

M.TECH. - COURSE STRUCTURE & SYLLABUS – RK24
(Applicable from the academic year 2024-25 onwards)

DEPARTMENT OF CIVIL ENGINEERING

M. Tech (Structural Engineering) Programme

Course Code Format:

Regulation	Branch	Year	Semester	Course Serial Number
2 Digits	2 Digits	1 Digit	1 Digit	2 Digits
24	87	1/2	1/2	01/02/03/04/..../09/10

Branch Code:

Code	Branch	Specialization
87	Civil Engineering	Structural Engineering

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M. Tech I Year, I Semester (Structural Engineering)

S.No.	Course Code	Category	Title	L	T	P	Credits
1	24871101	Core	Theory of Elasticity	3	0	--	3
2	24871102	Core	Structural Dynamics	3	0	--	3
3	24871103	Elective-I	i. Matrix Analysis of Structures ii. Analytical & Numerical Methods for Structural Engineering iii. Design of RCC Foundations	3	0	--	3
4	24871104	Elective-II	i. Bridge Engineering ii. Repair and Rehabilitation of Structures iii. Advanced Reinforced Concrete Design	3	0	--	3
5	24871105		Advanced Concrete Technology	2	0	0	2
6	24871106	Lab	Advanced Concrete Technology Laboratory	--	--	4	2
7	24871107	Lab	Advanced Structural Engineering Laboratory	--	--	4	2
8	24871108	Audit	Audit Course -1	2	0	0	0
Total				16	0	8	18

M. Tech I Year, II Semester (Structural Engineering)

S.No.	Course Code	Category	Title	L	T	P	Credits
1	24871201	Core	Finite Element Methods in Structural Engineering	3	0	--	3
2	24871202	Core	Theory of Plates and Shells	3	0	--	3
3	24871203	Elective-III	i. Stability of Structures ii. Advanced Steel Design iii. Analysis of Offshore Structures	3	0	--	3
4	24871204	Elective-IV	i. Earthquake Resistant Design of Buildings ii. Precast and Prefabricated Structures iii. Earth Retaining Structures	3	0	--	3
5	24871205	Lab	Computer Aided Design Laboratory	--	--	4	2
6	24871206	Lab	Structural Design laboratory	--	--	4	2
7	24871207	Project	Mini Project With Seminar	--	--	4	2
8	24871208	Audit	Audit Course -2	2	0	0	0
Total				14	0	12	18

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M. Tech II Year, I Semester (Structural Engineering)

S.No.	Course Code	Category	Title	L	T	P	Credits
1	24872101	Elective-V	Program Elective / MOOCS i. Design of Prestressed Concrete structures ii. Structural Health monitoring iii. Industrial Structures	3	0	--	3
2	24872102	Open Elective	Open Elective / MOOCS	3	0	--	3
3	24872103	Project	Dissertation Phase-I / Industrial Project (To be continued and Evaluated next Semester)*	--	--	20	10
Total				6	0	20	16

* Evaluated and displayed in 4th Semester marks list

** Students Going for Industrial Project / Thesis will complete these courses through MOOCS

M. Tech II Year, II Semester (Structural Engineering)

S.No.	Course Code	Category	Title	L	T	P	Credits
1	24872201	Project	Project / Dissertation Phase II (Continued from III Semester)	0	0	32	16
Total				0	0	32	16

Audit course 1 & 2

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

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I Year - I Semester	L	T	P	C
	3	0	0	3
THEORY OF ELASTICITY (Program Core1)				

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

CO1	Know the definition of stress and deformation and how to determine the components of the stress and strain tensors.
CO2	Apply the conditions of compatibility and equations of equilibrium.
CO3	Understand how to express the mechanical characteristics of materials, constitutive equations and generalized Hook law.
CO4	Use the equilibrium equations stated by the displacements and compatibility conditions stated by stresses
CO5	Understand index notation of equations, tensor and matrix notation and define state of plane stress, state of plane strain
CO6	Be able to analyze real problem and to formulate the conditions of theory of elasticity Applications
CO7	Determine the boundary restrictions in calculations. Solve the basic problems of the theory of elasticity by using Airy function expressed as bi- harmonic function

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	2	1	--	2	1
CO2	2	1	3	1	--	2	1
CO3	2	1	3	1	--	2	1
CO4	2	1	3	1	--	2	1
CO5	2	1	--	1	--	2	1
CO6	2	1	2	1	--	2	1
CO7	2	1	--	1	--	2	1

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

UNIT: 1

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.

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UNIT: 2

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: 3

Two dimensional problems in polar co- ordinates - General equations in polar co- ordinates – 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: 4

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: 5

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

REFERENCES

1. Elasticity: Theory, Applications and Numeric- Martin H. Sadd, Wiley Publishers
3. Theory of Elasticity -Sadhu Singh 3rd Edition, Khanna Publishers

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I Year - I Semester	L	T	P	C
	3	0	0	3
STRUCTURAL DYNAMICS (Program Core 2)				

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

CO1	Understand the response of structural systems to dynamic loads
CO2	Realize the behavior and response of linear and nonlinear SDOF and MDOF structures with various dynamic loading
CO3	Understand the behavior and response of MDOF structures with various dynamic loading.
CO4	Possess the ability to find out suitable solution for continuous system
CO5	Understand the behavior of structures subjected to dynamic loads under free vibration
CO6	Understand the behavior of structures subjected to dynamic loads Harmonic excitation and earthquake load

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	--	3	1	--	1	1
CO2	--	--	3	1	--	1	1
CO3	--	--	3	1	--	1	1
CO4	--	--	3	1	--	1	1
CO5	1	--	3	1	--	1	1

1. Slightly 2. Moderately 3. Substantially

Detailed 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.

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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

REFERENCE:

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

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I Year - I Semester	L	T	P	C
	3	0	0	3
MATRIX ANALYSIS OF STRUCTURES (Elective-I)				

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

CO1	Perform the structural analysis of determinate and indeterminate structures using classical compatibility methods, such as method of consistent displacements, force and equilibrium Methods
CO2	Perform structural analysis using the stiffness method.
CO3	Solve multiple degree of freedom two and three dimensional problems involving trusses, beams, frames and plane stress
CO4	Understand basic finite element analysis

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	- -	3	2	1	- -	1	1
CO2	- -	3	2	1	- -	1	1
CO3	1	3	2	1	- -	1	1
CO4	- -	3	2	1	- -	1	1

1. Slightly 2. Moderately 3. Substantially Detailed

Syllabus:

UNIT: 1

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: 2

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: 3

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

UNIT: 4

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.

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UNIT: 5

Analysis of plane truss - 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 Jersey
2. Advanced structural analysis, P. Dayaratnam- Tata McGraw hill publishing company limited.
3. Structural Analysis Matrix Approach - Pandit and Gupta, Mc Graw Hil 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, 5e, Amazon Publications.
4. Matrix Analysis of Framed Structures 3e-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

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I Year - I Semester	L	T	P	C
	3	0	0	3
ANALYTICAL & NUMERICAL METHODS FOR STRUCTURAL ENGINEERING (Elective-I)				

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

CO1	Understand the fundamentals of the theory of elasticity
CO2	Implement the principles and techniques of photo elastic measurement
CO3	Obtain the principles and techniques of strain gage measurement
CO4	Adopt the principles and techniques of moiré analysis
CO5	Apply the principles and techniques of holographic interferometer
CO6	Apply the principles and techniques of brittle coating analysis Understand the fundamentals of the theory of elasticity

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	- -	1	1	1	2	1	1
CO2	- -	- -	1	- -	2	- -	- -
CO3	- -	- -	1	- -	3	- -	- -
CO4	1	- -	- -	- -	3	- -	- -
CO5	- -	- -	- -	- -	3	- -	- -
CO6	- -	- -	1	1	3	1	1

1. Slightly 2. Moderately 3. Substantially Detailed

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

Random Variables And Estimation Theory Probability - Probability distributions - moments, M.G.F-Two dimensional random variables correlation, regression multiple and partial correlation and regression - Curve fitting - Principle of least squares - Fitting of straight line and parabola. Estimation theory basic concepts (Review) - Estimation of parameters - Maximum likelihood estimates - method of moments

TEXT BOOKS

1. Introduction to Partial Differential Equations, Sankara Rao. K, , PHI, New Delhi, 1995
2. Elements of Partial Differential Equations, Sneddon. I.N, Mc Graw Hill, 1986

REFERENCE

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. Numerical Methods for Engineering Problems N. Krishna Raju, K.U. Muthu Macmillan Publishers

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I Year - I Semester	L	T	P	C
	3	0	0	3
DESIGN OF REINFORCED CONCRETE FOUNDATIONS				
(Elective-I)				

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

CO1	Attain the perception of site investigation to select suitable type of foundation based on soil category
CO2	Capable of ensuring design concepts of shallow foundation
CO3	Can be efficient in selecting suitable type of pile for different soil stratum and in evaluation of group capacity by formulation
CO4	Design different types of well foundation

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	--	--	1	--	1	--
CO2	--	--	--	3	--	1	1
CO3	--	--	--	2	--	1	1
CO4	--	--	--	2	--	1	1

1. Slightly 2. Moderately 3. Substantially

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

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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.

REFERENCE

1. Design of Reinforced Concrete Structures by N. Subramaniam- Oxford University.
2. Reinforced Concrete Design by Unnikrishna Pillai and Devdas Menon, Tata Mc Graw Hill

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I Year - I Semester	L	T	P	C
	3	0	0	3
Elective III – DESIGN OF BRIDGES				

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

CO1	Design theories for super structure and substructure of bridges
CO2	Design Culvert, R.C.C T Beam Bridge.
CO3	Understand the behavior of continuous bridges, box girder bridges.
CO4	Possess the knowledge to design prestressed concrete bridges.
CO5	Design Railway bridges, Plate girder bridges, different types of bearings, abutments, piers and various types of foundations for Bridges

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	- -	1	2	1	- -	1	- -
CO2	- -	1	2	3	- -	2	2
CO3	- -	1	2	3	- -	2	1
CO4	- -	1	2	2	- -	2	1
CO5	- -	1	2	3	- -	2	2

1. Slightly 2. Moderately 3. Substantially

Detailed 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

Pigeaud's method- design of longitudinal girders- Guyon- Messonnet 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.

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UNIT-IV

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

UNIT: 5

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. Design of Bridges by N. Krishna Raju CBS Publishers and Distributors
2. Design of Concrete Bridges- M.G. Aswini, V.N. Vazirani, M.M Ratwani, Khanna Publishers
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. Bridge Engineering by S. Ponnuswamy, Mc Grawhill Publications
4. IRC 6- 2016 Standard Specifications and Code of Practice for Road bridges
5. IRC 112-2011 Code of Practice for Concrete Road Bridges

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I Year - I Semester	L	T	P	C
	3	0	0	3
REPAIR AND REHABILITATION OF STRUCTURES				

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

CO1	Recognize the mechanisms of degradation of concrete structures and to design durable concrete structures.
CO2	Conduct field monitoring and non- destructive evaluation of concrete structures.
CO3	Design and suggest repair strategies for deteriorated concrete structures including repairing with composites.
CO4	Understand the methods of strengthening methods for concrete structures
CO5	Assessment of the serviceability and residual life span of concrete structures by Visual inspection and in situ tests
CO6	Evaluation of causes and mechanism of damage
CO7	Evaluation of actual capacity of the concrete structure Maintenance strategies

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	1	--	1	--	1	--
CO2	--	1	1	1	--	1	1
CO3	--	1	1	1	--	1	1
CO4	--	--	1	1	--	1	1
CO5	--	--	1	1	--	1	1
CO6	--	--	1	1	--	1	1
CO7	--	--	--	2	--	1	1

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

UNIT: 1

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: 2

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.

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UNIT: 3

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: 4

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

UNIT: 5

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

TEXT BOOKS

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.

REFERENCE:

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

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I Year - I Semester	L	T	P	C
	3	0	0	3
ADVANCED REINFORCED CONCRETE DESIGN (Elective-II)				

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

CO1	Estimate the deflection of Concrete beams and slabs
CO2	Estimate crack width and its affects
CO3	Design flat slabs, bunkers, silos and chimneys
CO4	Understand the thermal effect on concrete members

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	- -	2	1	2	- -	2	1
CO2	- -	- -	1	3	- -	2	1
CO3	- -	- -	1	3	- -	2	1
CO4	- -	- -	1	2	- -	2	1

1. Slightly 2. Moderately 3. Substantially

Detailed 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. Inelastic Analysis of Slabs, Moment Redistribution.

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 and continuous 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.

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

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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.

Eccentrically Loaded columns- development of interaction Diagrams

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 University Press.
3. Reinforced Concrete Design, by S. Unnikrishna Pillai & Devdas Menon Tata Mc. Graw-Hill Publishing Company Ltd. New Delhi 2010.

REFERENCE

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.
5. Design Reinforced Concrete Foundations P.C. Varghese Prentice Hall of INDIA Private Ltd.
6. IS 456-2000 Plain and Reinforced concrete book of Practice.
7. SP 16- Design Aids for Reinforced Concrete to IS 456
8. SP 34 - Hand Book as Concrete Reinforcement and retaining

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I Year - I Semester	L	T	P	C
	2	0	0	3
ADVANCED CONCRETE TECHNOLOGY				

Objectives:

To impart knowledge on concrete making materials, concrete mix design for proportioning and their testing.

Outcomes:

The learner will be able to design concrete mixes of different grades and also use the special concretes.

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.

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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
5. Relevant BIS Codes

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I Year - I Semester	L	T	P	C
	0	0	4	2
ADVANCED CONCRETE TECHNOLOGY LABORATORY				

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

CO1	Conduct various laboratory tests on Cement, Aggregates
CO2	Know strain measurement
CO3	Non- destructive testing
CO4	Chemical analysis on concrete and Aggregate and Sand

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	--	--	--	3	1	1
CO2	--	--	--	--	3	1	1
CO3	--	--	--	--	3	1	1
CO4	--	--	--	--	3	1	1

1. Slightly 2. Moderately 3. Substantially

Detailed 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

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I Year - I Semester	L	T	P	C
	0	0	4	2
ADVANCED STRUCTURAL ENGINEERING LABORATORY				

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

CO1	conduct various laboratory tests on Cement, Aggregates
CO2	Know strain measurement
CO3	Non- destructive testing
CO4	Chemical analysis on concrete and Aggregate and Sand

A

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	--	--	--	3	1	1
CO2	--	--	--	--	3	1	1
CO3	--	--	--	--	3	1	1
CO4	--	--	--	--	3	1	1

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

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.

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I Year - II Semester	L	T	P	C
	3	0	0	3
FINITE ELEMENT METHODS IN STRUCTURAL ENGINEERING				

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

CO1	Develop finite element formulations of 1 degree of freedom problems and solve them
CO2	Understand any Finite Element software to perform stress, thermal and modal analysis
CO3	Compute the stiffness matrices of different elements and system
CO4	Interpret displacements, strains and stress resultants

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	2	3	--	--	2	1
CO2	1	2	3	--	--	2	1
CO3	1	2	3	--	--	2	1
CO4	1	2	3	--	--	2	--

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

UNIT: 1

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: 2

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: 3

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: 4

Finite element formulation for 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: 5

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

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

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I Year - II Semester		L	T	P	C
		3	0	0	3
THEORY OF PLATES AND SHELLS					

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

CO1	Have a knowledge about various plate theories due to bending
CO2	Gain the knowledge of Navier's solution, Levy's solution and solve for the rectangular and square plates
CO3	Analyze circular plates with various boundary conditions.
CO4	Focus on the finite difference method of solving plate problems.
CO5	Ability to realize the potential energy principle and find the solution of rectangular plates for various loadings
CO6	Understand the behaviour of folded plates and shells.

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	2	--	1	1	--
CO2	--	2	2	--	--
CO3	--	--	3	--	--
CO4	--	--	3	1	--
CO5	--	1	1	--	3

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

UNIT: 1

Derivation of governing differential equation for plate- in plane bending and transverse bending effects- Rectangular plates: 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: 2

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

UNIT: 3

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

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UNIT: 4

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: 5

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

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I Year - II Semester		L	T	P	C
		3	0	0	3
Elective III - STABILITY OF STRUCTURES					

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

CO1	Analyze different types of structural instabilities
CO2	Execute and work out the inelastic buckling using various methodologies.
CO3	Examine the behaviour of beam columns and frames with and without side sway using classical and stiffness methods
CO4	To be well versed in the lateral buckling, torsional buckling, Flexural torsional buckling of various beams and non- circular sections.

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	- -	3	2	1	- -	2	- -
CO2	- -	3	2	1	- -	2	- -
CO3	- -	3	2	1	- -	2	- -
CO4	- -	3	2	1	- -	2	- -

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

UNIT: 1

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: 2

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

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UNIT: 3

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: 4

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: 5

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

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I Year - II Semester	L	T	P	C
	3	0	0	3
Elective III –ADVANCED STEEL DESIGN				

Objectives:

- To impart knowledge on behavior and design of various connections, industrial and steel girders.

Outcomes: The learner will be able to design different steel structures.

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.

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UNIT-V

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

REFERENCE

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

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I Year - II Semester		L	T	P	C
		3	0	0	3
Elective III – ANALYSIS OF OFFSHORE STRUCTURES					

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

CO1	Perform concept development of offshore structure
CO2	Find the wave force on vertical cylinder
CO3	Perform static and dynamic analysis of fixed offshore structure

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	- - -	- -	- -	1	- -	1	1
CO2	- -	- -	2	1	- -	2	1
CO3	- -	- -	3	3	- -	2	1

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

UNIT: 1

Introduction to different 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: 2

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: 3

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

UNIT: 4

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

UNIT: 5

Static and dynamic analysis of fixed offshore structures.

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TEXT BOOKS

1. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.
2. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.

REFERENCES

1. Hand book of offshore Engineering, Vol I, Subrata Chakrabarti, Offshore Structure Analysis, Inc., Plainfield, Illinois, USA.
2. API RP 2A., Planning, Designing and Constructing Fixed Offshore Platforms, API.
3. McClelland, B & Reifel, M. D., Planning & Design of fixed Offshore Platforms, Van Nostrand, 1986.

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I Year - II Semester	L	T	P	C
	3	0	0	3
Elective 4 - - EARTHQUAKE RESISTANT DESIGN OF BUILDINGS				

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

CO1	To learn the fundamentals of seismology and basic earthquake mechanisms, tectonics types of ground motion, and propagation of ground motion.
CO2	Understand qualitative and quantitative representations of earthquake magnitude
CO3	Determine the natural frequency of a single degree of freedom dynamic system for given mass, stiffness and damping properties.
CO4	Determine the maximum dynamic response of an elastic vibrating structure to a given forcing function
CO5	Learn the fundamentals of building code based structural design
CO6	Determine the static design base shear based on the type of structural system, irregularity, location and occupancy.
CO7	Distribute the static base shear to the structure based on vertical distribution of mass horizontal distribution of mass, and centers of rigidity.
CO8	Recognize special conditions such as irregular buildings, building separation, P- delta

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	--	2	--	---	2	1
CO2	--	--	2	--	--	2	1
CO3	--	--	2	--	--	2	1
CO4	--	--	2	--	--	2	1
CO5	--	1	2	3	---	2	1
CO6	--	1	2	3	--	2	1
CO7	--	1	2	3	--	2	1

1. Slightly 2. Moderately 3. Substantially

Detailed 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 Shri Khande, Prentice – Hall of India, 2007, New Delhi.
2. Earthquake Resistant Design of Structures- S.K. Duggal, Oxford Publications

REFERENCE

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

I Year - II Semester	L	T	P	C
	3	0	0	3
Elective IV: PRECAST AND PREFABRICATED STRUCTURES				

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

CO1	Analyze the prefabricated load carrying members
CO2	Analyze the production technology of prefabrication
CO3	Design and detailing of precast UNIT for factories
CO4	Design single storied simple frames

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	3	2	1
CO2	2	1	1	3	2	1
CO3	2	1	2	3	3	1
CO4	2	1	1	3	3	1

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

UNIT -I

Need for 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 Load Carrying Members-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.

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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

Applications - Designing and detailing of precast UNIT for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, single 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
4. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.

REFERENCES

1. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.
2. Mokka L, (1964), Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest.

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I Year - II Semester		L	T	P	C
		3	0	0	3
Elective IV - EARTH RETAINING STRUCTURES					

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

CO1	Quantify the lateral earth pressures associated with different earth systems
CO2	Evaluate the mechanical properties of geosynthetics used for soil reinforcement
CO3	Identify the merits and demerits of different earth retaining systems.
CO4	Select the most technically appropriate type of retaining wall for the application from a thorough knowledge of available systems
CO5	Design of retaining structures using appropriate design methods, factors of safety, earth pressure diagrams and field verification methods
CO6	Aware of current guidelines regarding the design of earth retaining structures.
CO7	Design retaining structures considering both external and internal stability aspects

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	--	1	1	--	1	1
CO2	--	--	1	1	--	1	1
CO3	--	--	--	1	--	1	1
CO4	--	--	1	1	--	1	1
CO5	--	--	2	3	--	2	2
CO6	--	--	2	2	--	2	2
CO7	--	--	1	3	--	2	2

1. Slightly 2. Moderately 3. Substantially

Detailed 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 – different types - Type of Failures of Retaining Walls – Stability requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.

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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 7e by Braja Das, Cengage Learning
2. Foundation analysis and design by Bowles, J.E. – McGraw Hill

REFERENCES

1. Soil Mechanics in Engineering Practice – Terzaghi, K and Ralph, B. Peck 2^e. – John Wiley & Sons.,
2. Analysis and Design of Foundations and Retaining Structures, Samsheer Prakash, Gopal Ranjan and Swami Saran, Saritha Prakashan, New Delhi
3. NPTEL course materials on Geo-synthetics and Earth Retaining Structures

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I Year - II Semester		L	T	P	C
		0	0	4	2
Laboratory 3 – COMPUTER AIDED DESIGN LABORATORY					

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

CO1	Develop Computer Programs for Analysis and Design of various Structural Elements
CO2	Use different Structural Engineering software's to solve various civil Engineering programs

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	3	1	3	3
CO2	1	3	2	3	1	3	3

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

Analysis and Design using STADD, STADD FOUNDATION, ETABS, ANSYS

1. Programming for beams subject to different loading
2. Analysis and Design of reinforced concrete multistoried building
3. Analysis of plane and space truss
4. Analysis of plane and space frame
5. Determination of mode shapes and frequencies of tall buildings using lumped mass (stick model) approximation

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

REFERENCE:

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

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I Year - II Semester		L	T	P	C
		0	0	4	2
Laboratory 4 – STRUCTURAL DESIGN LABORATORY					

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

CO1	Develop Computer Programs for Analysis and Design of various Structural Elements
CO2	Use different Structural Engineering software's to solve various civil Engineering programs

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	3	1	3	3
CO2	1	3	2	3	1	3	3

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

Analysis and Design using STADD, STADD FOUNDATION, ETABS, ANSYS

1. Wind analysis on tall structure
2. Analysis of pre stressed concrete bridge girder
3. Analysis of Cylindrical shell
4. Analysis of Bridge Pier and Abutment
5. Dynamic Analysis of Multistory structure

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

REFERENCE:

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

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I Year - II Semester		L	T	P	C
		0	0	4	2
SEMINAR					

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

CO1	Collect research material on some topic and to summaries it report and give to present the same
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Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	--	--	1	1	2	2	2

1. Slightly 2. Moderately 3. Substantially

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AUDIT 1 and 2: VALUE EDUCATION**Course Objectives**

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit	Content	Hours
1	<ul style="list-style-type: none"> • Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgements 	4
2	<ul style="list-style-type: none"> • Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism. Love for nature ,Discipline 	6
3	<ul style="list-style-type: none"> • Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature 	6
4	<ul style="list-style-type: none"> • Character and Competence –Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence ,Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively 	6

Suggested reading

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values 3. Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA**Course Objectives:**

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Units	Content	Hours
1	History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)	4
2	Philosophy of the Indian Constitution: Preamble Salient Features	4
3	Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy Fundamental Duties.	4
4	Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	4
5	Local Administration: <ul style="list-style-type: none"> • District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. • Pachayati raj: Introduction, PRI: ZilaPachayat. • Elected officials and their roles, CEO ZilaPachayat: Position and role. • Block level: Organizational Hierarchy (Different departments), • Village level: Role of Elected and Appointed officials, • Importance of grass root democracy 	4
6	Election Commission: <ul style="list-style-type: none"> • Election Commission: Role and Functioning. • Chief Election Commissioner and Election Commissioners. • State Election Commission: Role and Functioning. • Institute and Bodies for the welfare of SC/ST/OBC and women. 	4

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Suggested reading

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

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

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AUDIT 1 and 2: PEDAGOGY STUDIES**Course Objectives:**

Students will be able to:

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

Units	Content	Hours
1	Introduction and Methodology: <ul style="list-style-type: none"> • Aims and rationale, Policy background, Conceptual framework and terminology • Theories of learning, Curriculum, Teacher education. • Conceptual framework, Research questions. • Overview of methodology and Searching. 	4
2	<ul style="list-style-type: none"> • Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education. 	2
3	<ul style="list-style-type: none"> • Evidence on the effectiveness of pedagogical practices • Methodology for the in depth stage: quality assessment of included studies. • How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? • Theory of change. • Strength and nature of the body of evidence for effective pedagogical practices. • Pedagogic theory and pedagogical approaches. • Teachers' attitudes and beliefs and Pedagogic strategies. 	4
4	<ul style="list-style-type: none"> • Professional development: alignment with classroom practices and follow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment • Barriers to learning: limited resources and large class sizes 	4
5	Research gaps and future directions <ul style="list-style-type: none"> • Research design • Contexts • Pedagogy • Teacher education • Curriculum and assessment • Dissemination and research impact. 	2

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Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, „learning to read“ campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

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AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA**Course Objectives**

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	Content	Hours
1	Definitions of Eight parts of yog. (Ashtanga)	8
2	Yam and Niyam. Do`s and Don`t`s in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	Asan and Pranayam 1. Various yog poses and their benefits for mind & body 2. Regularization of breathing techniques and its effects-Types of pranayam	8

Suggested reading

1. „Yogic Asanas for Group Training-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur.
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

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AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

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

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52,53,59 (dont"s) Verses- 71,73,75,78 (do"s)	8
2	Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	8
3	Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	8

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students

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