SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)

(Affiliated to JNTUK, Kakinada), (Recognized by AICTE, New Delhi)
Accredited by NAAC with 'A' Grade
CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R19)
M.TECH -STRUCTURAL ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
(With effect from **2019-2020**Admitted Batch onwards**)**
I-SEMESTER

Subject Code.	Name of the Subject	Category.	C	L	T	P	Internal Marks	External Marks	Total Marks
M19 ST 1101	Theory of Elasticity	PC	3	3	0	0	25	75	100
M19 ST 1102	Structural Dynamics	PC	3	3	0	0	25	75	100
#PE-I	Program Elective-I	PE	3	3	0	0	25	75	100
#PE-II	Program Elective-II	PE	3	3	0	0	25	75	100
M19 ST 1109	Advanced Concrete Technology	PC	2	2	0	0	25	75	100
M19 ST 1110	Advanced Concrete Laboratory	PC	2	0	0	4	25	75	100
M19 ST 1111	Advanced Structural Engineering Laboratory	PC	2	0	0	4	25	75	100
#AC-1	Audit course -1	AC	0	2	0	0	0	0	0
		Total	**18**	**16**	**0**	**8**	**175**	**525**	**700**

	Code	Course		Code	Course
#PE-I	M19ST1103	Matrix Analysis of Structures	**#AC1&2**	M19AC0001	English for Research Paper Writing
	M19ST1104	Analytical & Numerical Methods for Structural Engineering		M19AC0002	Disaster Management
	M19ST1105	Design of RCC Foundations		M19AC0003	Sanskrit for Technical Knowledge
				M19AC0004	Value Education
				M19AC0005	Constitution of India
#PE-II	M19ST1106	Bridge Engineering		M19AC0006	Pedagogy Studies
	M19ST1107	Repair and Rehabilitation of Structures		M19AC0007	Stress Management by Yoga
	M19ST1108	Advanced Reinforced Concrete Design		M19AC0008	Personality Development through Life Enlightenment Skills.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 1101	**PC**	**3**	**0**	**0**	**3**	**25**	**75**	**3 Hrs.**

THEORY OF ELASTICITY

Course Objectives:

1.	To know various notations for stress and strain in two and three dimensional
2.	To understand behaviour of a member in two and three dimensional
3.	To develop formulations for solving problems on elasticity

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Understand the notations of stress and strain	K2
2.	Analyze the stresses and strains in rectangular co-ordinate system and	K4
3.	Analyze the stresses and strains in polar co-ordinate system	K4
4.	Evaluate the equilibrium and compatibility conditions	K5
5.	Analyze members for different shaped bars subjected to torsion.	K4

SYLLABUS

UNIT-I (8 Hrs)	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 (8 Hrs)	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 (8 Hrs)	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-IV (10 Hrs)	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 (8 Hrs)	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, McGraw hill Publishers
2.	Advanced Mechanics of Solids L.S. Srinath, McGraw Hill Publishers

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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 1102	**PC**	**3**	**0**	**0**	**3**	**25**	**75**	**3 Hrs.**

STRUCTURAL DYNAMICS

Course Objectives:

1.	To find the behavior of structures subjected to dynamic loads such as wind, earthquake and blast loads.
2.	To study the different Dynamic analysis procedures for calculating the response of structures.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Understand the response of structural systems to dynamic loads	K2
2.	Understand the behavior and response of linear and nonlinear SDOF and MDOF structures with various dynamic loading	K2
3.	Understand the behavior and response of MDOF structures with various Dynamic loading.	K2
4.	Possess the ability to find out suitable solution for continuous system	K2
5.	Understand the behavior of structures subjected to dynamic loads under free vibration	K2
6.	Understand the behavior of structures subjected to dynamic loads Harmonic excitation and earthquake load	K2

SYLLABUS

UNIT-I (8 Hrs)	**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 – un damped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation - Vibration Isolation -Dynamic magnification factor – Phase angle.
UNIT-II (8 Hrs)	**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 (8 Hrs)	**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 (10 Hrs)	**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 (8 Hrs)	**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 HallPublishers
2.	Structural Dynamics Theory & Computation – Mario Paz, CBS Publishes andDistributors
3.	Elementary Structural Dynamics- V.K. ManikaSelvam, DhanpatRaiPublishers
Reference Book:	
1.	Dynamics of Structures by Clough &Penzien 3e, Computers & Structures Inc.
2.	Structural Dynamics of Earthquake Engineering - Theory and Application using Mathematical and Mat lab- S.Rajasekharan

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1103	**PE**	**3**	**0**	**0**	**3**	**25**	**75**	**3 Hrs.**

MATRIX ANALYSIS OF STRUCTURES

Course Objectives:

1.	To prepare the students to have a basic knowledge in the matrix methods such as flexible matrix method and Stiffness matrix method.
2.	To prepare the students to analyze the Plane frame and Plane truss problems by matrix methods

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Perform the structural analysis of determinate and indeterminate structures using classical compatibility methods, such as method of consistent displacements, force and equilibrium Methods	K4
2.	Perform structural analysis using the stiffness method.	K4
3.	Solve multiple degree of freedom two and three dimensional problems involving trusses, beams, frames and plane stress	K4
4.	Understand basic finite element analysis	K4

SYLLABUS

UNIT-I (10 Hrs)	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 (8Hrs)	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 (8Hrs)	Stiffness method for Grid elements – development of stiffness matrix coordinatetransformation. Examples of grid problems – tapered and curved beams
UNIT-IV (8 Hrs)	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 (8Hrs)	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 Jercy
2.	Advanced structural analysis, P. Dayaratnam-Tata McGraw hill publishing company limited.
3.	Structural Analysis Matrix Approach - Pandit and Gupta, McGrawHil Education

Reference Books:

1.	Indeterminate Structural analysis, C K Wang, Amazon Publications
2.	Matrix Analysis of Framed Structures 3e-William Weaver, Jr, James M. Gere, VanNostrandReinhold,Newyork
3	Foundation Analysis and design, J.E. Bowls, 5e, AmazonPublications.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1104	PE	3	0	0	3	25	75	3 Hrs.

ANALYTICAL & NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

Course Objectives: To explain the students

1.	The concepts of different Transform methods
2.	Study the calculation of variations
3.	Concepts of finite differences and their applications.
4.	Numerical methods to solve the various structural engineering mathematical models

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Understand the applications of Laplace and Fourier transforms	K2
2.	Implement the principles and techniques of Calculusof Variations	K4
3.	Find the solutions for different kinds of integral equations	K3
4.	Adopt the principles and techniques of finite difference methods	K3
5.	Use Numerical differentiation and integration techniquesfor finding numerical solutions	K3

SYLLABUS

UNIT-I (10 Hrs)	**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 (10 Hrs)	**Elliptic Equations**-Laplace equation - Properties of harmonic functions - Fourier transform methods for Laplace equation**Calculus Of Variations-** Variation and its properties - Euler's equation - Functional 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 (8Hrs)	**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 secondkind.
UNIT-IV (10 Hrs)	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 (10Hrs)	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.

Text Books:

1.	Introduction to Partial Differential Equations, SankaraRao. K, , PHI, New Delhi,1995
2.	Elements of Partial Differential Equations, Sneddon. I.N, McGraw Hill,1986

Reference Books:

1.	Differential Equations and Calculus of Variations Elsgolts. L, Mir Publishers, Moscow,1966
2.	Higher Engineering Maths for Engg. And Sciences Venkataraman. M. K, National Publishing Company,Chennai

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1105	**PE**	**3**	**0**	**0**	**3**	**25**	**75**	**3 Hrs.**

DESIGN OF REINFORCED CONCRETE FOUNDATIONS

Course Objectives:

1.	Able to learn design concept of different types of R.C foundations
2.	Able to learn design concept of cantilever and Basement Retaining Walls

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Attain the perception of site investigation to select suitable type of foundation based on soil category	K4
2.	Capable of ensuring design concepts of shallow foundation	K5
3.	Can be efficient in selecting suitable type of pile for different soil stratum and in evaluation of group capacity by formulation	K4
4.	Design different types of well foundation	K3

SYLLABUS

UNIT-I (8 Hrs)	**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 (8 Hrs)	**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 (12 Hrs)	**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 (12 Hrs)	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 (8 Hrs)	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 Book:	
1.	Design of Reinforced Concrete Foundations by P. C Varghese, PHI Learning Private Limited., New Delhi.
Reference Books:	
1.	Design of Reinforced Concrete Structures by N. Subramaniam- OxfordUniversity.
2.	Reinforced Concrete Design by UnnikrishnaPillai and DevdasMenon, Tata McGrawHill

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1106	**PE**	**3**	**0**	**0**	**3**	**25**	**75**	**3 Hrs.**

BRIDGE ENGINEERING

Course Objectives:

1.	To choose the appropriate bridge type for a given project and
2.	To understand different theories for analyses concrete bridges. Analysis and design of T- beam bridge.
3.	To analyses and design the components of the box culverts.
4.	To design of the plate girder bridges.
5.	To analysis and design of the sub-structures.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	To decide the structural form for a bridge depending on the functional requirements and site conditions. Identify various structural components of the chosen bridge form.	K3
2.	Design theories for super structure and substructure of bridges, R.C.C T Beam Bridge.	K4
3.	Design of box culverts.	K4
4.	Design of railway bridges, plate girder bridges.	K4
5.	Stability analysis of abutments, different types of bearings, abutments, piers and various types of foundations for Bridges	K4

SYLLABUS

UNIT-I (10 Hrs)	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 (10 Hrs)	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 (10 Hrs)	Box Culverts- Single Cell Box Culvert – Design Loads, Design Moments, Shears and Thrusts. Design of Critical sections.
UNIT-IV (10 Hrs)	Plate girder bridges - Elements of plate girder and their design-web-flange -intermediate stiffener- vertical stiffeners- bearing stiffener- Design problem.
UNIT-V (8 Hrs)	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, KhannaPublishers
Reference Books:	
1.	Concrete Bridge Design and Practice- V.K. Raina, Tata McGraw- Hill Publishing Company Limited
2.	E.C. Hambly, Bridge deck behaviour, Taylor & Francis, London, 1976.
3.	E.J. O'Brien and D.L. Keogh, Bridge deck analysis, E& FN Spon, New York , 1999.
4.	D.Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi, 2001.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1107	**PE**	**3**	**0**	**0**	**3**	**25**	**75**	**3 Hrs.**

REPAIR AND REHABILITATION OF STRUCTURES

Course Objectives:

1.	To familiarize the students with various types of deteriorations and need for rehabilitation.
2.	To familiarize the student with Non – destructive testing and repairs.
3.	To familiarize the student with strengthening and stabilization of deteriorated concrete structures.
4.	To familiarize the student with special concretes.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Recognize the various materials for repair and rehabilitation. Non- destructive evaluation of concrete structures.	K2
2.	Design and suggest repair strategies for deteriorated concrete structures including repairing with composites.	K3
3.	Understand the methods of strengthening methods for concrete structures.	K3
4.	Design of special concretes.	K3

SYLLABUS

UNIT-I (8 Hrs)	Materials for repair and rehabilitation-Admixtures- types of admixtures- purposes of using admixtures- chemical composition- Natural admixtures- Fibers- wraps- Glass and Carbon fiber wraps-Steel Plates-Non destructiveevaluation: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 (10 Hrs)	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 (8 Hrs)	Bonded installation techniques- Externally bonded FRP- Wet layup sheet, bolted plate, near surface mounted FRP, fundamental de-bonding mechanisms- intermediate crack de-bonding- CDC de-bonding- plate end de-bonding- strengthening of floor of structures
UNIT-IV (8 Hrs)	Fibre reinforced concrete- Properties of constituent materials- Mix proportions, mixing and casting methods- Mechanical properties of fiber reinforced concrete- applications of fiber reinforced concretes-Light-weight 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 (8 Hrs)	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
Reference Books:	
1.	Concrete Repair and Maintenance illustrated, Peter HEmmons
2.	Handbook on Repair and Rehabilitation of RC Buildings published by CPWD, Delhi

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST1108	**PE**	**3**	**0**	**0**	**3**	**25**	**75**	**3 Hrs.**

ADVANCED REINFORCED CONCRETE DESIGN

Course Objectives:

1.	To know redistribution of moments in fixed and continuous beams
2.	To design the flat slabs and deep beams
3.	Analyze the slender columns

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Analyze fixed and continuous beams after redistribution of moments	K4
2.	Apply virtual work / equilibrium method for analysis of R.C Elements	K4
3.	Design flat slab with and without drop panel or column heads	K5
4.	Analyze and Design deep beams	K4
5.	Compute /determinate manually in slender columns	K5

SYLLABUS

UNIT-I (8 Hrs)	**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 (8 Hrs)	**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 (10 Hrs)	**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.
UNIT-IV (6 Hrs)	**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 (8 Hrs)	**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 IndiaLimited
2.	Reinforced Concrete Design, by S. UnnikrishnaPillai&DevdasMenon Tata Mc. Graw-Hill Publishing Company Ltd. New Delhi2010.
Reference Books:	
1.	Reinforced concrete structural elements – behavior, Analysis and design by P.Purushotham, Tata Mc.Graw-Hill,1994.
2.	Design Reinforced Concrete Foundations P.C. Varghese Prentice Hall of INDIA PrivateLtd.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1109	**PC**	**2**	**0**	**0**	**2**	**25**	**75**	**3 Hrs.**

ADVANCED CONCRETE TECHNOLOGY

Course Objectives:

1.	This course mainly aims to develop the knowledge about properties of cement concrete and importance of admixtures in concrete.
2.	To develop an advanced knowledge of the mechanical performance of cement-based materials and how it can be controlled
3.	To recognize the effects of the rheology and early-age properties of concrete on its long-term behavior

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Classify and explain various concrete making materials	K2
2.	Apply fundamental knowledge in the fresh, hardened and high strength properties of concrete	K3
3.	Determine the application and use of various special concrete and form work	K5
4.	Design and develop a concrete mix design for different codes.	K6

SYLLABUS

UNIT-I (10 Hrs)	**Concrete Making Materials :** Cement – Bogus Compounds – Hydration Process – Types of Cement – Aggregates – Gradation Charts – Combined Aggregate – Alakali Silica Reaction – Admixtures – Chemical and Mineral Admixtures. Bureau of Indian Standards (BIS) Provisions.
UNIT-II (8 Hrs)	**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 (10 Hrs)	**High Strength Concrete** – Microstructure – Manufacturing and Properties – Design of HSC Using ErintroyShaklok method – Ultra High Strength Concrete. High Performance Concrete – Requirements and Properties of High Performance Concrete – Design Considerations. BIS Provisions.
UNIT-IV (10 Hrs)	**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 (10 Hrs)	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
2.	Concrete Technology by M.S. Shetty, S.Chand& Co.
3.	Concrete Technology by A. R. Santhakumar, 2nd Edition, Oxford University Press.
4.	Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
Reference Books:	
1.	Concrete: Micro Structure, Properties and Materials by P. K. Mehta and P. J. Monteiro,. Mc. Graw-Hill Publishing Company Ltd. NewDelhi
2.	Design of Concrete Mixes by N. Krishna Raju, CBS Publications,2000.
3.	Special Structural concretes by Rafat Siddique, Galgotia Publications 2000.
4.	Relevant BIS Codes

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 1110	**LAB**	**0**	**0**	**4**	**3**	**25**	**75**	**3 Hrs.**

ADVANCED CONCRETE TECHNOLOGY LABORATORY

Course Objectives:

1.	To familiarize the students with physical properties and mechanical behaviour of concrete and related construction materials.
2.	To demonstrate the students background theoretical aspects related to concrete making materials and to highlight the link with actual practice.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Conduct various laboratory tests on Cement, Aggregates	K4
2.	Know the strain measurement	K5
3.	Perform Non- Destructive testing of concrete	K7
4.	Chemical analysis on concrete and Aggregate and Sand	K4

SYLLABUS

EXP - I	Study on Water / Cement Ratios Vs Workability of different concretes
EXP - II	Study on Water / Cement Ratios Vs Strength of different concretes
EXP - III	Study of variation of Coarse Aggregate to Fine Aggregates on Workability
EXP - IV	Study of variation of Coarse Aggregate to Fine Aggregates on Strength
EXP - V	Strain measurement - Electrical resistance strain gauges
EXP - VI	Non Destructive testing- Impact Hammer test, UPV test
EXP - VII	Qualifications tests on Self compaction concrete- L Box , J Box , U box and Slump tests

Text Books:

1.	Properties of Concrete by A. M. Neville, ELBS publications
2.	Design of Concrete Mixes by N. Krishna Raju, CBS Publications,2000.

Reference Book:

1.	Concrete Technology by M.S. Shetty, S.Chand& Co.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 1111	**LAB**	**0**	**0**	**4**	**3**	**25**	**75**	**3 Hrs.**

ADVANCED STRUCTURAL ENGINEERING LABORATORY

Course Objectives:

1.	Understand Serviceability criteria on reinforced concrete structures
2.	Understand Shear behaviour in RCC Beam
3.	Understand flexure behaviour in RCC Beam
4.	Understand flexure behaviour in RCC one way slab and Two way slabs

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Design and test the deflection and cracks in R.C.Beams	K5
2.	Design and test the Shear behaviour in RCC Beam	K6
3.	Design and test the flexure behaviour in RCC Beam	K5
4.	Design and test the flexure behaviour in RCC one way slab and Two way slabs	K6
5	Determine the Young's Modulus of Elasticity ofConcrete	K5

SYLLABUS

EXP - I	Study on Deflection and Cracks on a Under Reinforced Over Reinforced and Balanced Sections
EXP - II	Study on Performance of RCC Beams designed for Bending and failing in Shear
EXP - III	Study on Performance of RCC Beams designed for Shear and failing in Bending
EXP - IV	Study on Performance of RCC One ways labs
EXP - V	Study on Performance of RCC Two way slabs with simply supported edge conditions
EXP - VI	Study on Performance of RCC Two way slabs with fixed edge conditions
EXP -VII	Calculation of Young's Modulus of Elasticity of Concrete
EXP -VII	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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19AC0001	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**

ENGLISH FOR RESEARCH PAPER WRITING

Course Objectives:

1.	Understand how to improve your writing skills and level of readability
2.	Learn about what to write in each section.
3.	Understand the skills needed when writing a Title.
4.	Ensure the good quality of paper at very first-time submission

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Understand that how to improve your writing skills and level of readability	K2
2.	Learn about what to write in each section	K2
3.	Understand the skills needed when writing a Title Ensure the good quality of paper at very first time submission	K2

SYLLABUS

UNIT-I (4Hrs)	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
UNIT-II (4Hrs)	Clarifying Who Did What, Highlighting Your Findings, Hedging And Criticizing, Paraphrasing and Plagiarism, Sections of a Paper.
UNIT-III (4Hrs)	Abstracts,Introduction,Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.
UNIT-IV (4Hrs)	Key skills are needed when writing a Title, key skills are needed when writing an abstract, key skills are needed when writing an introduction, skills needed when writing a Review of the Literature, skills are needed when writing the Methods.
UNIT-V (4Hrs)	skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Text Books:

1.	Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2.	Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

Reference Books:

1.	Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
2.	Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Code	Category	L	T	P	C	I.M	E.M	Exam
M19AC0002	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**

DISASTER MANAGEMENT

Course Objectives:

1.	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2.	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3.	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4.	Critically understand the strengths and weaknesses of disaster management approaches, planning & programming in different countries, particularly their home country or the countries they work in.

SYLLABUS

UNIT-I (4Hrs)	**Disaster:** Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.
UNIT-II (4Hrs)	Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts
UNIT-III (4Hrs)	**Disaster Prone Areas In India:** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.
UNIT-IV (4Hrs)	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.
UNIT-V (4Hrs)	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. **Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Text Books:

1.	R. Nishith, Singh AK, Disaster Management in India: Perspectives, issues and strategies New Royal Book Company.

2.	Sahni, PardeepEt.Al. (Eds.),Disaster Mitigation Experiences And Reflections, Prentice Hall Of India, New Delhi.
3.	Goel S. L. Disaster Administration And Management Text And Case Studies ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19AC0003	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**

SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives:

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

Course Outcomes

S.No	Outcome	Knowledge Level
1	Understanding basic Sanskrit language.	K2
2	Ancient Sanskrit literature about science & technology can be understood.	K2
3	Being a logical language will help to develop logic in students.	K6

SYLLABUS

UNIT-I (7Hrs)	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences
UNIT-II (7Hrs)	Order, Introduction of roots, Technical information about Sanskrit Literature
UNIT-III (7Hrs)	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Text Books:

1.	"AbhyasaPustakam" – Dr.Vishwas, Samskrita-Bharati Publication, New Delhi
2.	"Teach Yourself Sanskrit" PrathamaDiksha-VempatiKutumbasastry, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3.	"India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi

Code	Category	L	T	P	C	I.M	E.M	Exam
M19AC0004	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**

VALUE EDUCATION

Course Objectives:

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

Course Outcomes

S.No	Outcome	Knowledge Level
1	Knowledge of self-development	K1
2	Learn the importance of Human values	K2
3	Developing the overall personality	K3

SYLLABUS

UNIT-I (4Hrs)	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.Moral and non- moral valuation. Standards and principles. Value judgements.
UNIT-II (4Hrs)	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
UNIT-III (4Hrs)	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
UNIT-IV (4Hrs)	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.

Text Books:

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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19AC0005	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**

CONSTITUTION OF INDIA

Course Objectives:

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

Course Outcomes

S.No	Outcome	Knowledge Level
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.	K2
2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	K2
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.	K2
4	Discuss the passage of the Hindu Code Bill of 1956.	K2

SYLLABUS

UNIT-I (4Hrs)	**History of Making of the Indian Constitution:** History , Drafting Committee, (Composition & Working)
UNIT-II (4Hrs)	Philosophy of the Indian Constitution: Preamble ,Salient Features
UNIT-III (4Hrs)	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
UNIT-IV (4Hrs)	**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 **Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zilla Panchayat. Elected officials and their roles, CEO Zilla Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments),Village

	level: Role of Elected and Appointed officials, Importance of grass root democracy
UNIT-V (4Hrs)	**Election Commission:** 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.
Text Books:	
1.	The Constitution of India, 1950 (Bare Act), Government Publication.
2.	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3.	M. P. Jain, Indian Constitution Law, 7th Edn., LexisNexis, 2014.
4.	D.D. Basu, Introduction to the Constitution of India, LexisNexis, 2015.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19AC0006	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**

PEDAGOGY STUDIES

SYLLABUS

UNIT-I (4Hrs)	**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.
UNIT-II (4Hrs)	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.
UNIT-III (4Hrs)	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.
UNIT-IV (4Hrs)	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. Professional development: alignment with classroom practices andfollow-up support
UNIT-V (4Hrs)	**Research gaps and future directions:** Research design, Contexts,Pedagogy,Teachereducation,Curriculum and assessment,Dissemination and research impact.

Text Books:

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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19AC0007	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**

STRESS MANAGEMENT BY YOGA

Course Objectives:

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

Course Outcomes

S.No	Outcome	Knowledge Level
1	Develop a healthy mind in a healthy body thus improving social health also.	K2
2	Improve efficiency	K2

SYLLABUS

UNIT-I (7Hrs)	Definitions of Eight parts of yoga (Ashtanga)
UNIT-II (7Hrs)	Yam and Niyam. Do's and Don'ts in life. i) Ahinsa, satya, astheya, brahmacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishvarapranidhana
UNIT-III (7Hrs)	Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types pranayama

Text Books:

1.	'Yogic Asanas for Group Training-Part-I" : Janardan Swami YogabhyasiMandal, Nagpur
2.	"Raja Yoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Code	Category	L	T	P	C	I.M	E.M	Exam
M19AC0008	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**

PERSONALITY DEVELOPMENT THROUGH LIFEENLIGHTENMENT SKILLS

Course Objectives:

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

Course Outcomes

S.No	Outcome	Knowledge Level
1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.	K2
2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity.	K2
3	Study of Neetishatakam will help in developing versatile personality of students.	K2

SYLLABUS

UNIT-I (7Hrs)	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 (don'ts),Verses- 71,73,75,78 (do's)
UNIT-II (7Hrs)	Approach to day to day work and duties. ShrimadBhagwadGeeta : 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.
UNIT-III (7Hrs)	Statements of basic knowledge, ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14, 15, 16,17, 18, Personality of Role model. ShrimadBhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39, Chapter18 – Verses 37,38,63

Text Books:

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

SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
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CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204
Estd:1980

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R19)
M.TECH -STRUCTURAL ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
(With effect from **2019-2020**Admitted Batch onwards**)**
II-SEMESTER

Subject Code.	Name of the Subject	Category.	C	L	T	P	Internal Marks	External Marks	Total Marks
M19 ST 1201	Finite Element Methods in Structural Engineering	PC	3	3	--	--	25	75	100
M19 ST 1202	Theory of Plates and Shells	PC	3	3	--	--	25	75	100
#PE-III	Program Elective-III	PE	3	3	--	--	25	75	100
#PE-IV	Program Elective-IV	PE	3	3	--	--	25	75	100
M19 ST 1209	Computer Aided Design Laboratory	PC	2	--	--	4	25	75	100
M19 ST 1210	Design of Structures Laboratory	PC	2	--	--	4	25	75	100
M19 ST 1211	Mini Project With Seminar	PC	2	--	--	4	100	---	100
M19AC 0005	Audit Course -2	AC	--	2	--	--	--	--	--
		Total	**18**	**14**	**0**	**12**	**250**	**450**	**700**

	Code	Course
#PE-III	M19ST1203	Stability of Structures
	M19ST1204	Advanced Steel Design
	M19ST1205	Analysis of Offshore Structures
#PE-IV	M19ST1206	Earthquake Resistant Design of Buildings
	M19ST1207	Structural Optimization Techniques
	M19ST1208	Earth Retaining Structures

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 1201	**PC**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

FINITE ELEMENT METHODS IN STRUCTURAL ENGINEERING

Course Objectives

The students are expected to have fair understanding of

1.	basics of Finite Element Analysis.
2.	analysis of 1D, 2D and 3D elements
3.	analysis of axisymmetric and Iso-parametric elements

Course Outcomes

The student will be able to

S.No	Outcome	Knowledge Level
1.	Apply finite element method to solve problems in solid mechanics.	K1, K2 and K3
2.	Formulate and solve problems in one dimensional structures including trusses, beams.	K3
3.	Formulate finite element characteristic equations for two dimensional elements and analyze plain stress, plain strain, axisymmetric and plate bending problems.	K3

SYLLABUS

UNIT-I (6 Hrs)	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 (8 Hrs)	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 3D truss- Inclined and skewed supports- Galerkin's method for 1D truss – Computation of stress in a truss element.
UNIT-III (8 Hrs)	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 - 2D Arbitrarily oriented beam element – inclined and skewed supports –rigid plane frame examples
UNIT-IV (8 Hrs)	Finite element formulation for plane stress, plane strain and axisymmetric problems- Derivation of CST and LST stiffness matrix and equations- treatment of body and surface forces- Finite Element solution for plane stress and axisymmetric problems-comparison of CST and LST elements –convergence of solution- interpretation of stresses.
UNIT-V (6 Hrs)	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
Reference Books:	
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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 1202	**PC**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

THEORY OF PLATES AND SHELLS

Course Objectives:

1.	To familiarize with the concepts of plates and shells and designing of shells.
2.	Have a knowledge about various plate theories due to bending

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Gain the knowledge of Navier‟s solution, Levy‟s solution and solve for the rectangular and square plates	K3
2.	Analyze circular plates with various boundary conditions.	K4
3.	Focus on the finite difference method of solving plate problems.	K4
4.	Ability to realize the potential energy principle and find the solution of rectangular plates for various loadings	K5

SYLLABUS

UNIT-I (8 Hrs)	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-II (6 Hrs)	Circular plates: Symmetrically loaded, circular plates under various loading conditions, Annular plates.
UNIT-III (8 Hrs)	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 (8 Hrs)	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 (8 Hrs)	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.	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
Reference Book:	
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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 1203	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

STABILITY OF STRUCTURES

Course Objectives:

1.	Understand behaviour beam-columns subjected to various types of loads
2.	Know and understand various methodologies of elastic and inelastic buckling of columns
3	Know the concepts of lateral buckling of beams and torsional buckling of circular sections

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Analyze different types of structural instabilities	K4
2.	Execute and work out the inelastic buckling using various methodologies.	K4
3.	Examine the behaviour of beam columns and frames with and without side sway using classical and stiffness methods	K4
4.	To be well versed in the lateral buckling, torsional buckling, Flexural torsional buckling of various beams and non- circular sections.	K4

SYLLABUS

UNIT-I (8 Hrs)	**Beam columns:** Beams column with a concentrated lateral load – Beams column with a uniformly distributed lateral load- Beams column with end moments lateral load Superposition of Solutions – simply supported Beam column- Differential equation for beam columns-Fixed-Fixed beam column with concentrated load at mid-span- Fixed-Fixed beam column with Uniformly distributed loads.
UNIT-II (8 Hrs)	**Elastic buckling of columns:** Method of Neutral Equilibrium- Critical load of the Euler Column-Boundary Conditions Effective-Length Concept and design Curve – Higher –Order Differential Equation for Columns- The Behavior of Imperfect Columns- Initially Bent columns- Eccentrically loaded columns– Effect of shear force on critical load – **In-elastic buckling of Columns**- Tangent modulus theory- Double modulus theory- Shanley's theory of inelastic column behaviour.
UNIT-III (8 Hrs)	**Approximate Methods of Analysis:** Conservation of energy principles, Calculation of critical loads using approximate deflection curve, Principle of stationary potential energy, Raleigh-Ritz method, Buckling load of column with variable cross-section, Galerkin's method, Calculation of critical load by finite differences.
UNIT-IV (8 Hrs)	**Buckling of Frames:** Introduction-Mode of Buckling-Elastic Critical Load of Frame Using Neutral Equilibrium- Elastic Critical Load of Frame Using Slope-deflection Equations-Elastic Critical Load of Frame Using Matrix Analysis.
UNIT-V (8 Hrs)	**Torsional Buckling:** Pure Torsion of Thin Walled Bars Open Cross Section–Non Uniform Torsion of Thin Walled Bars of Open Cross Section - Torsional buckling – Buckling of Torsion and Flexure. **Lateral Buckling of Beams:** Lateral Buckling of Simply Supported

	Rectangular Beams of Cross Section subjected for Pure Bending, Lateral Buckling of I-Section subjected to Pure Bending
Text Books:	
1.	Principles of Structural Stability Theory by Alexander Chajes, Prentice-Hall, Inc, Engle wood Cliffs, New Jersey.
2.	Structural Stability Theory and Implementation by W.F.Chen and E.M.Lui, Elsevier science Publishing Co., Inc, New York
3.	Theory of Elastic Stability by S. P. Timshenko & J.M. Gere- Mc Graw Hill Publications
Reference Books:	
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.	Theory of Elastic Stability by Manikaselvam

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1204	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

ADVANCED STEEL DESIGN

Course Objectives:

1.	To impart knowledge on behavior and design of various connections, industrial and steel girders.
2.	To familiarize the student on various design principles of plastic analysis and design.
3.	To familiarize the student on various eccentric and moment connections

Course Outcomes

S.No	Outcome	Knowledge Level
1.	The learner will be able to design different connections in steel structures	K5
2.	The learner will be able to apply concepts of plastic analysis and design for beams and frames	K5
3	The learner will be able to Design of purlins for roofs and Design Of Steel Truss Girder Bridges	K5

SYLLABUS

UNIT-I (10 Hrs)	**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 (10 Hrs)	**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 (10Hrs)	**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 (10 Hrs)	**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 (10Hrs)	**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 Books:	
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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1205	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

ANALYSIS OF OFFSHORE STRUCTURES

Course Objectives:

1.	To impart knowledge on different types of offshore structures ,Conservation mass and momentum
2.	To familiarize the student on Wave force estimation on small bodies and large bodies, Static and dynamic analysis of fixed offshore structures.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Perform concept development of off-shore structure	K4
2.	Find the wave force on vertical cylinder	K5
3.	Perform static and dynamic analysis of fixed offshore structure	K4

SYLLABUS

UNIT-I (8 Hrs)	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-II (8 Hrs)	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 (12 Hrs)	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-IV (12 Hrs)	Wave force on large bodies- Froude- krylov theory, Diffraction theory.
UNIT-V (8 Hrs)	Static and dynamic analysis of fixed offshore structures.

Text Book:

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

Reference Books:

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.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1206	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

EARTHQUAKE RESISTANT DESIGN OF BUILDINGS

Course Objectives:

1.	To learn the fundamentals of seismology and basic earthquake mechanisms, tectonics types of ground motion, and propagation of ground motion.
2.	Understand qualitative and quantitative representations of earthquake magnitude
3.	Learn the fundamentals of building code based structural design

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Determine the natural frequency of a single degree of freedom dynamic system for given mass, stiffness and damping properties.	K3
2.	Determine the maximum dynamic response of an elastic vibrating structure to a given forcing function	K4
3.	Determine the static design base shear based on the type of structural system, irregularity, location and occupancy.	K4
4.	Distribute the static base shear to the structure based on vertical distribution of mass horizontal distribution of mass, and centers of rigidity.	K4
5.	Recognize special conditions such as irregular buildings, building separation, P-delta	K4

SYLLABUS

UNIT-I (10 Hrs)	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 (10 Hrs)	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 (10 Hrs)	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 (10 Hrs)	Cyclic loading behavior of RC, steel and pre- stressed concrete elements - modern concepts- Base isolation – Adaptive systems – case studies
UNIT-V (8 Hrs)	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
Reference Books:	
1.	Seismic design of reinforced concrete and masonry buildings by Paulay and Priestley
2.	Earthquake Resistant Design and Risk Reduction- David Dowrick
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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1207	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

STRUCTURAL OPTIMIZATION TECHNIQUES

Course Objectives:

1.	To familiarize the student on various methods of optimization and design of structural members.
2.	To familiarize the student on classical optimization techniques, Non-Liner programming and Linear programming

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Derive optimized structure using classical and modern methods of optimization.	K3
2.	Gain the knowledge on Formulation of Structural Optimization problems.	K3
3.	Gain the knowledge on the concept of classical methods of optimization for multivariable	K3
4.	With equality or inequality constraints: solution by method of Lagrange Multiplier -Applications in structural engineering, Kuhn-Tucker conditions.	K4

SYLLABUS

UNIT-I (8 Hrs)	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 behaviour (monotonic and unimodal)
UNIT-II (10 Hrs)	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 (8 Hrs)	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 (10 Hrs)	Linear programming: Definitions and theorems- Simplex method-Duality in Linear programming- Plastic analysis and Minimum weight design and rigid frame
UNIT-V (10 Hrs)	Introduction to quadratic programming: Geometric programming- and dynamic programming-Design of beams and frames using dynamic programming technique

Text Books:

1.	"Optimization Theory and Applications" by Rao, S.S., Wiley Eastern Ltd., New Delhi, 1978.

2.	"Optimum Design of Structures" by Majid, K.I., Newnes-Butter Worths, London, 1974.
3.	Optimization Concepts and Application in Engineering- Belegundu A.D. and Chandrupatla
4.	
REFERENCE BOOKS:	
1.	"Mathematical Foundations for Design: Civil Engg. Systems" by Robert, M. Stark and Robert L. Nicholls, McGraw Hill Book Company, New York, 1972.
2.	"Optimum Structural Design, Theory and Applications", Edited by Gallegher, R.H. and Zienkiewiez, O.C., John Wiley and Sons, New York, 1973.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST1208	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

EARTH RETAINING STRUCTURES

Course Objectives:

1.	To develop fundamental understanding of science and engineering of earth retaining structures, through rigorous theoretical discussions, designs and live examples.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Solve for earth pressure exerted by soil on retaining walls using earth pressure theories.	K3
2.	Analyze the stability of conventional retaining walls.	K4
3.	Design reinforced soil wall using the concept of reinforced soil.	K4
4.	Analyze the stability of sheet pile walls.	K4
5.	Design various components of braced cuts and coffer dams.	K4

SYLLABUS

UNIT-I (10 Hrs)	**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 (10 Hrs)	**Retaining walls** – different types - Type of Failures of Retaining Walls – Stability requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.
UNIT-III (10 Hrs)	**Reinforced Soil Retaining Walls** – Reinforced soil - Different components – their functions – Design principles of reinforced soil retaining walls.
UNIT-IV (10 Hrs)	**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-V (10 Hrs)	**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
3.	An Introduction to Soil Reinforcement and Geosynthetics by G L Sivakumar Babu – University Press.
Reference Books:	
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, Samsher Prakash, Gopal Ranjan and Swami Saran, Saritha Prakashan, New Delhi
3.	NPTEL course materials on Geo-synthetics and Earth Retaining Structures

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1209	**PC**	**--**	**--**	**4**	**2**	**25**	**75**	**3 Hrs.**

COMPUTER AIDED DESIGN LABORATORY

Course Objectives:

1.	To apply the civil engineering software to some of the structural engineering problems.
2.	

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Develop Computer Programs for Analysis and Design of various Structural Elements	K2
2.	Use different Structural Engineering software's to solve various civil Engineering programs	K3

SYLLABUS

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

EXP - I	Programming for beams subject to different loading
EXP - II	Analysis and Design of reinforced concrete multistoried building
EXP - III	Analysis of plane and space truss
EXP - IV	Analysis of plane and space frame
EXP - V	Determination of mode shapes and frequencies of tall buildings using lumped mass (stick model) approximation
EXP - VI	Wind Analysis on tall structures
EXP - VII	Dynamic analysis of Multistory structures
NOTE	**A minimum of Five from the above set have to be conducted.**

Reference Books:

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

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 1210	**LAB**	**--**	**--**	**4**	**2**	**25**	**75**	**3 Hrs.**

DESIGN OF STRUCTURES LABORATORY

Course Objectives:

1.	To design the different type of structures and Bridges

Course Outcomes

S.No	Outcome	Knowledge Level
1.	To design the Folded Plates, blast resistant structures and berth structures	K4
2.	To design the Bow string girder bridge and Balanced cantilever bridge	K5

SYLLABUS

Any **THREE** of the following:

I	Design of Folded Plates
II	Design of blast resistant structures
III	Design of berth structures
IV	Elevated Service Reservoirs
V	Bow string girder bridge
VI	Balanced cantilever bridge
VII	Design of Piles and pile caps

Text Books:

1.	D.Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi, 2001.
2.	Design of Bridges by N. Krishna Raju CBS Publishers and Distributors

Reference Book:

1.	Design of Concrete Bridges- M.G. Aswini, V.N. Vazirani, M.M Ratwani, KhannaPublishers

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST1211	**MP**	**0**	**0**	**4**	**2**	**100**	**--**	**3 Hrs.**

MINI PROJECT WITH SEMINAR

For **Mini Project with Seminar**, a student under the **supervision of a faculty member**, shall collect the **literature on a topic and critically review the literature** and submit it to the department in a **report form** and shall make an **oral presentation** before the **Project Review Committee consisting of Head of the Department, supervisor/mentor and two other senior faculty members** of the department. For Mini Project with Seminar, there will be only **internal evaluation of 100 marks**. A candidate has to secure a minimum of **50% of marks** to be declared successful.

Code	Category	L	T	P	C	I.M	E.M	Exam
#AC-2	**AC**	**2**	**0**	**0**	**0**	**0**	**0**	**--**
AUDIT COURSE-2								
List of Audit Courses and their Syllabi are mentioned in the First Semester Syllabus. The students can opt any one course for AC 2 from the list mentioned in first semester by not opting the course which is already taken for AC 1								

SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)
(Affiliated to JNTUK, Kakinada), (Recognized by AICTE, New Delhi)
Accredited by NAAC with 'A' Grade, All UG Programmes are accredited by NBA
CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204
Estd:1980

SCHEME OF INSTRUCTION & EXAMINATION (Regulation R19)

M.TECH -STRUCTURAL ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
(With effect from **2019-2020**Admitted Batch onwards**)**

III-SEMESTER

Subject Code.	Name of the Subject	Category.	C	L	T	P	Internal Marks	External Marks	Total Marks
#PE-V/MOOCS	Program Elective-V/ MOOCS	PE	3	3	0	0	25	75	100
#OE-I/MOOCS	Open Elective-I / MOOCS	OE	3	3	0	0	25	75	100
M19ST2106	**Dissertation-I / Industrial Project**	PR	10	0	0	20	50	50	100
TOTAL			16	6	0	20	100	200	300

	Course Code	Course
#PE-V/ MOOCS	M19 ST 2101	Design of Pre-stressed Concrete Structures
	M19 ST 2102	Reliability Analysis and Design
	M19 ST 2103	Industrial Structures
	M19 ST 2104 (MOOCS-I)	Students Going for Industrial Project / Thesis will complete these courses through MOOCS. Students can also choose SWAYAM or NPTEL with a 12 weeks' course duration in PG level with 3 credits, but the chosen subject should not be covered in their M. Tech Course
#OE-I/ MOOCS	#OE-I	Students have to choose one open elective course offered by departments other than the parent department. List of open Electives offered by other departments are enclosed.
	M19 ST 2105 (MOOCS-II)	Students Going for Industrial Project / Thesis will complete these courses through MOOCS. Students can also choose SWAYAM or NPTEL with a 12 weeks' course duration in PG level with 3 credits, but the chosen subject should not be covered in their M. Tech Course

OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS	
M19 ST 2107	Construction Management
M19 ST 2108	Green Technology
M19 ST 2109	Analysis of Offshore Structures

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 2101	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

DESIGN OF PRE- STRESSED CONCRETE STRUCTURES

Course Objectives:

1.	To impart the knowledge on pre-stressing systems, materials required for pre-stressing, losses of pre-stress, deflections and flexural strength of pre-stressed members
2.	To familiarize the student with the design of composite beams, design of prestressed concrete slabs, pipes and poles.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Explain the principle, types and systems of prestressing and analyze the deflections.	K3
2.	Determine the flexural strength and design the flexural members, end blocks.	K3
3.	Analyze the statically indeterminate structures and design the continuous beam.	K3
4.	Design the tension and compression members and apply it for design of piles.	K3
5.	Analyze the stress, deflections, flexural and shear strength and apply it for the design of bridges.	K3
6.	Analyze the Composite construction of Pre- stressed and in- situ concrete.	K3

SYLLABUS

UNIT-I (6 Hrs)	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 (8 Hrs)	**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 (8 Hrs)	**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 (8 Hrs)	**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 (8 Hrs)	**CONTINUOUS BEAMS:** Advantage of Continuous Members – Effect of Prestressing Inderterminate 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.	Design of Prestressed Concrete- T. Y. Lin, Ned H. Burns 3e, Wiley Publications
2.	Prestressed Concrete, 6e by N. Krishna Raju, Mc Graw Hill Publishers
3.	Prestressed Concrete by K. U.Muthu, PHI Learning Pvt Limited
Reference Books:	
1.	Prestressed Concrete Analysis and Design, Antone E. Naaman 2e, Techno Press 3000
2.	Design of prestressed Concrete by E.G. Nawy
3.	Prestressed Concrete by N. Rajagopalan, Narosa Publishing
4.	IS1343 2012 Prestressed concrete Code

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 2102	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

RELIABILITY ANALYSIS AND DESIGN

Course Objectives:

1.	To learn the importance of reliability in Civil engineering and concepts of computing structural reliability.
2.	To impart knowledge of level 2 reliability methods and reliability based design.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Understand the importance of reliability in Civil engineering.	K5
2.	Apply the concepts of computation of structural reliability for solving engineering problems.	K5
3.	Gain the knowledge of reliability based structural design.	K5

SYLLABUS

UNIT-I (6 Hrs)	**Concepts of Structural Safety**: General, Design methods. **Basic Statistics**: Introduction, Data reduction, Histograms, Sample correlation. **Probability Theory**: Introduction, Random events, Random variables, Functions of random variables, Moments and expectation, Common probability distribution, Extremal distribution.
UNIT-II (8 Hrs)	**Resistance Distributions and Parameters:** Introduction, Statistics of properties of concrete, Statistics of properties of steel, Statistics of strength of bricks and mortar, Dimensional variations, Characterization of variables, Allowable stresses based on specified reliability.
UNIT-III (8 Hrs)	**Probabilistic Analysis of Loads:** Gravity loads, Wind load. **Basic Structural Reliability**: Introduction, Computation of structural reliability. Monte Carlo Study of Structural Safety: General, Monte Carlo method, Applications.
UNIT-IV (8 Hrs)	**Level 2 Reliability Methods:** Introduction, Basic variables and failure surface, First-order second-moment methods (FOSM).
UNIT-V (8 Hrs)	**Reliability Based Design:** Introduction, Determination of partial safety factors, Safety checking formats, Development of reliability based design criteria, Optimal safety factors, Summary of results of study for Indian standard – RCC design. Reliability of Structural Systems: Preliminary concepts as applied to simple structures.

Text Books:

1.	"Structural Reliability Analysis and Design" by Ranganatham, R.
2.	"Structural Reliability" by Melchers, R.E.

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 2103	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**

INDUSTRIAL STRUCTURES

Course Objectives:

1.	This subject imparts a broad knowledge in the area of industrial structures.
2.	Possess the ability to understand the design concepts of light gauge steel structures, analysis of Transmission line Towers, Steel Chimneys and gantry girder.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Plan the functional requirements of structural systems for various industries.	K3
2.	Get an idea about the materials used and design of industrial structural elements.	K3
3.	Design power transmission structures.	K5
4.	Possess the ability to understand the design concepts of design of gantry girder	K5

SYLLABUS

UNIT-I (6 Hrs)	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 (8 Hrs)	**Light gauge steel structures**: Local buckling of thin sections, Post packing of thin elements, Light gauge steel columns and compression members, Form factor for columns and compression members, Stiffened compression elements, Multiple stiffened compression elements, Unstiffened compression elements effective length of light gauge steel compression members,
UNIT-III (8 Hrs)	Basic design stress, Allowable design stress, Light gauge steel beams, Laterally supported light gauge steel beams web crippling. Allowable design stress in beams, Beams subjected to combined axial end bending stress, connections.
UNIT-IV (8 Hrs)	**Analysis of Communication Towers**: Analysis of Transmission line Towers: Loads on towers, Sag (dip) and Tension in uniformly loaded conductors, Analysis of towers (analysis as coplanar assembly), Design of members in towers, Design of foundation of towers. Design of Steel Chimneys for wind and gravity loads.
UNIT-V (8 Hrs)	Industrial buildings- roofs for industrial buildings (Steel) - design of gantry girder-design of corbels and nibs- machine foundations

Text Books:

1.	Transmission Line Structures by S. S. Murthy and A. R. Santakumar McGraw Hill
2.	"Comprehensive Design of Steel Structures", B.C.Punmia,Ashok Kumar Jain, Arun Kumar Jain,

	Laxmi Publications (P) Ltd.
Reference Books:	
1.	"Design of Steel Structures" by Arya&Ajmani, Nemchand Publishers.
2.	SP 32: 1986, Handbook on functional requirements of Industrial buildings
3.	Design of steel structures by N. Subramanian

Code	Category	L	T	P	C	I.M	E.M	Exam
M19 ST 2104	**PE**	**3**	**0**	**--**	**3**	**25**	**75**	**3 Hrs.**
MOOCS-I								
Students Going for Industrial Project / Thesis will complete these courses through MOOCS. Students can also choose SWAYAM or NPTEL with a 12 weeks' course duration in PG level with 3 credits, but the chosen subject should not be covered in their M. Tech Course								

Code	Category	L	T	P	C	I.M	E.M	Exam
	OE	**--**	**--**	**--**	**3**	**25**	**75**	**3 Hrs.**
OPEN ELECTIVE								
Students have to choose one open elective course offered by departments other than the parent department. List of open Electives offered by other departments are given below.								

Offered from	Course Code	Course Name	Offered to
COMPUTER SCIENCE & ENGINEERING	M19 CST 2106	Python Programming	**ST, CS, PSA & CAD/CAM**
	M19 CST 2107	Artificial Intelligence	
	M19 CST 2108	Advanced Data structures	
ELECTRONICS & COMMUNICATION ENGINEERING	M19 CS 2107	Signals and systems	**ST, CST, PSA, IT & CAD/CAM**
	M19 CS 2108	Principles of Communication	
	M19 CS 2109	Image and video Processing	
ELECTRICAL & ELECTRONICS ENGINEERING	M19PS2107	Electric And Hybrid Vehicles	**ST, CST, CS, IT & CAD/CAM**
	M19PS2108	Energy From Waste	
	M19PS2109	Energy Management and Auditing	
INFORMATION TECHNOLOGY	M19IT2108	Web Technologies	**ST, CS, PSA & CAD/CAM**
	M19IT2109	Internet of Things	
	M19IT2110	Machine Learning	
MECHNAICAL ENGINEERING	M19CAD 2107	Operations Research	**ST, CST, CS, PSA & IT**
	M19CAD 2108	Nano Technology	
	M19CAD 2109	Product Design & Manufacturing	
SCIENCE & HUMANITIES	M19BS2101	Management and Organisational Behaviour	**ST, CST, CS, PSA, IT & CAD/CAM**

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST2105	**OE**	**--**	**--**	**--**	**3**	**25**	**75**	**3 Hrs.**
MOOCS-II								
Students Going for Industrial Project / Thesis will complete these courses through MOOCS. Students can also choose SWAYAM or NPTEL with a 12 weeks' course duration in PG level with 3 credits, but the chosen subject should not be covered in their M. Tech Course								

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST2106	**PR**	**0**	**0**	**20**	**10**	**50**	**50**	**3 Hrs.**

DISSERTATION-I/INDUSTRIAL PROJECT

The Student has to register for Dissertation-I / Industrial project in III semester. Student has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).

Continuous assessment of Dissertation-I during the III-Semester will be monitored by the PRC.

Dissertation-I/ Industrial Project is evaluated for 50 internal marks and 50 external marks.

Internal marks 50 awarded by Project Guide and PRC jointly based on continuous assessment consisting of two seminars based on Dissertation work-I.

External marks 50 awarded by External Examiner, Supervisor and Head of the Department jointly based on a review and Viva voce on Dissertation work-I.

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R19)

M.TECH -STRUCTURAL ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING
(With effect from **2019-2020**Admitted Batch onwards**)**

IV-SEMESTER

Subject Code.	Name of the Subject	Category.	C	L	T	P	Int. Marks	Ext. Marks
M19ST2201	**Dissertation-II /Industrial Project**	PR	16	0	0	32	--	100

Code	Category	L	T	P	C	I.M	E.M	Exam
M19ST2201	**PR**	**0**	**0**	**32**	**16**	**--**	**100**	**3 Hrs.**

DISSERTATION-II/INDUSTRIAL PROJECT

The student has to continue his/her work from Dissertation-I / Industrial project to complete Dissertation-II in IV semester.

Continuous assessment of Dissertation-II during IV-Semester will be monitored by the PRC.

Dissertation-II is evaluated for 100 external marks based on Review and Viva Voce.

Review and Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work for 100 marks.

If the report of the Viva-Voce is unsatisfactory (ie, < 50 marks), the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the College.