SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY- TUMAKURU
(A constituent College of Siddhartha Academy of Higher Education, Tumakuru)
CHOICE BASED CREDIT SYSTEM (CBCS)
SCHEME OF TEACHING AND EXAMINATION FOR M.Tech DEGREE COURSE
(Effective from the academic year 2021-22)

Department: Civil Engineering, M.Tech CADS

Semester: I

Sl. No.	Subject Code	Subject Name	**Teaching dept.**	**Board of Exam.**	**Credits**	**CIE**	**SEE**	**Total Marks**	**Exam Hours**
1	CAD101	Continuum Mechanics - Classical	CV	CV	4	50	50	100	3
2	CAD102	Computational Structural Mechanics	CV	CV	4	50	50	100	3
3	CAD103	Computational Structural Dynamics	CV	CV	4	50	50	100	3
4	CAD104	Optimum Design of Structures	CV	CV	3	50	50	100	3
5	CAD 1PE5X	**Elective – I**	CV	CV	3	50	50	100	3
6	CAD 1PE6X	**Elective - II**	CV	CV	3	50	50	100	3
7	CAD107	Technical Seminar-I	CV	CV	1.5	50	-	50	-
8	CAD 1LB1	Advance Structural Analysis Laboratory	CV	CV	1.5	50	-	50	-
Total Contact Hours					24	400	300	700	-

Elective – I

CAD 1PE51Advanced Numerical Methods
CAD 1PE52 Composite and Smart – Materials
CAD 1PE53 Concepts of Pre Fabrication and Precast Structures

Elective – II

CAD 1PE61 Advanced Mechanics of Materials
CAD 1PE62 Advance Design of Prestressed Concrete Structures
CAD 1PE63 Advance R C Design

Subject Name: Continuum Mechanics - Classical and FE Approach

SubjectCode: CAD101 **L-T-P-C:4-0-0-4**

Course Objectives:

Course Objective
The objective of this course is 1. To make students to learn principles of Analysis of Stress and Strain, 2. To predict the stress-strain behaviour of continuum. 3. To evaluate the stress and strain parameters and their inter relations of the continuum.

UNIT	Description	Hours
I	**Introduction**: Elasticity –Notation for forces and stresses-Components of stresses–components of strain–Hooke'slaw.Definitionof stress and strain at a point, components of stress and strain at a point in Cartesian and polar co-ordinates, constitutive relations, equilibrium equations, compatibility equations and boundary conditionsin 2-D and 3-D cases, Plane stress, plane strain – Definition.Analysis of Stress and Strain in Three Dimensions: Introduction – Principal stresses– Stress Ellipsoid and stress – director surface – Determination of the principal stress– Stress invariants – Determination of the maximum shearing stress.	12
II	**Plane Stress and Plane Strain:**Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution by Polynomials – End Effects, Saint – Venant's Principle – Determination of Displacements – bending of a Cantilever Loaded at the end – Bending of Beam by uniformload.	10
III	**Two-Dimensional Problems in Polar Coordinates** :General equation in Polar coordinates – Stress distribution symmetrical about an axis – Pure bending of curved bars – Strain components in polar coordinates – Displacements for symmetrical stress distributions – Rotating disks – Bending of a curved bar by a force at theend.	10
IV	**Solution of Axi-symmetric Problems**: The effect of circular holes on stress distribution in plates, stress concentration due to the presence of a circular hole in plates. Elementary problems of in three dimensions, Two - dimensional problems in Rectangular coordinates, twist of circularshafts, torsion of non-circular sections, membrane analogy, Propagation of waves in solid media.Applications of finite difference equations in elasticity.	10

V	**FE Approach**: 2D and 3D Elements - CST, LST, Rectangular family, TetrahedraandHexahedra : Shape functions, Element Stiffness matrix, Equivalent Loads, Iso - parametric formulation of Triangular and General quadrilateral elements, Axisymmetric elements, Gauss Quadrature.	10

Course Outcomes

Course outcome	**Descriptions**
CO1	Students will be able to Understand the principles of stress-strain behavior of continuum
CO2	Students will be able to Understand the principles of Polynomials stress functions
CO3	Students will be able to Understand the principles of Polar Coordinates& axis symmetric problems
CO4	Students will be able to Understand the concept of Finite element method

Text Books:

SlNo	**Text Book title**	**Author**	**Volume and Year of Edition**
1	Theory of elasticity	Timoshenko and Goodier,	McGraw Hill Book Company,III Edition, 2016
2	Foundations of Solid Mechanics	Y.C.Fung	Prentice-Hall.
3	Advanced Mechanics of Solids	L.S. Srinath	Tata McGraw-Hill Publishing Co ltd.,New Delhi 2016

Reference Book:

Sl No	**Text Book title**	**Author**	**Volume and Year of Edition**
1	"ContinuumMechanics Fundamentals"	Valliappan C,	Oxford IBH Publishing Co.Ltd.
2	"Theory of Elasticity"	Sadhu Singh	Khanna Publishers

Subject Name: COMPUTATIONAL STRUCTURAL MECHANICS

SubjectCode:CAD102 **L-T-P-C:4-0-0-4**

Course Objectives:

The objective of this course is to make students to learn principles of Structural Analysis, To implement these principles through different methods and to analyse various types of structures. To evaluate the force and displacement parameters of the structures.

UNIT	Description	Hours
I	**Direct Stiffness Method –Trusses:** Degrees of static and kinematic indeterminacies, concepts of stiffness and flexibility, local and global coordinate system, analysis of indeterminate trusses, with and without initial strains for different types of boundary conditions such as fixed, hinged, roller, slider, elastic (spring) supports, support settlement.	**12Hrs**
II	**Direct Stiffness Method** : Continuous beam, 2d frames: analysis of continuous beams, for different types of boundary conditions such as fixed, hinged, roller, slider, elastic (spring) supports, support settlement. Analysis of simple 2d frames with and without sway, element stiffness matrix for 3d frames andgrids	. **10Hrs**
III	**Basic Concept of Finite Element Method**: Concept of FEM, formulation using principle of virtual work, principles minimum potential energy, method of weighted residuals(Galerkin's), choice of displacement function, degree of continuity. Generalized and natural coordinates.	. **10Hrs**
IV	**FE Analysis using Bar Elements:** Derivation of shape function for linear and higher order elements using inverse and Lagrange interpolation formula, element stiffness matrix two and three nodded elements. Examples with constant and varying cross sectional area subjected to concentrated loads, distributed body force and surface traction and initial strains due to temperature. Isoparimetric formulation.	. **10Hrs**

V	**FE Analysis using Beam Element**: Derivation of shape function for two noded beam element, Hermitian interpolation, element stiffness matrix, consistent nodal loads, concept of reduced or lumped loads. Examples: cantilever and simply supported Beams.	. **10Hrs**

Course Outcomes

Course outcome	Descriptions
CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of Structural Analysis
CO3	Design and develop analytical skills
CO4	Understand the concepts of structural behaviour

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Computational Structural Mechanics	Rajasekaran.S,	PHI, New Delhi 2001
2	Basic Structural Analysis	Reddy.C.S	TMH, New Delhi 2001

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Concepts and Applications of Finite Element Analysis	Robert D Cook	3rd Edition, JohnWiley and Sons, New York
2	Finite element procedures in Engineering Analysis	Bathe.K.J	PHI. New Delhi.

Subject Name: **COMPUTATIONAL STRUCTURAL DYNAMICS**

Subject Code: CAD103 **L-T-P-C:4-0-0-4**

Course Objectives:

Course Objectives
After studying this course, students will be able to: • Learn the effect of damping in the structures • Analyze the systems using FE

UNIT	Description	Hours
I	**Single degree of freedom system**: Degrees of freedom, undamped system, springs in parallel or in series, Newton's law of motion, free body diagram, D'Alembert's principle, solution of the differential equation of motion, frequency and period, amplitude of motion. Damped Single degree of freedom system – viscous damping, equation of motion, critically damped system, over damped system, underdamped system, and logarithmic decrement. Response of one degree of freedom system to harmonic loading – undamped harmonic excitation, damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the foundation, seismicinstruments	12
II	**Response to general dynamic loading**: Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral, undamped system numerical evaluation of Duhamel's integral, damped system. Fourier analysis and response in frequency domain Fourier analysis, Fourier co-efficient for piece-wise liner functions, exponential form of Fourier series, discrete Fourier analysis, and fastFourier transform.	10
III	**Generalized co-ordinates and Rayleigh's method**: Principle of virtual work, generalized single degree of freedom system (rigid body and distributed elasticity), and Rayleigh's method.Multistory shear building. Free vibration – natural frequencies and normalmodes, zero modes of vibration. Forced motion – modal superposition method – response of a shear building to base motion. Damped motion of shear building – equations of motions – uncoupled damped equation – conditions for damping uncoupling	10

IV	**Discretization of Continuous systems**: Longitudinal Vibration of a uniform rods. Transverse vibration of a pretension cable. Free transverse vibration of uniform beams – Rotary inertia and shear effects – the effect of axial loading. Orthogonally of normal modes. Undamped forced vibration of beams by mode superposition.	10
V	**Dynamic analysis of beams**: stiffness matrix, mass matrix (lumped and consistent) equations of motions for the discritiesed beam in matrix form and its solutions	10

Course Outcomes

Course outcome	Descriptions
CO1	Understand effect of structural vibrations on safety and reliability of structural systems
CO2	Apply knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response.
CO3	Apply modal methods to calculate the forced response of these systems. Use finite element methods for the analysis of the vibrations of structures.
CO4	Design and develop analytical skills.

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Dynamics of Structures	Ray W Clough and J Penzien	2nd Edition, McGraw-Hill,New Delhi.
2	Vibration, Dynamics and structural problems	Mukopadyaya	Oxford IBH Publishers,NewDelhi.

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Structural dynamics, Theory and computation	Mario Paz	2nd Edition, CBSPublisher and Distributers, New Delhi
2	Fundamentals of Structural Dynamics	Roy R. Craig, Andrew J. Kurdila	John Wiley & Sons

Subject Name: OPTIMUM DESIGN OF STRUCTURES

SubjectCode: CAD104 **L-T-P-C:3-0-0-3**

Course Objectives:

Sl.No	Course Objectives
1	To Make the student understand the principles of Classical Optimization Techniques
2	To Make the student understand the principles of Linear Programming
3	To Make the student understand the principles of Non-Linear Optimization
4	To Make the student understand the principles of Dynamic Programming and Practical applications of Optimization in Civil Engineering

UNIT	Description	Hours
I	**Classical Optimization techniques**: Engineering application, Statement of Optimization problem, Classification of Optimization problems, Single variable Optimization, Simple problems which can be converted to single variable optimization.	9
II	**Linear programming**: Standard form of linear programming problem, Graphical method for two variable problem and development of simplex method, simplex problems with two and three variables fundamentals and basic theorems on Linear Programming.	9
III	**Multivariable Optimization with constraints**: semi-definite case and saddle point. Multivariable optimization with equality constraints: Solution for direct substitution for simple cases, Lagrange's multiplier method, constrained variation method. Multivariable optimization with inequality constraints-Kuhn Tucker conditions. Convex and concave functions.	11
IV	**Nonlinear programming:** Introduction to one dimensional minimization methods concept of Unimodal function, unrestricted search(search with fixed step size, search with accelerated step size), exhaustive search, dichotomous search, Fibonacci method and Golden section method	11
V	**Structural ApplicationsandDynamic programming**: Use of Dynamic programming in water tank design given the estimation of its component parts. Optimum design of a structural element RC simply supported solid slab.	10

Course Outcomes

Course outcome	Descriptions
CO1	Students will have the ability to use Principles of Linear and Dynamic Programming
CO2	Students will have the ability to use Classical Optimization techniques
CO3	Apply Knowledge of Optimization to Structural Engineering Problems
CO4	Students will have the ability touse Principles Non Linear Optimization

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Engineering Optimization - Theory and Practice, New Age International,1978.	S.S.Rao	3rd Edition ISBN 978-81-224-2723-3
2	Operations Research an Introduction	Hamdy A Taha	9th Edition, 2019 ISBN – 81-203-2235-5
3	Optimization Methods for Engineering Design, Addison Wesley, 1971.	R.L.Fox	ISBN10: 0201020785 ISBN-13: 978-0201020786

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Optimization Techniques	K.C.Jain	
2	System simulation with digital computer, Prentice – Hall of India Pvt, Ltd. New Delhi – 1989.	NarsingkDeo	
3	Applied Structural Mechanics: Fundamentals of Elasticity, Load- Bearing Structures, Structural Optimization	Hans Eschenauer	

Subject Name: ADVANCED NUMERICAL METHODS

Subject Code: CAD1PE51 **L-T-P-C:3-0-0-3**

Course Objectives:

Course Objectives
The objective of this course is to make students to learn on applications of numerical methods, To implement the numerical methods for the structural engineering problems.

UNIT	Description	Hours
I	**Matrices and Linear Algebra** : Elementary Concepts of Matrices – Introduction to Matrices – special matrices – matrix equality – addition and multiplication by a scalar – Multiplication of matrices – the inverse matrix – partitioning of matrices – the trace and determinant of a matrix.	9
II	**Linear System of Equations (Direct Methods) and Iterative Methods for Solving Linear Equation** : Introduction – Cramer's Rule – Gaussian Elimination – Gauss – Jordan Method. Stationary Methods: Jacobi Iteration – Computer Time Requirement for Jacobi Iteration – Gauss – Seidel Method – Relaxation Method – Condition of Convergence of Iterative Method – Summary – Exercises.	7
III	**Statistical Methods** 1. Sampling and Frequency Distribution : Sampling – Frequency distribution. 2. Discrete Probability Distributions : Introduction – Probability – discrete distributions – binomial distribution – Poisson distribution 3. Curve Fitting: Regression – Introduction – Linear Least Squares Fit – Nonlinear fit – Fitting a Polynomialfunction.	8
IV	**Interpolation and Numerical Integration** : Introduction – Definition – Newton's Forward difference –Remarks on Newton's forward or backward interpolation formula, Newton's divided difference, Neville Iterated Interpolation, Lagrange Interpolation, spline interpolation, summary,exercises Numerical Integration : Introduction, Trapezoidal rule ,Gaussian quadrature– numerical integration using Spline Monte Carlo method for numerical integration.	7

V	The Approximation for the Solution of Ordinary First Order Differential Equations : Introduction – nth order differential equation – physical problem – taylor series – euler method or first order taylor series – modified euler method – picard method of successive approximation – Runge – Kutta methods – solution of simultaneous ordinary differential equations by R K Methods. Predictor / corrector method.	**8**

Course Outcomes

Course outcome	Descriptions
CO1	To impart the students the knowledge of algorithms, flowcharts and solution of linear simultaneous equations.
CO2	To educate the students on applications of numerical methods to civil engineering problems.
CO3	To impart skills of development of algorithms, solution of ODE and application of finite difference techniques in structural mechanics

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Numerical Methods: Design, Analysis and Computer Implementation of Algorithms.	A. Greenbaum and T. P. Chartier.	Princeton University Press, 2012
2	Numerical Analysis.	L. R. Scott.	Princeton University Press, 2012

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Advanced Numerical Methods	J. Sakthivel	Suchitra Publications

Subject Name: COMPOSITE AND SMART – MATERIALS

Subject Code: CAD1PE52 **L-T-P-C:3-0-0-3**

Course Objectives:

The objective of this course is to make students to learn the basic properties and manufacturing process of various composites, different classes of ceramic and polymeric smart materials and their response of a system.

UNIT	Description	Hours
I	**Introduction to Composite materials**: Classifications and applications. Anisotropic elasticity - unidirectional and anisotropic laminate, thermo-mechanical properties, micro- mechanical analysis, characterization tests. Classical composite lamination theory, cross and angle play laminates, symmetric, antisymmetric and general symmetric laminates, mechanical coupling. Analysis of simple laminated structural elements ply-stress and strain, lamina failure theories - first fly failure, vibration and buckling analysis. Sandwich structures face and core materials, secondary failure modes environmental effects, manufacturing of composites	9
II	**Introduction-smart materials** and structures- piezoelectric materials – coupled electro-mechanical constitutive relations – depoling and coercive field – field-strain relation - hysterics – creep-strain rate effects – manufacturing.	7
III	**Actuators and sensors** – single and dual actuators – pure extension, pure bending – bending extension relations – uniform strain beam model – symmetric induced strain actuators – bond shearing force – Bernoulli-Euler (BE) beam model – embedded actuators – Asymmetric induced strain actuatorsinuniformstrainandEuler-Bernoullimodels.Uniformstrainmodel – energy principle formulation –BE model –single and dual surface bonded actuators- Extension-bending and torsion model.	8
IV	**Introductions to control systems** – open loop and close loop transfer functions stability criteria – deflection control of beam like structures - using piezoelectric sensors and actuators – shape memory alloys.	7
V	Beam modeling with strain actuator, bending extension relation.	8

Course Outcomes

Course outcome	Descriptions
CO1	Students will be able to use basic properties and manufacturing process along with their application in various industries for different types of composites.
CO2	Students will be Familiarized with different classes of ceramic and polymeric smart materials; development of actuators and sensors and Their integration into a smart structure
CO3	Students will be able to Generate controllable force and response of a system.
CO4	Students will be able to Monitor the response of the system.

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Mechanic of Composite Materials	Robert M Jones	McGraw Hill Publishing Co.
2	Analysis and Performance of Fiber Composites	Bhagwan D Agarwal, and Lawrence J Brutman	John Willy and Sons

Subject Name: CONCEPT OF PRE FABRICATION AND PRECAST STRUCTURES

Subject Code:CAD1PE53 **L-T-P-C:3-0-0-3**

Course Objectives:

Sl.No	Course Objectives
1	To study the technology of Prefabricated construction and precast structures in Civil Engineering

UNIT	Description	Hours
I	Concept of Prefabricated construction, necessity, advantages, disadvantages, Mass produced steel, reinforced concrete and masonry systems Industrialized buildings.	9
II	Concept of modular coordination, basic module, planning and design modules, modular grid systems, National Building Code Specifications, standardization, dimensioning of products, preferred dimensions and sizes, tolerances and deviations, layout and process.	7
III	Prefabricates classification, foundation, columns, beams, roof and floor panels, wall panels, clay units, box prefabricates, erection and assembly.	8
IV	Construction techniques, large panel construction, lift slab system, control of construction processes. Equipment for horizontal and vertical transportation. Concept of Ferro cement and faro concrete elements.	7
V	Design of prefabricated elements, Lift point's beams, slabs, columns, wall panels, footings, design of joints to transfer axial forces, moments and shear forces.	8

Course Outcomes

Course outcome	Descriptions
CO1	Students are able to understand the concept of prefabrication structures
CO2	Students are able to use the National Building Code Specifications codes for concept of prefabrication structures as per the design.
CO3	Students are able to design of prefabricated elements
CO4	Students are able to understand Construction techniques and equipments used in construction

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Precast Concrete	Hass A.M.	2000.
2	Precast concrete structures	Kim S Elliott	2016.

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Plant cast, Precast and Prestressed concrete	David Sheppard	McGraw Hill; 1989.
2	Multi–Storey Precast Concrete Framed Structures	Kim S Elliott, Collin K Jolly.	2nd edition 2014

Subject Name: ADVANCED MECHANICS OF MATERIALS

SubjectCode:CAD1PE61 **L-T-P-C:3-0-0-3**

Course Objectives:

Sl.No	Course Objectives
1	To study mechanics of Curved Beams Beams on Elastic Foundations, Shear Centre, and Torsion.

UNIT	Description	Hours
I	**Curved Beams:** Introduction, Circumferential stress in a curved beam, Radial stresses in curved beams, Correction for circumferential stresses in curved beams having I, T, or similar cross sections, Deflections of curved beams, Statically indeterminate curved beams, Closed ring subjected to a concentrated load.	9
II	**Shear center for thin-wall beam cross sections**: Definition of shear center in bending approximations employed for shear in thin-wall beam cross sections, shear flow in thin-walled beam cross sections.	7
III	Symmetric and unsymmetrical sections. nonsymmetrical bending of straight beams:, symmetrical and nonsymmetrical bending, bending stresses in beams subjected to nonsymmetrical bending, deflections of straight beams subjected to nonsymmetrical bending	8
IV	**Torsion:** Torsion of straight bars of elliptic cross section – St.Venants semi-inverse method and Prandtl's function approach – membrane analogy – torsion of a bar of narrow rectangular cross section torsion of thin walled open cross sections – torsion of thin walled tubes.	7
V	**Structures subjected to out of plane loading:** Analysis of simple bents, frames, grids and beams circular in plan – cantilever beams, semicircular continuous beams with three equally spaced supports, circular beams with different number of equally spaced supports.	8

Course Outcomes

Course outcome	Descriptions
CO1	Students are able to understand the curved beams and to solve the problems involving stresses of curvedbeams.
CO2	Students are able to understand concepts of shear centre and bending of beams.
CO3	Students are able to understand Beams on Elastic Foundations and are able to solve the problems beams.
CO4	Students are able to understand Torsion and are able to do analysis of Structures subjected to out of plane loading

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Advanced Mechanics of Materials	Arthur P. Boresi Omar M. Sidebottom	Fourth Edition,1985
2	Advanced Mechanics of Solids and Structures	N Krishna Raju	First Edition. August 2018

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Mechanics of Materials	James M. Gere and Barry J Goodno	Eighth Edition,2012
2	Advanced Strength of material and Applied Elasticity"	A.C. Ugural and S. K. Fenster	Sixth Edition, 2019
3	Mechanic of Structures	S.B. Junnarkar H J Shah	Volume I, 32nd Edition, 2012

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CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME OF TEACHING AND EXAMINATION FOR M.Tech DEGREE COURSE

(Effective from the academic year 2021-22)

Subject Name: ADVANCED DESIGN OF PRESTRESSED CONCRETE STRUCTURES

SubjectCode:CAD1PE62 **L-T-P-C:3-0-0-3**

Course Objectives :

Course Objectives
The objective of this course is 1. Design pre-stressedelements 2. Understand the behavior of pre-stressed elements. 3. Understand the behavior of pre-stressed sections

UNIT	Description	Hours
I	**Anchorage Zone stress in post-tensioned members:**Introduction to PSC, stress distribution in end block, investigations on anchorage zone stress, Magnel and Guyon’s methods, comparative analysis, anchorage zone reinforcement.	9
II	**Shear and torsional resistance:** Shear and principal stresses, ultimate shear resistance, design of shear reinforcement, torsion, design of reinforcement for torsion	7
III	**Composite Beams:** Introduction, types of composite beams, analysis for stress, differential shrinkage, serviceability limit state, design for flexural and shearstrength	8
IV	**Tension members and compression members:** Introduction, ties, Columns, Short columns, long columns, biaxially loaded columns, pre stressed concrete piles. Slab and grid floors- Types of floor slabs, design of one way, two way and flat slabs. Distribution of prestressed tendons, analysis and design of grid floors.	7
V	**Precast elements:** Introduction, pre-stressed concrete poles, manufacturing techniques, shapes and cross sectional properties, design loads, design principles. Railway sleepers-classification and manufacturing techniques, design loads, analysis and design principles. Pre-cast bridge girders and segmental constructions, external pre-stressing	8

Course Outcomes

Course outcome	Descriptions
CO1	Understand the concept of prestressed and post tensioned concrete
CO2	Analyze, Design and detail PSC elements
CO3	Achieve Knowledge of design and development of problem solving skills
CO4	Design and develop analytical skills.

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Pre-stressed concrete	N.Krishnaraju	Tata McGraw-Hill,4rd edition,2012
2	Design of pre-stressed concrete structures	Lin.T.Y and H.Burns	John Wiley and sons,1982.

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Pre-stressed concrete structures	P.Dayaratnam	Oxford and IBH, 5th edition, 1991
2	Pre-stressed concrete structures	Guyon,	Contractors Record books,1963
3	IS:1343:2012		

Subject Name: ADVANCED R.C. DESIGN

Subject Code: CAD1PE63 **L-T-P-C:3-0-0-3**

Course Objective:

To make students to understand the advanced of design of RCC and to apply the knowledge of RCC in civil engineering field

UNIT	Description	Hours
I	**Deflection of Reinforced Concrete Beams and Slabs** Introduction – Short term Deflection of Beams and Slabs – Deflection due to Imposed Loads – Short-term Deflection of Beams due to Applied Loads – Calculation of Deflection by IS 456 – Calculation of Deflection by BS 8110 – Deflection Calculation by Euro code – ACI Simplified Method – Deflection of Continuous Beams by IS 456 – Deflection of Cantilevers – Deflection Slabs	8
II	**Estimation of Crack width in Reinforced Concrete Members** Introduction – Factors affecting Crack width in Beams – Mechanism of Flexural Cracking – Calculation of Crack widths – Simple Empirical Method – Estimation of Crack width in Beams by IS 457 and BS 8110 – Shrinkage and Thermal Cracking	7
III	**Redistribution of Moments in Reinforced Concrete Beams** Introduction –Redistribution of Moments in a Fixed Beam – Positions of Points of Contraflexrues – conditions for Moment Redistribution – Final shape of redistributed bending moment diagram – Moment redistribution for a two- span continuous beam – Advantages and disadvantages of Moment redistribution – Modification of clear distance between bars in beams (for limiting crack width) with redistribution – Moment – curvature (M-) Relation of Reinforced Concrete sections – ACI conditions for redistribution of negative moments – conclusion	8
IV	**Design of Reinforced Concrete Deep Beams and Design of Ribbed (Voided) Slabs: Introduction** – Minimum Thickness – Steps of Designing Deep beams – design by IS 456 – Design according to British practice – ACI procedure for design of deep beams – checking for local failures – Detailing of Deep beams**.** Design of Ribbed (Voided) Slabs Introduction – Specification regarding the slabs – Analysis of the slabs for moment and shears – Ultimate Moment of Resistance – Design for shear – Deflection – Arrangement of Reinforcements – Corrosion of Steel with Clay blocks	7

V	**Design of Reinforced Concrete Members for Fire Resistance**: Introduction – ISO 834 Standard Heating Conditions – Grading or Classifications – Effect of High temperature on steel and concrete – Effect of High temperatures on different types of structural members – Fire resistance by structural detailing from tabulated data – Analytical determination of the ultimate bending moment capacity of reinforced concrete beams under fire – other considerations	9

Course Outcomes

Course outcome	Descriptions
CO1	Students are able to calculate the defections of beam and columns
CO2	Students are able to estimate the crack width in reinforced concrete members
CO3	Students are able to design of reinforced concrete deep beams and design of ribbed (voided) slabs and find redistribution of moments of RC beams
CO4	Students are able to design of reinforced concrete members for fire resistance

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Advanced Reinforced Concrete design	P.C. Varghese	**2nd edition 2002**
2	Advanced R.C. Design	Krishna Raju	**3rd edition 2016**
3	Design of Reinforced Concrete Structures	N Subramanian	**2013**

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Ultimate Strength Design for Structural Concrete	Ramakrishnan, V.	**1969**
2	Limit State theory and design of Reinforced Concrete	Karve. S.R. and Shah V.	**5th edition 2010**
3	Reinforced and Prestressed Concrete	Evans R.H	**3rd edition 1987**

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CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME OF TEACHING AND EXAMINATION FOR M.Tech DEGREE COURSE

(Effective from the academic year 2021-22)

Subject Name: ADVANCED STRUCTURAL ANALYSIS LABORATORY

Subject Code: CAD 1LB1 **L-T-P-C:0-0-3-1.5**

Course Objectives:

Sl. No	Course Objectives
1	This course will enable students to use industry standard software in a professional set up.

Description
EXPERIMENT1: Modeling of Tall structure with DBR (Design Based Report)- using STADPRO/ ETABS EXPERIMENT2: Static analysis of Tall structure- using STADPRO/ ETABS EXPERIMENT3: Dynamic analysis of Tall structure- using STADPRO/ ETABS EXPERIMENT4: Design of the following structural elements- using STADPRO/ ETABS i) Foundation ii) Column iii) Beam iv) Slab v) Staircase

Department: Civil Engineering, M.Tech CADS

Semester: II

Sl. No.	Subject Code	Subject Name	Teaching dept.	Board of Exam.	Credits	CIE	SEE	Total Marks	Exam Hours
1	CAD201	Stability Analysis of Structures	CV	CV	4	50	50	100	3
2	CAD202	Analysis of Plates and Shells	CV	CV	4	50	50	100	3
3	CAD203	Design of Structural Systems for Bridges	CV	CV	4	50	50	100	3
4	CAD204	Applications of AI and Expert Systems in Structural Engineering	CV	CV	3	50	50	100	3
5	CAD2PE5X	**Elective – III**	CV	CV	3	50	50	100	3
6	CAD2PE6X	**Elective - IV**	CV	CV	3	50	50	100	3
7	CAD2TS2	Technical Seminar-II	CV	CV	1.5	50	-	50	-
8	CAD2LB2	Advance Structural Computational Laboratory	CV	CV	1.5	50	-	50	-
Total Contact Hours					24	400	300	700	-

Elective – III

CAD2PE51 Special Concrete
CAD2PE52 Reliability Analysis and Reliability Based Design of Structures
CAD2PE53 Foundation Engineering

Elective – IV

CAD2PE61 Earthquake Resistant Design of Structures
CAD2PE62 Dynamics of Soil-Structure Interaction
CAD2PE63 Advanced Design of Steel Structures

Subject Name: STABILITY ANALYSIS OF STRUCTURES

Subject Code:CAD201 **L-T-P-C:4-0-0-4**

Course Objectives:

Sl.No.	**Course Objectives:** This course will enable students to
1	Understand the concepts of stability; types of buckling
2	Compute buckling loads of columns; elastic buckling of frames and Plates

UNIT	Description	Hours
I	**Beam column- Differential equation**: Beam column subjected to (i) lateral concentrated load, (ii) several concentrated loads, (iii)continuous lateral load. Application of trigonometric series. Euler's formulation using fourth order differential equation for pined-pined, fixed-fixed, fixed-free and fixed-pined column.	**10Hrs**
II	**Buckling of frames and continuous beams. Elastic Energy method**: Approximate calculation of critical loads for a cantilever. Exact critical load for hinged-hinged column using energy approach. Buckling of bar on elastic foundation. Buckling of cantilever column under distributed loads. Determination of critical loads by successive approximation. Bars with varying cross section. Effect of shear force on critical load. Columns subjected to non-conservative follower and pulsatingforces.	**10Hrs**
III	**Stability analysis by finite element approach**: derivation of shape functions for a two noded Bernoulli-Euler beam element (lateral and translational DOF) –element stiffness and element geometric stiffness matrices – assembled stiffness and geometric stiffness matrices for a discretized column with different boundaryconditions – evaluation of critical loads for a discretized (two elements) column (both ends built-in). Algorithm to generate geometric stiffness matrix for fournoded and eight nodedisoparametric elements. Buckling of pine jointed frames(maximum of two active DOF)-symmetrical single way portal frame.	**12Hrs**
IV	**Buckling of simply supported rectangular plate**: Buckling of uniformly compressedrectangular plate simply supported along two opposite sides perpendicular to the direction of compression and having various edge condition along the other two sides- Buckling of a Rectangular Plate Simply Supported along Two opposite sides and uniformly compressed in the Direction Parallel to thosesides.	**10Hrs**

V	**Buckling of simply supported rectangular plate – Combined effects**: Buckling of a SimplySupported Rectangular Plate under Combined Bending and Compression – Buckling of Rectangular Plates under the Action of Shearing Stresses – Other Cases of Buckling of Rectangular Plates.	**10Hrs**

Course Outcomes

Course outcome	**Descriptions:** After studying this course, students will be able to:
CO1	Determine the critical loads for discrete and continuous systems
CO2	Application of the shape functions in the structures
CO3	Determine the critical load of the plates
CO4	Determine the critical load of the plates along with its combined effects

Text Books:

Sl No	**Text Book title**	**Author**	**Volume and Year of Edition**
1	Theory of Elastic Stability	StephenP.Timoshenko, JamesM. Gere	2^{nd}Edition,McGraw-Hill, New Delhi
2	Concepts and Applications of Finite Element Analysis”,	Robert D Cook et al,	3^{rd}Edition, John Wiley and Sons, New York
3	Computational Structural Mechanics	S.Rajashekaran,	Prentice-Hall, India

Reference Book:

Sl No	**Text Book title**	**Author**	**Volume and Year of Edition**
1	Dynamics of Structures	Ray W Clough and J Penzien,	2^{nd}Edition,McGraw-Hill, New Delhi.

Subject Name: ANALYSIS OF PLATES AND SHELLS WITH FE APPROACH

Subject Code: CAD 202 **L-T-P-C: 4-0-0-4**

Course Objectives:

The objective of this course is to make students to learn different methods of analysis and design of plates and shells, To critically detail the plates, folded plates and shells. To evaluate the performance of spatial structures.

UNIT	Description	Hours
I	**Differential equation for cylindrical bending of plate**s: Bending of plates subjected to uniformly distributed loads – (i) two opposite sides free and other two opposite sides simply supported (ii) two opposite sides free and other two opposite sides fixed. Pure bending of plates – slope and curvature of slightly bent plates – relations between bending moments and curvature in pure bending of plates – strain energy in purebending.	**10Hrs**
II	**Circular plates**: Differential equation for symmetrical bending of laterally loaded circular plates – uniformly loaded circular plates with and without central cutouts with two different boundary conditions (simple and clamped). Centrally loaded clamped circular plate. circular plate, exact solution for circular plate with clamped edge, rectangular plates with simple supported edges.	**10Hrs**
III	**Bending of rectangular simply supported plate**: Subjected to distributed moments at a pair of opposite edges. Bending of rectangular pates subjected toudl (i) two opposite edges simply supported and the other two edges clamed, (ii) three edges simply supported and one edge built-in and (iii) all edges built in. Bending of rectangular plates subjected to uniformly varying lateral load (i) all edges built-in and (ii) three edges simply supported and one edge built-in.Circular plate on elasticfoundation.	**10Hrs**

IV	**Bending of orthotropic plates: Application** of finite difference technique for the analysis of isotropic and orthotropic rectangular plates subjected to uniformly distribute lateral loads. Large deflections of plates – approximate formulas for uniformly loaded Plate bending analysis: Basic theories of thin plates, displacement functions, plate bending elements, shear deformation in plates, Basic relationships in finite element formulation, four and eight nodded isoparamatric elements.	**10Hrs**
V	**Differential geometry of curves and surfaces**: Classifications of shells – membrane action and bending action – force resultants and moment resultant in terms of mid surface strains and changes in curvatures –analysis of simple shells of revolution subjected to symmetrical loading. General bending theory of shells of double curvature, shells of revolution and cylindrical shells. Analysis of shells: Thin shell theory, review of shell elements, four and eight nodded shell element and finite element formulation.	**12Hrs**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Theory of Plates and Shells	Timoshenko, S. and Woinowsky-Krieger, W.	2nd Edition, McGraw-Hill Co., New York, 1959
2	Theory and analysis of plates—classical and numerical methods,	R. Szilard,	Published in 1974 - 1974 in Englewood Cliffs NJ by Prentice-Hall. Services.
3	Stress in Plates and shells	Ugural A C	2nd edition, McGraw-Hill, 1999

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Finite Element Analysis	S SBhavaikatti	McGraw-Hill International Edition, 1984.
2	Theory of Plates	Chandrashekara K	UniversityPress, Hyderabad,2001

Subject Name:DESIGN OF STRUCTURAL SYSTEMS FOR BRIDGES

Subject Code:CAD 203 **L-T-P-C:4-0-0-4**

Course Objectives:

Course Objectives
The objective of this course is to make students to learn principles of Structural Design, To design different types of structures and to detail the structures. To evaluate performance of the structures.

UNIT	Description	Hours
I	Introduction: Classification, investigations and planning, choice of type – economic span length – IRC specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.General aspects – Design loads – Design moments, shears and thrusts – Design of critical section.	**10Hrs**
II	Design of Slab Bridges: Effective width of analysis – workings stress design and detailing of slab bridges for IRC loading. Bridge bearings– General features – Types of bearings – forces on bearings basis for selection of bearings – Design principles of steel rocker and roller bearings and its design – Design of elastomeric pad bearing detailing of elastomeric potbearings	**10Hrs**
III	T-Beam Bridges: Introduction – wheel load analysis – B.M. in slab – Pigaud's theory –analysis of longitudinal girders by Courbon's theory working stress design and detailing of reinforced concrete T-beam bridges for IRC loading. Design of Box culverts.	**10Hrs**
IV	Prestressed Concrete Bridge: General features – Advantages of Prestressed concrete bridges – pretensionedPrestressed concrete bridges – post tensioned Prestressed concrete Bridge decks. Design of post tensioned Prestressed concrete slab bridge deck.	**10Hrs**
V	Piers and Abutments : General features – Bed block – Materials for piers and abutments – types of piers – forces acting on piers – Design of pier – stability analysis of piers – general features of abutments – forces acting on abutments – stability analysis of abutments. bridge foundations– General Aspects – Types of foundations – Pile foundations – well foundations – caisson foundations.	**12Hrs**

Course Outcomes

Course outcome	Descriptions
CO1	Students will be made familiar about hydrological data regarding the bridge site.
CO2	Students will be made familiar about bridge sub structure and IRC loads, design and maintenance of bridges.
CO3	Students will be made familiar about components of bridge structure and design Of RC bridge for IRC loads.
CO4	Students will be made familiar about design of steel bridges, moveable steel Bridges and bearings.

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Essentials of bridges engineering	D. Johnson Victor	Oxford & IBH publishers co- Private Ltd
2	Bridge Engineering	S. Ponnuswamy.	
3	Reinforced concrete Bridges	Taylor F.W., Thomson, S.E., and Smulski E	John Wiley and sons, New York

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Concrete Bridge Design	B Rowe, R.E	C.R.Books Ltd., London.
2	Design of Bridges	N.KrishnaRaju	Oxford & IBH

Subject Name: APPLICATION OF AI AND EXPERT SYSTEMS IN STRUCTURAL ENGINEERING

Subject Code: CAD 204 **L-T-P-C:3-0-0-3**

Course Objectives:

Use expert systems to achieve fairly high levels of performance in task areas which require a good deal of specialized knowledge and training.

UNIT	Description	Hours
I	**Artificial Intelligence**: Introduction: AI – Applications fields, defining the problems – state space representation – problem characteristics – production system – production system characteristics.Knowledge representation: Formal logic – predicate logic – logic programming – forward v/s backward reasoning – matching control knowledge.	9
II	**Search and contro**l: Concepts – uniformed / blind search: depth first search – breadth first search - bi-directional search – informed search – heuristic graph search – generate and test - hill climbing – best–first search – AND OR graph search.Non-formal knowledge – semantic networks – frames – scripts – production systems. Programming in LISP	7
III	**Expert Systems**: Their superiority over conventional software – components of an expert system – expert system life cycle – expert system developments process – nature of expert knowledge – techniques of soliciting and encoding expert knowledge. Inference: Forward chaining – backward chaining – rule valueapproach.	8
IV	**Uncertainty**: symbolic reasoning under uncertainty: logic for non-monotonic reasoning. Statistical reasoning: Probability and Bayes' theorem – certainty factor and rule based systems – Bayesian network -Dempster – Shafer theory.	7
V	**Fuzzy reasoning and Neural Networks**:Features of rule based, networks based and frame based expert systems – examples of expert systems in Construction Management and Structural Engineering. Expert systems shells.Neural Networks: An introduction – their possible applications in Civil Engineering	8

Course Outcomes

Course outcome	Descriptions
CO1	To identify the logical reasons in the system
CO2	To know various AI search algorithms
CO3	Develop expert systems to perform tasks which are physically difficult, tedious, or expensive to have a human perform
CO4	Knowledge on the entire system of neural networks and application in the structural system

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Artificial Intelligence and Expert Systems	Patterson D W	Prentice-Hall,
2	Artificial Intelligence and Expert Systems	Rich, E. and Knight K	McGraw Hill, New York

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Principals of Artificial Intelligence	Nilsson, N.J	Narosa., New Delhi
2	Expert Systems in Constructions and Structural Engg	Adeli, H	Chapman & Hall, New York.

Subject Name: SPECIAL CONCRETE

Subject Code: CAD2PE51 **L-T-P-C:3-0-0-3**

Course Objectives:

Sl.No	Course Objectives
1	To Make the student understand the fundamental material properties of concrete
2	To Make the student understand the principles of Mix design of Light Weight Concrete
3	To Make the student understand the principles of Ferro Cement and Fiber reinforced concrete
4	To Make the student understand the principles of High Performance Concrete

UNIT	Description	Hours
I	**Components of modern concrete and developments in the process and constituent materials**: Role of constituents, Development in cements and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates, chemical admixtures. Mix proportioning of Concrete: Principles and methods.	9
II	**Light Weight concrete:** Introduction, classification, properties, strength and durability, mix proportioning and problems. High density concrete: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods.	7
III	**Ferro cement**: Ferro cement materials, mechanical properties, and cracking of Ferro cement, strength and behaviour in tension, compression and flexure, Design of Ferro cement in tension, Ferro cement constructions, durability, and applications.	8
IV	**Fiber reinforced concrete**: Fiber materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, strength and behavior in tension, compression and flexure of steel fiber reinforcedconcrete, mechanical properties, crack arrest and toughening mechanism, applications.	7
V	**High Performance concrete**: constituents, mix 8 Hours proportioning, properties in fresh and hardened states, applications and limitations. Ready Mixed Concrete-QCI-RMCPC scheme requirements, Self Compacting Concrete, Reactive powder concrete.	8

Course Outcomes

Course outcome	Descriptions
CO1	Students will have the ability to understand behavior of concrete knowing fundamental properties of ingredients
CO2	Students will have the ability to design Light Weight Concrete
CO3	Students will have the ability to design Ferro cement
CO4	Students will have the ability to design Fiber Reinforced Concretes and High Performance Concretes

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Design of Concrete Mixes	N. Krishna Raju	5th Edition ISBN: 978-81-239-2467-0
2	Concrete Technology Theory and Practice	M. L. Gambhir	5th Edition ISBN-10 1259062554 ISBN-139781259062551
3	Concrete Technology”-Oxford University Press, New Delhi,2007	A.R.Santhakumar,	2nd Edition ISBN10-0199458529 ISBN13-978-0199458523

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Properties of Concrete	A.M.Neville	5th Edition2011 ISBN 978-81-317-9107-3
2	Corrosion Of Reinforcement In Concrete Construction (Special Publications)	C.L.Page P.B. Bamforth And JWFigg	1996 Edition
3	High Performance Fiber Reinforced Cement Composites 6 HPFRCC 6 (RILEM Book series)	Gustavao J Parra, Montesinos	2011 Edition

Subject Name: RELIABILITY ANALYSIS AND RELIABILITY BASED DESIGN OFSTRUCTURES

SubjectCode: CAD2PE52 **L-T-P-C:3-0-0-3**

Course Objectives :

Sl.No	Course Objectives
1	To Make the student understand the in depth principles of Probability and Statistics
2	To Make the student understand the principles of Level 2 Reliability Methods
3	To Make the student understand the principles of Monte Carlo Simulation
4	To make student pply principles of Reliability to Structures

UNIT	Description	Hours
I	**Introduction to reliability and difference in approach used in civil engineering**: Statistics for raw data and classified data. Mean Median Mode, Standard deviation and Coefficient of variation, Moments, Skewness and Kurtosis.	9
II	Curve fitting: Method of least squares linear and nonlinear non-linear. Introduction to Probability axioms of probability mutually exclusive and independent events, fundamental of set theory De Morgan's rule conditional probability probability tree diagram.	7
III	Normal distribution, Lognormal distribution and their properties, Probability and exceedance probability. Statistical sensitivity analysis, Calculation of statistic of RC beam in flexure (Ultimate Resistance) and probability of its failure, Design of a tension member for a given probability of failure when loadisnormallyandlognormallydistributed..Chisquaretest,Suitabilityof probabilistic model (Log Normal distribution) by Chi square test.	8
IV	Concepts of Reliability reliability index problems on column simply supported beam cantilever be statistical sensitivity analysis, establishing statistics of Resistance of column and simply supported beam Application of Monte Carlo techniquewith Box Muller Technique, when parameters are normally distributed] for cube strength of concrete the strength, Comparison of standard deviation and mean strength of axially loaded short column obtained by simulation and theory. Obtaining the probability of failure by simulation when load of short column when all parameters are either non-random or normally distributed.	7

V	Level 2 reliability methods FOSM and AFOSM methods, determination of Cornell's Beta for steel tensile member, Column, I section. Hasofer Lind method for invariant beta, Problem on I section & steel tension member to check invariance of Beta. Fiessler's method for invariant beta, problem on short column, simply supported beam, Elastic cantilever beam for a given deflection. Reliability based design by inverse formulation, Determination of mean depth of an I beam using Hasofer Lind method. Definitions of Nominal value, mean value, characteristic value. Finding partial safety factor for RC beam for ultimate strength, simply supported beam [RSJ]. Theory of LRFD design factors. Theory of LRFD [procedure] for Indian Standards.	8

Course Outcomes

Course outcome	Descriptions
CO1	Students will have the ability to use Principles of Statistics and Probability
CO2	Students will have the ability to apply Level 2 Reliability methods
CO3	Students will have the ability to apply principles of Monte Carlo Simulation
CO4	Students will have the ability to analyze Structure in light of theory ofreliability

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Reliability Analysis and Design of Structures, Tata McGraw Hill Publishing Co. Ltd., NewDelhi.	R.Ranganthan,	**First Edition**
2	Basic Statistical Methods for Engineers and Scientists, Harper and Row Publishers, New York.	John B.Kennedy and Adam M.Neville,	**First Edition**
3	Probability concepts in Engineering planning andDesign, John Wiley and sons, New York,	Ang A.H.S and W.H.Tang,	Vol.I and II.

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Probability and Statistics in Engineering and Management Sciences	William W. Hines, Douglas C. Montgomery	1990, 3rdEdition
2	Concepts in reliability Engineering	L.S.Srinath	2ndEdition
3	Theory of Probability	B. Gnedenko	1969

Subject Name: **FOUNDATION ENGINEERING**

Subject Code:CAD 2PE53 **L-T-P-C:3-0-0-3**

Course Objective:

Gain the knowledge of shallow and deep foundation design with analysis and to incorporate the soil parameters into consideration.

UNIT	Description	Hours
I	**Bearing Capacity &Settlement:**Introduction to bearing capacity and settlement, Factors affecting bearing capacity. Numerical problems on bearing capacity of soils. Typesandmodes of settlement. Computation of settlement for cohesion and cohesion less soils.	9
II	**Shallow Foundations**: Principles of Design of foundation,Requirements for geotechnical and structural aspects of design, Proportioning of Isolated footing, Combined Footing, Strap footing, Strip footing and Raftfoundation.	7
III	**Pile Foundation:** Historical Development, Necessity of pile foundations, Classification, Load carrying capacity of piles by Static formula in cohesive and cohesion less soils. Pile groups, group action of piles in sand and clay, group efficiency of piles and negative skin friction. Numerical problems on above.	8
IV	**Well Foundations**: Introduction, Classification of well foundation, Components of well foundation, Forces acting on well foundation, Sinking of wells, Causes and remedies for tilts and shifts. Drilled Piers and Caissons-Construction, advantages and disadvantages of drilled piers. Design concepts and Advantages and disadvantages of open, pneumatic and floating caissons.	7
V	**Foundations on Expansive Soils**: Definition, Identification, Mineral Structure, Index properties of expansive soils, Swell potential and Swell pressure, Free swell Tests on expansive soils, foundation treatment for structures in expansive soil, CNSlayer.	8

Course outcome	Descriptions
CO1	To understand the concept of bearing capacity and settlement of footings.
CO2	To know the different types of foundations and their suitability.
CO3	To understand the necessity of pile and well foundation including design.
CO4	To enhance the knowledge of placing of foundations in expansive soils.

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	"Pile Design, Construction And Practice",Taylor And Francis Publications, New York.	Michael Tomlinson And John Woodward	5th Edition, 2008
2	"Soil Mechanics And Foundation Engineering", UBS Publishers And Distributors, New Delhi.	V N S Murthy	6thEdition, 2009
3	"Theory And Practice Of Foundation Design", Prentice Hall Of India, New Delhi.	N NSom And S C Das	3rd Edition, 2009

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	"Soil Mechanics Fundamentals", John Wiley And Sons Publications,New York.	Muni Budhu And Wiley Blackwell	1stEdition, 2006
2	"Pile Foundations In Engineering", Wiley Inter-Science Publications,New York.	ShamsherPrakash And Hari D Sharma	2nd Edition, 2005
3	"Geotechnical Engineering", New Age Publications, New Delhi	Venkatramaiah C	3rdEdition, 2009

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Subject Name: EARTH QUAKE RESISTANT DESIGN OF STRUCTURES

Subject Code:CAD2PE61 **L-T-P-C:3-0-0-3**

Course Objectives :

The objective of this course is to make students to learn principles of engineering seismology, To design the reinforced concrete buildings for earthquake resistance. To evaluate the seismic response of the structures

UNIT	Description	Hours
I	**Seismic Hazard Assessment**: Engineering Seismology – Definitions, Introduction to Seismic hazard ,– Characteristics of strong Earthquake motion - Estimation of Earthquake parameters – Microzonation. Earthquake phenomenon – Seismotectonics and seismic zoning of India – Earthquake monitoring and seismic instrumentation.	9
II	**Earthquake Effects on Structures:** Response to ground acceleration – response analysis by mode superposition – torsional response of buildings - response spectrum analysis – selection of design earthquake – earthquake response of inelastic structures, allowable ductility demand Response Spectra / Average response Spectra - Design Response Spectra - Evaluation of earthquake forces – Effect of earthquake of on different types of structures – Lesson learnt from past earthquakes	7
III	**Concepts of Earthquake Resistant Design**: Structural Systems / Types of buildings – Causes of damage – Planning consideration / Architectural Concept (IS 4326 –1993) (Do's and Donts for protection of life and property) – Philosophy and principle of earthquake resistance design – Guidelines for Earthquake ResistantDesign.	8
IV	**Earthquake Resistant Earthen and Masonry Buildings**: Earthquake Resistant low strength masonry buildings, Strength and Structural properties of masonry – lateral load – Design Considerations	7
V	**Earthquake Resistant design of RCC Buildings**: Material properties – lateral load analysis – design and detailing. Basic concept of seismic base isolation – Seismic Isolation systems.	8

Course Outcomes

Course outcome	**Descriptions**
CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of engineering seismology
CO3	Understand the concepts of earthquake resistance of earthen masonry and reinforced concrete buildings.
CO4	Design and develop analytical skills

Text Books:

Sl No	**Text Book title**	**Author**	**Volume and Year of Edition**
1	Dynamics of structures	Chopra, A.K	Prentice-Hall of India Pvt. Ltd. New Delhi
2	Earthquake Resistant Design of Structures	PankajAgarwal and Manish Shrikhande	Prentice Hall of India, 2006
3	“Earthquake Resistant Design of Structures	S K Duggal	Oxford University Press, 2007

Reference Book:

Sl No	**Text Book title**	**Author**	**Volume and Year of Edition**
1	“Earthquake Resistance Design of Concrete Structures	Ghose, S.K.	SDCPL –R&D Center – New Mumbai 73
2	Elements of Earthquake Engineering	Jaikrishna et al	South AsiaPublishers, New Delhi

Subject Name: DYNAMICS OF SOIL-STRUCTURE INTERACTION

Subject Code:CAD2PE62 **L-T-P-C:3-0-0-3**

Course Objectives :

To apply the knowledge of soil structure interaction in civil engineering field for dynamic analysis

UNIT	Description	Hours
I	Introduction: Objectives and practical significance and importance of soil structure interaction (SSI); Fixed base structure, structures on soft ground; Modeling of unbounded media. Fundamentals of Soil-Structure Interaction: Direct and substructure methods of analysis; Equation of motion for flexible and rigid base; Kinematic interaction, inertial interaction and effect of embedment	9
II	Modeling of Structure: Temporal and spatial variation of external loads (including seismic loads); Continuous models, discrete models (lumped mass) and finite element models. Wave Propagation for SSI: Waves in semi-infinite medium – one, two and three-dimensional wave propagation; Dynamic stiffness matrix for out-of plane and in-plane motion.	7
III	Free-Field Response of Site: Control point and control motion for seismic analysis; Dispersion and attenuation of waves; Half-space, single layer on half-space; Parametric studies. Modeling of Boundaries: Elementary, local, consistent and transmitting boundaries. 8 Hours Module -4 Modeling of Soil: Green’s influence functions, boundary-element method, finite element model; Dynamic stiffness coefficients for different types of foundations – surface foundation, embedded foundation, shallow (strip) foundation and deep (piles) foundations. Soil Structure Interaction in Time Domain: Direct method; Substructure method (using dynamic stiffness and Green’s functions of soil); Hybrid frequency-time domain approach	8
IV	Nonlinear Analysis: Material nonlinearity of soil (including plasticity and strain hardening), geometrical nonlinearity (slip and separation of foundation with soil); Nonlinear structure with linear soil considering both soil and structure nonlinearity	7

V	Engineering Applications of Dynamic Soil-Structure Interaction: Low-rise residential buildings, multistory buildings, bridges, dams, nuclear power plants, offshore structures, soil-pile structure interactions. Course outcomes: After studying this course, students will be able to: • Predict type of waves and its movement • Predict the behaviour of structures in such movements	8

Course Outcomes

Course outcome	**Descriptions**
CO1	Students are able to understand the fundamentals and importance of SSI
CO2	Students are able to do modeling of structure to analyze and apply the dynamic SSI
CO3	Students are able to do modeling of soil to analyze and apply the dynamic SSI
CO4	Students are able know engineering applications of Dynamic Soil-Structure Interaction

Text Books:

Sl	**Text Book title**	**Author**	**Volume and Year**
1	Dynamic Soil-Structure Interaction	Wolf, J. P	1985
2	Soil-Structure Interaction	Cakmak, A.S	1987
3	Soil-Structure Interaction in the Time- Domain	Wolf, J. P	1988

Reference Book:

Sl No	**Text Book title**	**Author**	**Volume and Year of Edition**
1	Finite Element Modeling of Unbounded Media	Wolf, J.P. and SongC.	2000
2	Boundary Element Method for Soil-Structure Interaction	Hall, W.S. and Oliveto G	2003
3	Geotechnical-Earthquake Engineering	Kramer, S.L.,	1996

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Subject Name: ADVANCED DESIGN OF STEEL STRUCTURES

Subject Code:CAD2PE63 **L-T-P-C:3-0-0-3**

Course Objectives:

This course will enable students to
1. Understand the background to the design provisions for hot-rolled and cold formed steel structures, including the main differences between them.
2. Proficiency in applying the provisions for design of columns, beams, beam columns
3. Design structural sections for adequate fire resistance

UNIT	Description	Hours
I	Laterally Unrestrained Beams: Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non- uniform beams – Design Examples.	9
II	Beam- Columns in Frames: Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 – Examples.	7
III	Steel Beams with Web Openings: Shape of the web openings, practical guide lines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs(Concepts), Design of laterally restrained castellated beams for given sectional properties, Structural behaviour of Vierendeel girders (Concepts).	8
IV	Cold formed steel sections: Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801& 811 code provisions, numerical examplesbeamdesign, column design.	7
V	Fire resistance: Fire resistance level, Period of Structural Adequacy, Properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members-Numerical Examples, Methods of fire protection, Fire resistance ratings.	8

Course Outcomes

Course outcome	Descriptions
CO1	Students will be able to understand the behavior of Laterally Unrestrained Beams.
CO2	Students will be able to understand the concept of Beam- Columns in Frames.
CO3	Students will be able to understand the concept of Steel Beams with Web Openings.
CO4	Students will be able to understand the concept of Cold formed steel sections and fire resistance.

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Design of Steel Structures By Limit State Method	S. S. Bhavikatti	Second Edition, I K International Publishing House, India, 2010
2	Limit State Design of Steel Structures	S. K. Duggal,	Tata McGraw Hill Education Private Limited, New Delhi, India, 2015
3	Design of Steel Structures	N. Subramanyam	Oxford University Press, New Delhi, india, 2008.

Reference Book:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Design of steel structures	Rama Chandra and VirendraGehlot,	Scientific Publishers, india , 2009
2	Steel Structures	J.F. Baker	Vol - 1 and 2
3	Design of Steel Structures	DrN.Ramachandra.	Vol 2 standarad book house new Delhi

Subject Name: ADVANCED STRUCTRAL COMPUTATIONAL LABORATORY

Subject Code:CAD 2LB2 **L-T-P-C:0-0-3-1.5**

Course Objectives:

Course Objectives
This course will enable students to use industry standard software in a professional set up.

Description
EXPERIMENT 1: Analysis of 2D & 3D Trusses (using ANSYS/ETABS) **EXPERIMENT 2:** Structural Analysis of Beam for Different Loading Conditions (using ANSYS) **EXPERIMENT 3:** FE Analysis of Framed Structures Due to Seismic Forces (SAP2000) **EXPERIMENT 4:** SSI using Winkler approach (SAP2000)

Course Outcomes

Course outcome	Descriptions
CO1	Understand the elements of finite element modeling, specification of loads and boundary condition
CO2	Performing analysis and interpretation of results for final design