vertical stiffeners- bearing stiffener-design problem

UNIT V

Sub structure: Abutments- Stability analysis of abutments- piers- loads on piers – Analysis of piers- Design problem(Ref: IRC-13, IRC-21, IRC-78)- Pipe culvert- Flow pattern in pipe culvers- culvert alignment-culvert entrance structure- Hydraulic design and structural design of pipe culverts-reinforcements in pipes .(Ref: IRC: SP-13)

Text Books:

1. 1.Design of Bridges by N. Krishna Raju CBS Publishers and Distributors
2. Bridge Engineering by S. Ponnuswamy, Mc Grawhill Publications
3. 3.Essentials of Bridge Engineering- Jhonson Victor D, 7e, Oxford IBH Publications

References:

1. Bridge Deck Behavior- E.C. Hambly 2e- CRC Press
2. Concrete Bridge Design and Practice- V.K. Raina, Tata McGraw- Hill Publishing Company Limited
3. IRC 6- 2016 Standard Specifications and Code of Practice for Road bridges
4. IRC 112-2011 Code of Practice for Concrete Road Bridges.

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation / Year	V21 / 2021-2022	3	0	0	3	V21STET06
Name of the Course	REPAIR AND REHABILITATION OF STRUCTURES					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Recognize the mechanisms of degradation of concrete structures and to design durable concrete structures. (K2)
- Describe and suggest repair strategies for deteriorated concrete structures including repairing with composites. (K2)
- Develop the methods of strengthening methods for concrete structures. (K3)
- Demonstrate the fiber reinforced concrete and its properties. (K3)
- Examine the structural member's strength by high performance concrete. (K3)

SYLLABUS

UNIT I

Materials for repair and rehabilitation: Admixtures- types of admixtures- purposes of using admixtures- chemical composition- Natural admixtures- Fibres- wraps- Glass and Carbon fibre wraps- Steel Plates-Non destructive evaluation: Importance- Concrete behavior under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods- Corrosion activity measurement- chloride content – Depth of carbonation- Impact echo methods- Ultrasound pulse velocity methods- Pull out tests.

UNIT II

Strengthening and stabilization: Techniques- design considerations-Beam shear capacity strengthening- Shear Transfer strengthening-stress reduction techniques- Column strengthening- flexural strengthening- Connection stabilization and strengthening, Crack stabilization.

UNIT III

Bonded installation techniques: Externally bonded FRP- Wet layup sheet, bolted plate, near surface mounted FRP, fundamental debonding

mechanisms-intermediate crack debonding- CDC debonding- plate end debonding- strengthening of floor of structures

UNIT IV

Fibre reinforced concrete: Properties of constituent materials- Mix proportions, mixing and casting methods-Mechanical properties of fiber reinforced concrete- applications of fibre reinforced concretes-Lightweight concrete- properties of light weight concrete- No fines concrete- design of light weight concrete- Fly ash concrete-Introduction- classification of Fly ash- properties and reaction mechanism of fly ash- Properties of fly ash concrete in fresh state and hardened state- Durability of fly ash concretes

UNIT V

High performance concretes: Introduction- Development of high-performance concretes- Materials of high-performance concretes- Properties of high-performance concretes- Self Consolidating concrete- properties-qualifications.

Textbooks:

1. Maintenance Repair Rehabilitation & Minor works of Buildings- P.C. Varghese, PHI Publications
2. Repair and Rehabilitation of Concrete Structures – P.I. Modi, C.N. Patel, PHI Publications
3. Rehabilitation of Concrete Structures- B. Vidivelli, Standard Publishers Distributors
4. Concrete Bridge Practice Construction Maintenance & Rehabilitation- V.K. Raina, Shroff Publishers and Distributors.

References:

1. **Concrete Technology Theory and Practice- M.S. Shetty, S Chand and Company**
2. **Concrete Repair and Maintenance illustrated- Peter H Emmons**
3. **Concrete Chemical Theory and Applications- Santa Kumar A.R. Indian Society for Construction Engineering and Technology, Madras**
4. **Handbook on Repair and Rehabilitation of RC Buildings published by CPWD, Delhi**

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET07
Name of the Course	**STRUCTURAL OPTIMIZATION**					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Study the optimization methodologies applied to structural engineering
- Solve some continuous structural optimization problems using calculus of variations.
- Have sufficient knowledge on various optimization techniques like, non-linear programming, geometric and dynamic
- Describe numerical algorithms and linear programming suitable for structural optimization problems.
- Use and describe quadratic and dynamic programming .

SYLLABUS

UNIT I
Introduction: Need and scope for optimization – statements of optimization problems Objective function and its surface design variables- constraints and constraint surface Classification of optimization problems (various functions continuous, discontinuous and discrete) and function behavior (monotonic and unimodal)

UNIT II
Classical optimization techniques: Differential calculus method, multi variable optimization by method of constrained variation and Lagrange multipliers (generalized problem) Khun-Tucker conditions of optimality -Fully stressed design and optimality criterion based algorithms introduction, characteristics of fully stressed design theoretical basis-examples

UNIT III
Non-Liner programming: Unconstrained minimization- Fibonacci, golden search, Quadratic and cubic interpolation methods for a one dimensional minimization and univariate method, Powel's method, Newton's method and Davidon Fletcher Powell's method for multivariable optimization- Constrained minimization- Cutting plane method- Zoutendjik's method- penalty function methods

UNIT IV
Linear programming: Definitions and theorems- Simplex method-Duality in Linear programming- Plastic analysis and Minimum weight design and rigid frame

UNIT V
Introduction to quadratic programming: Geometric programming- and dynamic programming Design of beams and frames using dynamic programming technique

Text books:

1. Iyengar.N.G.R and Gupta.S.K, “Structural Design Optimization”, Affiliated East West Press Ltd, New Delhi, 1997 .
2. Rao,S.S. “Optimization theory and applications”, Wiley Eastern (P) Ltd., 1984
3. Spunt, “Optimization in Structural Design”, Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.
4. Uri Krish, “Optimum Structural Design”, McGraw Hill Book Co. 1981

References:

1. G. Hadley,"Linear programming", Narosa Publishing House, New Delhi, 1990.
2. H.A. Taha,"Operations Research:An Introduction", 5th Edition, Macmillan, New York, 1992.
3. K. Deb,"Optimization for Engineering DesignAlgorithms and Examples",Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
4. K.Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management",PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.28

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	2	0	0	2	V21STET08
Name of the Course	ADVANCED CONCRETE TECHNOLOGY					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Explain the materials of concrete and its chemical proportions (K2)
- Describe the fresh and hardened properties of concrete (K2)
- Explain high strength and high-performance concrete manufacturing process and its properties (K2)
- Develop the special concrete and enhance the durability properties (K3)
- Describe the formwork considerations used in designs (K2)

SYLLABUS

UNIT I

Concrete Making Materials: Cement – Bogus Compounds – Hydration Process – Types of Cement – Aggregates – Gradation Charts – Combined Aggregate – Alkali Silica Reaction – Admixtures – Chemical and Mineral Admixtures - Bureau of Indian Standards (BIS) Provisions.

UNIT II

Fresh And Hardened Concrete: Fresh Concrete – workability tests on Concrete – Setting Times of Fresh Concrete – Segregation and bleeding.

Hardened Concrete: Abrams Law, Gel space ratios, Maturity concept – Stress strain Behaviour– Creep and Shrinkage – Durability Tests on Concrete – Non-Destructive Testing of Concrete. BIS Provisions**.**

UNIT III

High Strength Concrete – Microstructure – Manufacturing and Properties – Design of HSC Using Erintroy Shaklok method – Ultra High Strength Concrete.

High Performance Concrete – Requirements and Properties of High-Performance Concrete – Design Considerations. BIS Provisions.

UNIT IV

Special Concretes: Self Compacting concrete, Polymer Concrete, Fibre Reinforced Concrete – Reactive Powder Concrete – Requirements and Guidelines – Advantages and Applications.

Concrete Mix Design: Quality Control – Quality Assurance – Quality Audit - Mix Design Method – BIS Method – IS.10262 – 2019 Concrete Mix proportion guidelines. DOE Method– Light Weight Concrete, Self-Compacting Concrete.

UNIT V

Form work – materials – structural requests – form work systems – connections – specifications – design of form work – shores – removal for forms - shores – reshoring – failure of form work**.**

Text Books:

1. Properties of Concrete by A. M. Neville, ELBS publications Oct 1996.
2. Concrete Technology by A. R. Santhakumar, 2nd Edition, Oxford University Press.
3. Concrete Technology by M.S. Shetty, S.Chand & Co 2009.

References:

1. **Concrete: Micro Structure, Properties and Materials by P. K. Mehta and P. J. Monteiro,. Mc. Graw-Hill Publishing Company Ltd. New Delhi**
2. **Design of Concrete Mixes by N. Krishna Raju, CBS Publications, 2000.**
3. **Special Structural concretes by Rafat Siddique, Galgotia Publications 2000.**
4. **IS 10262-2009: Concrete Mix Proportioning - Guidelines.**

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	0	0	4	2	V21SEL01
Name of the Course	ADVANCED CONCRETE TECHNOLOGY LABORATORY					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Develop relation between Water / Cement Ratios Vs Workability, Water / Cement Ratios Vs Strength in concrete.
- Develop strength and workability relation between fine aggregate, coarse aggregates.
- Calculate Strain measurement in concrete.
- Assess concrete properties by using Non destructive testing methods.
- Find properties of Self compaction concrete by using L Box , J Box , U box and Slump tests

SYLLABUS

List of Experiments:

1. Study on Water / Cement Ratios Vs Workability of different concretes
2. Study on Water / Cement Ratios Vs Strength of different concretes
3. Study of variation of Coarse Aggregate to Fine Aggregates on Workability
4. Study of variation of Coarse Aggregate to Fine Aggregates on Strength
5. Strain measurement - Electrical resistance strain gauges
6. Non destructive testing- Impact Hammer test, UPV test
7. Qualifications tests on Self compaction concrete- L Box , J Box , U box and Slump tests

NOTE: **A minimum of five experiments from the above set have to be conducted.**

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	0	0	4	2	V21SEL02
Name of the Course	ADVANCED STRUCTURAL ENGINEERING LABORATORY					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Conduct various laboratory tests on Cement, Aggregates
- Know strain measurement
- Non destructive testing
- Chemical analysis on concrete and Aggregate and Sand

List of Experiments:

1. Study on Deflection and Cracks on a Under Reinforced Over Reinforced and Balanced Sections
2. Study on Performance of RCC Beams designed for Bending and failing in Shear
3. Study on Performance of RCC Beams designed for Shear and failing in Bending
4. Study on Performance of RCC One way slabs
5. Study on Performance of RCC Two way slabs with simply supported edge conditions
6. Study on Performance of RCC Two way slabs with fixed edge conditions
7. Calculation of Young's Modulus of Elasticity of Concrete
8. Extraction and Study of Concrete Core samples from pavements

NOTE : **A minimum of five experiments from the above set have to be conducted as demonstration to entire class..**

II SEMESTER – SYLLABUS

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET09
Name of the Course	FINITE ELEMENT METHODS IN STRUCTURAL ENGINEERING					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Compute principle of potential energy of an elastic body (K3)
- Calculate the stiffness matrices of truss element (K3)
- Calculate the stiffness matrices of beam elements (K3)
- Interpret displacements, strains and stress resultants (K3)
- Formulate the shape functions for element (K3)

SYLLABUS

UNIT I

Introduction: Review of stiffness method- Principle of Stationary potential energy- Potential energy of an elastic body- Rayleigh-Ritz method of functional approximation - variational approaches -weighted residual methods

UNIT II

Finite Element formulation of truss element: Stiffness matrix- properties of stiffness matrix – Selection of approximate displacement functions- solution of a plane truss- transformation matrix and stiffness matrix for a 3-D truss- Inclined and skewed supports-Galerkin's method for 1-D truss – Computation of stress in a truss element.

UNIT III

Finite element formulation of Beam elements: Beam stiffness- assemblage of beam stiffness matrix- Examples of beam analysis for concentrated and distributed loading-Galerkin's method - 2-D Arbitrarily oriented beam element – inclined and skewed supports –rigid plane frame examples.

UNIT IV

Finite element formulation: Plane stress, plane strain and axi-symmetric problems- Derivation of CST and LST stiffness matrix and equations- treatment of body and surface forces-Finite Element solution for plane stress and axi-symmetric problems- comparison of CST and LST elements – convergence of solution- interpretation of stresses.

UNIT V

Iso-parametric Formulation: Iso-parametric bar element- plane bilinear Iso-parametric element – quadratic plane element - shape functions, evaluation of stiffness matrix, consistent nodal load vector - Gauss quadrature- appropriate order of quadrature – element and mesh instabilities – spurious zero energy modes, stress computation- patch test.

Text Books:

1. A first course in the Finite Element Method – Daryl L. Logan, Thomson Publications.
2. Concepts and applications of Finite Element Analysis – Robert D. Cook, Michael E Plesha, John Wiley & Sons Publications
3. Fundamental Finite Element Analysis and Applications: with Mathematica and Matlab Computations, Bhatti, M.A. Wiley Publications
4. A first course in the Finite Element Method, Dary L. Logan, Thomson Publications.

References:

1. Introduction to Finite Elements in Engineering- Tirupati R. Chandrupatla, Ashok D.Belgunda, PHI publications.
2. Finite Element Methods (For Structural Engineers) Wail N Rifaie, Ashok K Govil, New Age International (P) Limited.
3. Introduction to Finite Element Method, Desai & Abel CBS Publication.
4. An Introduction to Finite Element Method- Reddy, J. N., McGraw-Hill Education.

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET10
Name of the Course	STABILITY OF STRUCTURES					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Develop differential equation based on loading and end conditions of beam column (K3)
- Illustrate and work out the elastic buckling using various methodologies (K3)
- Illustrate and work out the in-elastic buckling using various methodologies (K3)
- Assess the torsional buckling behaviour of pure and non uniform torsion of thin walled bars (K3)
- Illustrate and work out the lateral buckling of various cross sections (K3)

SYLLABUS

UNIT I

Beam columns: Differential equation for beam columns – Beams column with concentrated loads – continuous lateral load – couples – Beam column with built in ends – continuous beams with axial load – application of Trigonometric series – Determination of allowable stresses

UNIT II

Elastic buckling of bars: Elastic buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns –Sway & Non Sway mode - Energy methods – Buckling of a bar on elastic foundation – Buckling of bar with intermediate compressive forces and distributed axial loads – Buckling of bars with change in cross section – Effect of shear force on critical load – Built up columns – Effect of Initial curvature on bars – Buckling of frames – Sway & Non Sway mode

UNIT III

In-elastic buckling: Buckling of straight bars – Double modulus theory Tangent modulus theory. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae of design – various end conditions – Design of columns based on buckling. Mathematical

Treatment of stability problems: Buckling problem orthogonality relation – Ritz method –Stiffness method and formulation of Geometric stiffness matrix- Applications to simple frames

UNIT IV

Torsional Buckling: Pure torsion of thin walled bars of open cross section – Non uniform torsion of thin walled bars of open cross section - Torsional buckling – Buckling of Torsion and Flexure

UNIT V

Lateral Buckling of simply supported Beams: Beams of rectangular cross section subjected for pure bending, Buckling of I Section subjected to pure bending

Text Books:

1. Theory of Stability of Structures by Alexander ChaJes.
2. Theory of Elastic Stability by S. P. Timshenko & J.M. Gere-Mc Graw Hill Publications
3. Theory of Elastic Stability by Manikaselvam

References:

1. Fundamentals of Structural Stability by George J Smith & Dewey H. Hodges, Elsevier Publications
2. Elastic Stability of Structural Elements, N.G.R. Iyengar Macmillan Publications
3. Structural stability of Steel, Theodore v. Galambos & andrea e. Surovek

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET11
Name of the Course	THEORY OF PLATES AND SHELLS					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Analyze Navier's solution, Levy's solution and solve for the rectangular and square plates (K3)
- Analyze circular plates with various boundary conditions (K3)
- Practice on the finite difference method of solving plate problems(K3)
- Develop the potential energy principle and find the solution of rectangular plates for various loadings(K3)
- Identify the behavior of folded plates and shells.(K3)

SYLLABUS

UNIT I

Rectangular Plates: Derivation of governing differential equation for plate– in plane bending and transverse bending effects - Plates under various loading conditions like concentrated, uniformly distributed load and hydrostatic pressure. Navier and Levy's type of solutions for various boundary condition.

UNIT II

Circular plates: Symmetrically loaded, circular plates under various loading conditions, annular plates.

UNIT III

Shells: Introduction to Shells- Single and double curvature- Equations of Equilibrium of shells. Derivation of stress resultants, Principles of membrane theory and bending theory

UNIT IV

Cylindrical Shells: Derivation of the governing DKJ equation for bending theory, details of Schorer's theory. Application to the analysis and design of short and long shells. Use of ASCE Manual coefficients for the design.

UNIT V

Beam theory of cylindrical shells: Beam and arch action. Design of diaphragms - Geometry analysis and design of elliptic Paraboloid, Conoidal and Hyperbolic Paraboloid shapes by membrane theory.

Text Books:

1. Theory of Plates and Shells 2e –S. Timoshenko and S. Woinowsky Krieger, McGraw-Hill book company, INC, New York.
2. Reinforced Concrete Shells and Folded Plates by P.C. Varghese, Prentice Hall India Publications
3. Analysis of Thin Concrete Shells by K. Chandrasekhara, New Age International (P) Ltd

References:

1. Theory and Analysis of Elastic Plates and Shells by J. N. Reddy, CRS Press
2. A Text Book of Shell Analysis – Bairagi, K, Khanna Publisher, New Delhi.
3. Design and Construction of Concrete Shell Roofs – Ramaswamy, G.S, Mc Graw Hill, New York

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET12
Name of the Course	**ADVANCED STEEL DESIGN**					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Examine the simple connection used in various joints and design of connection (K3)
- Assess the plastic analysis to different beams based on their considerations (K3)
- Illustrate the eccentric and moment connection on various structural members (K3)
- Develop and analyse the industrial buildings subjected to transverse and lateral loading (K3)
- Complete the design of steel truss girder bridges and strengthening measures to girders (K3)

SYLLABUS

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Text Books:

1. Limit State Design of Steel Structures S.K. Duggal Mc Graw Hill Education Private Ltd. New Delhi.
2. Design of steel structures by N. Subramanian, Oxford University Press
3. Design Steel Structures Volume-II, Ramachandra & Vivendra Gehlot, Scientific Publishes Journals Department.

References:

1. Design of Steel Structures. P. Dayaratnam, S. Chand, Edition 2011-12.
2. Design of Steel Structures Galyord & Gaylord, Tata Mc Graw Hill, Education, Edition 2012.
3. Indian Standard Code – IS – 800-2007.
4. Indian Standard Code – IS – 875 – Part III - 2015

.

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET13
Name of the Course	ANALYSIS OF OFFSHORE STRUCTURES					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Illustrate different types of offshore structures. (K3)
- Calculation of Conservation mass and momentum. (K3)
- Assess the Wave force estimation on small bodies. (K3)
- Assess the Wave force estimation on long bodies. (K3)
- Compute Static and dynamic analysis of fixed offshore structures. (K3)

SYLLABUS

UNIT I

Introduction: Types of offshore structures, Concept of fixed, compliant and floating structures, Law of floatation, fluid pressure and centre of pressure, estimation of centre of gravity, hydrostatic particulars, stability criteria of floating bodies, and motions of a floating body.

UNIT II

Dynamics and Kinematics : Conservation mass and momentum, Euler equation, Bernoullis Equation, Potential flow, Classification of waves, small amplitude or Linear Airy's theory, dispersion relationship, water particle kinematics, wave energy.

UNIT III

Wave force on small bodies: Estimation - Morison equation, Estimation of wave force on a vertical cylinder, Force due to current, Effect of marine growth on vertical cylinders.

UNIT IV

Wave force on large bodies: Froude-krylov theory, Diffraction theory.

UNIT V

Static and dynamic analysis of fixed offshore structures.

Text Books:

1. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.
2. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.
3. McClelland, B & Reifel, M. D., Planning & Design of fixed Offshore Platforms, Van Nostrand, 1986.

References:

1. API RP 2A., Planning, Designing and Constructing Fixed Offshore Platforms, API.
2. Hand book of offshore Engineering, Vol I, Subrata Chakrabarti, Offshore Structure Analysis, Inc., Plainfield, Illinois, USA.
3. Dynamic Analysis and Design of Offshore Structures 2015th Edition, by Srinivasan Chandrasekaran

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET14
Name of the Course	EARTHQUAKE RESISTANT DESIGN OF BUILDINGS					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Demonstrate the fundamentals of seismology and basic earthquake mechanisms, tectonics types of ground motion, magnitude and propagation of ground motion. (K3)
- Assess the seismic design concepts of various moment resisting frames and their ductility behaviour (K3)
- Compute the earthquake load on various building frames and study on ductile behavior of building frames (K3)
- Assess the Cyclic loading behavior of RC, steel and pre- stressed concrete elements (K3)
- Illustrate the methods of Retrofitting and restoration of buildings subjected to damage due to earthquakes (K3)

SYLLABUS

UNIT I

Engineering seismology: Rebound theory – plate tectonics – seismic waves - earthquake size and various scales – local site effects – Indian seismicity – seismic zones of India – theory of vibrations – near ground and far ground rotation and their effects

UNIT II

Seismic design concepts: EQ load on simple building – load path – floor and roof diaphragms – seismic resistant building architecture – plan configuration – vertical configuration – pounding effects – mass and stiffness irregularities – torsion in structural system- Provision of seismic code (IS 1893 & 13920) – Building system – frames – shear wall – braced frames – layout design of Moment Resisting Frames(MRF) – ductility of MRF – Infill wall – Non-structural elements

UNIT III

Calculation of EQ load: 3D modeling of building systems and analysis (theory only) Design and ductile detailing of Beams and columns of frames

Concept of strong column weak beams, Design and ductile detailing of shear walls.

UNIT IV

Cyclic loading behavior of RC, steel and pre- stressed concrete elements: modern concepts- Base isolation – Adaptive systems – case studies

UNIT V

Retrofitting and restoration of buildings subjected to damage due to earthquakes- effects of earthquakes – factors related to building damages due to earthquake- methods of seismic retrofitting- restoration of buildings

Text Books:

1. Earthquake Resistant Design of Structures Pankaj Agarwal and Manish ShriKhande, Prentice Hall of India, 2007, New Delhi.
2. Earthquake Resistant Design of Structures- S.K. Duggal, Oxford Publications.
3. Seismic design of reinforced concrete and masonry buildings by Paulay and Priestley .

References:

1. Earthquake Resistant Design and Risk Reduction- David Dowrick
2. IS 4326 -1998: Earthquake Resistant Design and Construction of Buildings
3. IS 1893 (Part 1 to 5)- 2016: General Provisions and Building
4. IS 4928–1993: Code of practice for Earthquake Resistant Design and Construction of Buildings
5. IS 13920-2016: Code of Practice for Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces
6. IS 13935-1993: Guidelines for Repair and Seismic Strengthening of Building

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET15
Name of the Course	PRECAST AND PREFABRICATED STRUCTURES					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes

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

- Explain impotence of prefabrication and Principles of Prefabrication. (K3)
- Find Prefabricated Load Carrying Members. (K3)
- Assess Joints for different structural connections. (K3)
- Analyze the production technology of prefabrication. (K3)
- Design and detailing of precast UNIT for factories. (K3)

SYLLABUS
UNIT I

Introduction to prefabrication: General Principles of Prefabrication - Comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization – Materials – Modular coordination – Systems – Production – Transportation – Erection.

UNIT II

Prefabricated Members: Load Carrying Capacity - Planning for components of prefabricated structures, disuniting of structures, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses, beams, columns, symmetric frames. Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls..

UNIT III

Joints: Joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction.

UNIT IV

Production Technology: Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening. Hoisting Technology - Equipment for hoisting and erection,

techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

UNIT V

Designing and detailing of precast: For factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns. Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

Text Books:

1. Precast Concrete Structures- Kim S Elliott, CRC Press
2. CBRI, Building materials and components, India, 1990
3. Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994

References:

1. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.
2. Mokk. L, (1964), Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest.
3. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET16
Name of the Course	EARTH RETAINING STRUCTURES					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Compute the lateral earth pressures associated with different earth systems (K3)
- Assess the failure criterion and stability requirements in selecting the most technically appropriate type of retaining wall (K3)
- Employ different techniques to design a sheet pile structure considering both external and internal stability (K3)
- Apply the knowledge of reinforced earth in the designing the earth retaining systems (K3)
- Relate different methods in analyzing the stability of braced cuts and cofferdams (K3)

SYLLABUS

UNIT I

Earth pressures: Different types and their coefficients; Classical Theories of Earth pressure – Rankine's and Coulomb's Theories for Active and Passive earth pressure; Computation of Lateral Earth Pressure in Homogeneous and Layered soils; Graphical solutions for Coulomb's Theory in active and passive conditions.

UNIT II

Retaining walls: Types, Type of Failures of Retaining Walls – Stability requirements –Drainage behind Retaining walls – Provision of Joints – Relief Shells.

UNIT III

Sheet Pile Structures: Types of Sheet piles – Cantilever sheet piles in sands and clays – Anchored sheet piles – Free earth and Fixed earth support methods – Rowe's moment reduction method – Location of anchors and Design of Anchorage system.

UNIT IV

Soil reinforcement: Reinforced earth - Different components – their functions – Design principles of reinforced earth retaining walls.

UNIT V

Braced cuts and Cofferdams: Lateral Pressure in Braced cuts – Design of Various Components of a Braced cut – Stability of Braced cuts – Bottom Heave in cuts. – Types of cofferdam, suitability, merits and demerits – Design of single – wall cofferdams and their stability aspects – TVA method and Cummins' methods.

Text Books:

1. Principles of Foundation Engineering by Braja M Das, Cengage Learning
2. Foundation analysis and design by Bowles, J.E., McGraw Hill
3. Soil Mechanics in Engineering Practice – Terzaghi, K and Ralph B. Peck, John Wiley & Sons.

References:

1. Earth Pressure and Earth Retaining Structures by Chris RI Clayton, Rick I woods, Andrew J Bond and Jarbas Milititsky, CRC Press, Taylor and Francis Group, New York.
2. Analysis and Design of Foundations and Retaining Structures, Samsher Prakash
3. Gopal Ranjan and Swami Saran, Saritha Prakashan Publishers, New Delhi.
4. NPTEL course materials on Geo-synthetics and Earth Retaining Structures

Year/Sem	I Sem	L	T	P	C	COURSE CODE
Regulation	V21	2	0	0	2	V21STET17
Name of the Course	ADVANCED REINFORCED CONCRETE DESIGN					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Explain the limit state method provisions in analysis of structures (K2)
- Apply the yield line method to analyze slab (K3)
- Develop the designs to flat slabs and ribbed slabs (K3)
- Explain the design steps involved in deep beams, corbel design procedure (K2)
- Interpret the Design method of slender and eccentric column (K3)

SYLLABUS

UNIT I

Limit Analysis of R C Structures: Rotation of a plastic hinge, Redistribution of moments, moment rotation characteristics of RC member, I.S. code provisions, loading pattern, Bending Moment Envelop, Application for Fixed Beams and Continuous Beams.

UNIT II

Yield line analysis for slabs: Yield line criterion – Virtual work and equilibrium methods of analysis – For square circular, Rectangular, Triangular and Hexagonal with simple andcontinuous end conditions**.**

UNIT III

Ribbed slabs: Analysis of the Slabs for Moment and Shears, Ultimate Moment of Resistance, Design for shear, Deflection, Arrangement of Reinforcements**.**

UNIT IV

Design of Reinforced Concrete Deep Beams & Corbels: Steps of Designing Deep Beams, Design by IS 456. Checking for Local Failures, Detailing of Deep Beams, Analysis of Forces in a Corbels, Design of Procedure of Corbels, Design of Nibs. Detailing of reinforcement.

UNIT V

Design of Slender Columns – Slenderness limits, Methods of Design of Slender Columns, Additional Moment Method, Procedure for Design of Slender Columns. Detailing of reinforcement.

Text Books:

1. Advanced Reinforced Concrete Design, by P.C. Varghese Prentice Hall India Limited
2. Design of Reinforced Concrete Structures by N.Subramanian, Oxford UniversityPress.
3. Reinforced Concrete Design, by S. Unnikrishna Pillai & Devdas Menon Tata Mc.Graw-Hill Publishing Company Ltd. New Delhi 2010.

References:

1. Limit State Theory and Design of Reinforced Concrete S. R. Karve and V.L Shah.Standard Publishers
2. Reinforced concrete structural elements – behavior, Analysis and design by P.Purushotham, Tata Mc.Graw-Hill, 1994.
3. Design of concrete structures – Arthus H. Nilson, David Darwin, and Chorles W.Dolar, Tata Mc. Graw-Hill, 3rd Edition, 2005.
4. Reinforced Concrete design by Kennath Leet, Tata Mc. Graw-Hill International,editions, 2nd edition, 1991.

Year/Sem	II Sem	L	T	P	C	COURSE CODE
Regulation	V21	0	0	4	2	V21SEL03
Name of the Course	STRUCTURAL DESIGN LABORATORY					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Develop Computer Programs for Analysis and Design of various Structural Elements
- Use different Structural Engineering software's to solve various civil Engineering programs

SYLLABUS

1. Analysis and Design of reinforced concrete multistoried building
2. Analysis of plane and space truss
3. Analysis of plane and space frame
4. Wind analysis on tall structure
5. Analysis of Cylindrical shell
6. Dynamic Analysis of Multistory structure Analysis and Design using STADD, STADD FOUNDATION, ETABS, ANSYS

NOTE: A minimum of four from the above set have to be conducted.

References:

1. Computer aided design laboratory (Civil Engineering) by Shesha Prakash and Suresh.S

III SEMESTER – SYLLABUS

Year/Sem	III Sem	L	T	P	C	COURSE CODE
Regulation / Year	V21 / 2021-2022	3	0	0	3	V21STET18
Name of the Course	DESIGN OF PRESTRESSED CONCRETE STRUCTURES					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Compute the Analysis of prestress , losses in prestress and Anchorage slip (K3)
- Deflections of prestressed concrete members (K3)
- Employ types and advantages and analysis of composite sections (K3)
- Apply the knowledge of prestressed concrete slabs (K3)
- Analyze continuity beams in prestressed concrete structures (K3)

SYLLABUS

UNIT I

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

UNIT II

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

UNIT III

Composite Constructions: Introduction, Advantages, Types of Composite Construction, Analysis of Composite beams- Differential shrinkage- Ultimate

Flexural and shear strength of composite sections- Deflection of Composite Beams. Design of Composite sections.

UNIT IV

Prestressed Concrete Slabs: Types Of Prestressed Concrete Floor Slabs- Design of Prestressed Concrete One Way and Two Way Slabs. Prestressed Concrete Pipes and Poles : Circular prestressing- Types of Prestressed Concrete Pipes- Design of Prestressed Concrete Pipes - Prestressed Concrete Poles.

UNIT V

Continuous Beams: Advantage of Continuous Members – Effect of Prestressing Indeterminate Structures – Methods of Achieving Continuity – Methods of Analysis of Secondary Moments – Concordant Cable Profile – Guyon's Theorem. Redistribution of moments in a continuous beam. Anchorage Zone Stresses in Beams : Introduction, Stress distribution in End Block – Anchorage zone stresses –Magnel's method- Guyon's Method - Anchorage zone Reinforcement.

Text Books:

1. Prestressed Concrete, by N. Krishna Raju, Mc Graw Hill Publishers – fourth edition
2. Prestressed Concrete by K. U.Muthu, PHI Learning Pvt Limited - 18 January 2016
3. Design of Prestressed Concrete by S.S.Bhavikatti – 1 January 2019

References:

1. 1 Prestressed Concrete Analysis and Design, Antone E. Naaman, Techno Press 3000
2. Design of Prestressed Concrete- T. Y. Lin, Ned H. Burns
3. 3 Wiley Publications 3. Design of prestressed Concrete by E.G. Nawy

Year/Sem	III Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET19
Name of the Course	STRUCTURAL HEALTH MONITORING					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Assess the structural health by investigation and regular maintenance (K3)
- Employ various measures for monitoring structural health (K3)
- Employ various Investigations for monitoring structural audit (K3)
- Discover the dynamic field testing (K3)
- Apply the knowledge of Repairing and rehabilitation of structures (K3)

SYLLABUS

UNIT I

Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT II

Structural Health Monitoring: Concept, Various Measures, Structural Safety in Alteration.

UNIT III

Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT IV

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

UNIT V

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

Text Books:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring by Daniel Balageas, Claus-peter fritzen and Alfredo Guemes

References:

1. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
2. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.
3. Advances in Condition Monitoring and Structural Health Monitoring: WCCM by Len Gelman .et.al.

Year/Sem	III Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21STET20
Name of the Course	**INDUSTRIAL STRUCTURES**					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- functional requirements of structural systems for various industries (K3)
- Get an idea about the materials used and design of industrial structural elements (K3)
- Pre Engineered Buildings (K3)
- Realize the basic concepts and design of power plant structures (K3)
- Design power transmission structures (K3)

SYLLABUS

UNIT I

Planning and functional requirements- classification of industries and industrial structures- planning for layout- requirements regarding lighting ventilation and fire safety- protection against noise and vibrations.

UNIT II

Industrial buildings- roofs for industrial buildings (Steel) - design of gantry girder- design of corbels and nibs- machine foundations

UNIT III

Design of Pre Engineered Buildings

UNIT IV

Power plant structures- Bunkers and silos- chimney and cooling towers- Nuclear containment structures

UNIT V

Power transmission structures- transmission line towers- tower foundations- testing towers

Text books:

1. Machine Foundations by P. Srinivasulu and C. V. Vaidyanathan, Structural Engineering Research Center - 1 July 2017
2. Tall Chimneys- Design and Construction by S. N. Manohar Tata Mc Grawhill Publishing Company -
3. The Design & Construction of Industrial Buildings by Moritz Kahn

References:

1. Transmission Line Structures by S. S. Murthy and A. R. Santakumar McGraw Hill
2. SP 32: 1986, Handbook on functional requirements of Industrial buildings
3. Design of steel structures by N. Subramanian
3. The Architect's Studio Companion: Rules of Thumb for Preliminary Design by Edward Allen

Year/Sem	III Sem	L	T	P	C	COURSE CODE
Regulation	V21	3	0	0	3	V21MBT56
Name of the Course	COST MANAGEMENT OF ENGINEERING PROJECTS					
Branch	STRUCTURAL ENGINEERING					

Course Outcomes:

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

- Understand the cost management process and various costs involved in a project (K2)
- Understand various aspects of a project and related processes. (K2)
- Analyze the concepts of Break even and CVP analysis. (K3)
- Demonstrate quality management techniques besides budgeting strategies (K2)
- Apply quantitative techniques for cost management (K4)

SYLLABUS

UNIT I

Introduction and Overview of the Strategic Cost Management Process: Cost concepts in decision-making; relevant cost, Differential cost, Marginal cost, Incremental cost and Opportunity cost. Objectives of Costing System; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II

Project Management: Meaning, Different types of projects.

Various stages of project execution: conception to commissioning, Project execution as a conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution, main clearances and documents.

Project team: Role of each member, Importance of Project site. Project contracts: Types and its contents. CPM & PERT Techniques.

UNIT III

Cost Behavior and Profit Planning: Marginal Costing, Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Standard Costing and Variance Analysis.

UNIT IV

Quality management and Budgeting strategies: Pareto Analysis, Target costing, Life Cycle Costing, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. **Budgetary Control**; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing & decisions including transfer pricing.

UNIT V

Quantitative techniques for cost management, Linear Programming, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Reference Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

ANNEXURE – CE- V

AUDIT COURSES OFFERED IN I & II SEMESTER

Audit course	I & II Sem	Disaster Management	V21STEAC1

Year/Sem		**L**	**T**	**P**	**C**	**COURSE CODE**
Regulation Year	V21 / 2021-2022	3	0	0	3	V21STEAC1
Name of the Course	**DISASTER MANAGEMENT**					
Branch	Common to all					

Course Outcomes:

Upon successful completion of this course the student will be able to

- Describe to student to have a idea on different natural hazards and disaster management (K2)
- Develop the student to understand manmade disaster and their management (K3)
- Prepare the student in such a way inorder to understand building codes and vulnerability of disaster (K3)
- Illustrate to student about role of technology in disaster management (K2)
- Assess the importance of education and community preparedness in disaster management to student (K3)

SYLLABUS

UNIT I

Natural Hazards and Disaster Management: Introduction of DM Disaster Management cycle – Five priorities for action- Case study methods of the following: floods, droughts – Earthquakes – global warming, cyclones & Tsunamis – Post Tsunami hazards along the Indian coast – landslides.

UNIT II

Man Made Disastar And Their Management Along With Case Study Methods Of The Following: Fire hazards – transport hazard dynamics – solid waste management – post disaster – bio terrotirism - rail and air craft's accidents-Management of these disasters

UNIT III

Risk And Vulnerability: – Building codes and land use planning – social vulnerability – environmental vulnerability -Financial management of disaster.

UNIT IV

Role Of Technology In Disaster Managements: Disaster management for infra structures, taxonomy of infra structure - mitigation programme for earth quakes –geospatial information in agriculture drought assessment-multimedia technology in disaster risk management and training-transformable indigenous knowledge in disaster reduction.

UNIT V

Education And Community Preparedness: Education in disaster risk reduction-Essentials of school disaster education-Community capacity and disaster resilience-Community based disaster recovery -Community based disaster management and social capital-Designing resilience- building.

Text Books:

1. Disaster Management – Global Challenges and Local Solutions' by Rajib shah & R R Krishnamurthy(2009),Universities press.
2. Disaster Science & Management' by Tushar Bhattacharya, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. Disaster Management – Future Challenges and Opportunities' by Jagbir Singh (2007), I K International Publishing House Pvt. Ltd.

Reference Books:

1. 'Disaster Management' edited by H K Gupta (2003), Universities press.
2. Natural Hazards and Disaster Management, Vulnerability and Mitigation by RB Singh
3. Disaster Management by Harish K.Gupta