SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)

(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)
Accredited by NAAC with 'A+' Grade.
Recognised as Scientific and Industrial Research Organisation
SRKR MARG, CHINA AMIRAM, BHIMAVARAM – 534204 W.G.Dt., A.P., INDIA

Regulation: R25	**I - M.Tech. I - Semester**

STRUCTURAL ENGINEERING

COURSE STRUCTURE
(With effect from 2025-26 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
D2518701	Theory of Elasticity	PC	3	1	0	4	40	60	100
D2518702	Structural Dynamics	PC	3	1	0	4	40	60	100
D2518703	Matrix Analysis of Structure	PC	3	1	0	4	40	60	100
#PE-I	Program Elective-I	PE	3	0	0	3	40	60	100
#PE-II	Program Elective-II	PE	3	0	0	3	40	60	100
D2518704	Advanced Concrete Technology Laboratory	PC	0	1	2	2	40	60	100
D2518705	Advanced Structural Engineering Laboratory	PC	0	1	2	2	40	60	100
D2518706	Seminar-I	PR	0	0	2	1	100	--	100
		TOTAL	**15**	**5**	**6**	**23**	**380**	**420**	**800**

	Course Code	Course Name
#PE-I	D25187A0	Experimental Stress Analysis
	D25187A1	Analytical &Numerical Methods for Structural Engineering
	D25187A2	Design of Reinforced Concrete Foundation
	D25187A3	Structural Optimization
#PE-II	D25187B0	Bridge Engineering
	D25187B1	Repair and Rehabilitation of Structures
	D25187B2	Advanced Reinforced Concrete Design
	D25187B3	Fracture Mechanics

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2518701	PC	3	1	--	4	40	60	3 Hrs.

THEORY OF ELASTICITY

(For Structural Engineering)

Course Objectives:

1.	To introduce the fundamentals of elasticity and stress-strain analysis in two and three dimensions.
2.	To develop analytical skills for solving elasticity problems using rectangular and polar coordinates, including beam bending and torsion.
3.	To apply mathematical methods like polynomial solutions, Fourier series, and energy principles to analyze stress distributions and structural behaviour.

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

S.No	Outcome	Knowledge Level
1.	Know the definition of stress and deformation and how to determine the components of the stress and strain tensors.	K3
2.	Apply the conditions of compatibility and equations of equilibrium and Understand how to express the mechanical characteristics of materials, constitutive equations and generalized Hook law.	K3
3.	Use the equilibrium equations stated by the displacements and compatibility conditions stated by stresses and understand index notation of equations, tensor and matrix notation and define state of plane stress, state of plane strain	K3
4.	Be able to analyze real problem and to formulate the conditions of theory of elasticity applications	K4
5.	Determine the boundary restrictions in calculations. Solve the basic problems of the theory of elasticity by using Airy function expressed as bi- harmonic function	K3

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 (8Hrs)	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 (8Hrs)	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 (8Hrs)	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 (8Hrs)	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.
Textbooks:	
1.	Theory of Elasticity- Stephen Timoshenko & J. N. Goodier, Mc.Grawhill Publishers
Reference Books:	
1.	Elasticity: Theory, Applications and Numeric- Martin H. Sadd, Wiley Publishers
2.	Theory of Elasticity -Sadhu Singh 3rd Edition, Khanna Publishers
e-Resources	
1.	https://onlinecourses.nptel.ac.in/noc22_ce103/preview

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2518702	PC	3	1	--	4	40	60	3 Hrs.

STRUCTURAL DYNAMICS

(For Structural Engineering)

Course Objectives:

1.	To find the behaviour 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: At the end of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Understand the response of structural systems to dynamic loads Realize the behavior and response of linear and nonlinear SDOF and MDOF structures with various dynamic loading	K3
2.	Understand the behavior and response of MDOF structures with various dynamic loading.	K3
3.	Possess the ability to find out suitable solution for continuous system	K3
4.	Understand the behavior of structures subjected to dynamic loads under free vibration	K3
5.	Understand the behavior of structures subjected to dynamic loads Harmonic excitation and earthquake load	K3

SYLLABUS

UNIT-I (10Hrs)	**Theory of vibrations:** Introduction - Elements of vibratory system - Degrees of Freedom -Continuous System - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion- Victorian representation of S.H.M. - Free vibrations of single degree of freedom system – undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation - Vibration Isolation -Dynamic magnification factor –Phase angle.
UNIT-II (10 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 (10 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 (10 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.

Textbooks:	
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 Books:	
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.
3.	Theory of Vibration -William T Thomson, Springer Science.
4.	Mechanical Vibrations- S. S. Rao, 5e, Pearson Publications.
e-Resources	
1.	https://nptel.ac.in/courses/105106151
2.	https://nptel.ac.in/courses/105101209

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2518703	PC	3	1	--	4	40	60	3 Hrs.

MATRIX ANALYSIS OF STRUCTURE

(For Structural Engineering)

Course Objectives:

1.	To develop a fundamental understanding of structural idealisation, degrees of freedom, and formulation of stiffness and flexibility methods for basic structural elements.
2.	To enable learners to apply the stiffness method for assembling global stiffness matrices and analysing trusses, beams, and rigid-jointed plane frames.
3.	To impart knowledge on stiffness formulation and analysis of grid structures, tapered beams, and curved beams using coordinate transformations. To provide competence in analysing space trusses and frames through member stiffness formulation, transformation matrices, and structural analysis applications.

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

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.	K3
2.	Perform structural analysis using the stiffness method.	K3
3.	Solve multiple degree of freedom two and three dimensional problems involving trusses, beams, frames and plane stress	K3
4.	Understand basic finite element analysis.	K3
5.	Formulate member stiffness and transformation matrices for space trusses and frames, and analyze their behavior under applied loads.	K3

SYLLABUS

UNIT-I (8 Hrs)	Introduction of matrix methods of analysis – Static and kinematic indeterminacy – Degree of freedom– Structure idealisation-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 – coordinate transformation. Examples of grid problems – tapered and curved beams.
UNIT-IV (8Hrs)	Additional topics in stiffness methods – discussion of bandwidth – semi-bandwidth – static condensation – sub-structuring –Loads between joints-Support displacements- inertial and thermal stresses-Beams on elastic foundation by stiffness method.
UNIT-V (8Hrs)	Space trusses and frames - Member stiffness for space truss and space frame– Transformation matrix from Local to Global – Analysis of simple trusses, beams and

	frames.
Textbooks:	
1.	Matrix analysis of structures- Robert E Sennet- Prentice Hall-Englewood cliffs-New Jercy
2.	Advanced structural analysis-Dr. P. Dayaratnam- Tata McGraw hill publishing company limited.
Reference Books:	
1.	Indeterminate Structural analysis- C K Wang, Amazon Publications.
2.	Analysis of Tall buildings by force – displacement – Method M. Smolira Mc. Graw Hill.
3.	Foundation Analysis and design – J.E. Bowls, 5e, Amazon Publications.
4.	Structural Analysis Matrix Approach - Pandit and Guptha, Mc GrawHil Education
e-Resources:	
1.	nptel.ac.in/courses/105105180
2.	https://www.youtube.com/playlist?list=PLEE5D02698EAAF2C0

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25187A0	PE	3	--	--	3	40	60	3 Hrs.

EXPERIMENTAL STRESS ANALYSYS

(For Structural Engineering)

Course Objectives:

1.	Enable students to apply appropriate model study and strain measurement techniques for **evaluating structural response in laboratory and field settings**.
2.	Promote an understanding of the advantages, limitations, and appropriate selection of NDT techniques for real-world civil engineering applications.
3	Enable students to apply photoelastic methods to **determine stress fields and visualize stress distributions** in structural components.

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

S.No	Outcome	Knowledge Level
1.	Understand the fundamentals of the theory of elasticity	K3
2.	Implement the principles and techniques of photo elastic measurement	K3
3.	Obtain the principles and techniques of strain gage measurement	K3
4.	Adopt the principles and techniques of moiré analysis	K4
5.	Apply the principles and techniques of holographic interferometer	K3

SYLLABUS

UNIT-I (8 Hrs)	Introduction and Strain measurement methods – Model & Prototype – Dimensional analysis- Factors influencing model design – Scale factors and Model material properties – Methods of model design. Definition of strain and its relation to experimental determinations - properties of strain gauge systems – Mechanical, Optical, Acoustic and Pneumatic types
UNIT-II (8Hrs)	Electrical resistance strain gages: Introduction – gauge construction – strain gauge adhesives - mounting methods – gauge sensitivities and gage factor – performance characteristics of wire and foil strain gauges – environmental effects. Analysis of strain gauge data – the three element rectangular rosette – the delta rosette – correction for transverse sensitivity.
UNIT-III (8Hrs)	Non – destructive testing: Introduction – objectives of non destructive testing. Ultrasonic pulse velocity method – Rebound Hammer method (Concrete hammer) – Acoustic Emission- application to assessment of concrete quality.
UNIT-IV (8Hrs)	Theory of photo elasticity: Introduction – temporary double refraction – Index ellipsoid and stress ellipsoid – the stress optic law – effects of stressed model in a Polariscope for various arrangements - fringe sharpening.

UNIT-V (8Hrs)	Two dimensional photo elasticity: Introduction – Iso-chromatic fringe patterns – isoclinic fringe patterns – compensation techniques – calibration methods – separation methods – materials for photo- elasticity – properties of photo-elastic materials.
Textbooks:	
1.	Experimental Stress Analysis- William F. Riley and James W. Dally, Mc Graw Hill Publications
2.	Advanced Mechanics of Solids 3e - L.S. Srinath, Tata Mc Graw Hill Publications
Reference Books:	
1.	An Introduction to Experimental Stress Analysis – George Hamor Lee, Wiley Publishers.
2.	Experimental Stress Analysis- Sadhu Singh, Khanna Publishers
3.	Solid Mechanics – S.M.A. Kazimi, Mc Graw Hill Publications

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25187A1	PE	3	--	--	3	40	60	3 Hrs.

ANALYTICAL & NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

(For Structural Engineering)

Course Objectives:

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

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

S.No	Outcome	Knowledge Level
1.	Understand the fundamentals of the theory of elasticity	K3
2.	Implement the principles and techniques of photo elastic measurement	K4
3.	Obtain the principles and techniques of strain gage measurement	K3
4.	Adopt the principles and techniques of moiré analysis and Apply the principles and techniques of holographic interferometer	K3
5.	Apply the principles and techniques of brittle coating analysis Understand the fundamentals of the theory of elasticity	K3

SYLLABUS

UNIT-I (10Hrs)	**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 (10 Hrs)	**Integral Equations-** Fredholm and Volterra integral equations - Relation between differential and integral equations - Green's function -Fredholm equation with separable kernel - Iterative method for solving equations of second kind.
UNIT-IV (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 (10 Hrs)	**Numerical Differentiation:** Difference methods based on undetermined coefficients-optimum choice of step length– Partial differentiation. Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method – New Marks Method and Application to Beams – Calculations of Slopes & Deflections.

Textbooks:	
1.	Introduction to Partial Differential Equations, Sankara Rao. K, , PHI, New Delhi, 1995
2.	Numerical Methods For Scientific and Engineering Computations. M. K. Jain- S. R. K. Iyengar – R. K. Jain, New Age International (p) Ltd., Publishers
Reference Books:	
1.	Differential Equations and Calculus of Variations Elsgolts. L, Mir Publishers, Moscow, 1966
2.	Fundamentals of Mathematical Statistics Gupta. S.C, & Kapoor. V.K, Sultan Chand & Sons, Reprint 1999.
3.	.Higher Engineering Maths for Engg. And Sciences Venkataraman. M. K, National Publishing Company, Chennai
4.	.Numerical Methods for Engineering Problems N. Krishna Raju, K.U. Muthu Macmillan Publishers
5.	Elements of Partial Differential Equations, Sneddon. I.N, Mc Graw Hill, 1986

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25187A2	PE	3	--	--	3	40	60	3 Hrs.

DESIGN OF REINFORCED CONCRETE FOUNDATION

(For Structural Engineering)

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

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	K4
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	K4
5.	Design under-reamed pile foundations and rigid retaining walls and performance in various soil conditions, including expansive soils.	K4

SYLLABUS

UNIT-I (10Hrs)	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 (10 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 Unsymmetric Loading, Analysis of Strip Footing with Unsymmetrical Loads, Detailing of Members
UNIT-III (10 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 (10 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 (10 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.

Textbooks:

1.	Design of Reinforced Concrete Foundations by P. C Varghese, PHI Learning Private Limited., New Delhi.
2.	Design of Reinforced Concrete Structures by N. Subramaniam- Oxford University.

Reference Books:

1.	Reinforced Concrete Design by Unnikrishna Pillai and Devdas Menon, Tata Mc Graw Hill
2.	Limit State Design by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi publications Pvt. Ltd., New Delhi.
3.	Reinforced concrete design by N. Krishna Raju and R.N. Pranesh, New age International Publishers, New Delhi
4.	Fundamentals of Reinforced concrete design by M.L. Gambhir, Printice Hall of India Private Ltd., New Delhi.
5.	Reinforced concrete Limit state design by Ashok K. Jain, Nem Chand & Bros, Roorkee

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25187A3	PE	3	--	--	3	40	60	3 Hrs.

STRUCTURAL OPTIMIZATION

(For Structural Engineering)

Course Objectives:

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

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

S.No	Outcome	Knowledge Level
1.	Basic theoretical principles in optimization	K3
2.	Formulation of optimization models	K3
3.	Solution methods in optimization	K4
4.	Methods of sensitivity analysis and post processing of results	K4
5.	Applications to a wide range of engineering problems	K3

SYLLABUS

UNIT-I (10Hrs)	**Introduction:** Need and scope for optimization – statements of optimization problems- Objective function and its surface design variables- constraints and constraint surface- Classification of optimization problems (various functions continuous, discontinuous and discrete) and function behavior (monotonic and unimodal)
UNIT-II (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 (10 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 (8Hrs)	**Linear programming:** Definitions and theorems- Simplex method-Duality in Linear programming- Plastic analysis and Minimum weight design and rigid frame.

UNIT-V (8Hrs)	**Introduction to quadratic programming:** Geometric programming- and dynamic programming- Design of beams and frames using dynamic programming technique.

Textbooks:	
1.	Engineering Optimization Theory and Applications – S. S. Rao, Wiley Eastern Limited, New Delhi
2.	"Optimum Design of Structures" by Majid, K.I., Newnes-Butter Worths, London, 1974.
Reference Books:	
1.	Optimization Concepts and Application in Engineering- Belegundu A. D. and Chandrupatla T. R, Cambridge University Press
2.	"Mathematical Foundations for Design: Civil Engg. Systems" by Robert, M. Stark and Robert L. Nicholls, McGraw Hill Book Company, New York, 1972.
3.	"Optimum Structural Design, Theory and Applications", Edited by Gallegher, R.H. and Zienkiewiez, O.C., John Wiley and Sons, New York, 1973.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25187B0	PE	3	--	--	3	40	60	3 Hrs.

BRIDGE ENGINEERING

(For Structural Engineering)

Course Objectives:

1.	To understand the design principles of masonry arch bridges, including arch geometry, arch ring, and substructure components in accordance with IRC-SP-13.
2.	To develop the ability to analyse and design slab and T-beam superstructures using effective width, dispersion methods, and advanced analytical approaches specified in IRC-21.

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

S. No.	Outcome	Knowledge Level
1.	Design theories for super structure and substructure of bridges	K3
2.	Design Culvert, R.C.C T Beam Bridge.	K3
3.	Understand the behavior of continuous bridges, box girder bridges.	K3
4.	Possess the knowledge to design prestressed concrete bridges.	K3
5.	Design Railway bridges, Plate girder bridges, different types of bearings, abutments, piers and various types of foundations for Bridges	K3

SYLLABUS

UNIT-I (8 Hrs)	Masonry arch Bridge design details- Rise, radius, and thickness of arch- Arch ring- Dimensioning of substructures- Abutments, pier and end connections.(Ref: IRC- SP-13)
UNIT-II (10 Hrs)	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-Pigeaud's method design of longitudinal girders-Guyon-Messonet method- Hendry Jaegar method-Courbon's theory. (Ref: IRC-21), voided slabs, T-Beam bridges.
UNIT-III (10 Hrs)	Plate girder bridges- Elements of plate girder and their design-web-flange- intermediate stiffener vertical stiffeners- bearing stiffener-design problem.
UNIT-IV (10 Hrs)	Prestressed Concrete and Composite bridges- Preliminary dimensions-flexural and torsional parameters-Courbon's Theory – Distribution coefficients by exact analysis- design of girder section- maximum and minimum prestressing forces- eccentricity- live load and dead load shear forces- cable zone in girder- check for stresses at various sections- check for diagonal tension diaphragms and end block design- short term and long term deflections- Composite action of composite brides- shear connectors- composite or transformed section- design problem. (Ref: IRC: Section-VI)
UNIT-V (10 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 culverts- culvert alignment-culvert entrance structure- Hydraulic design and structural design of pipe culverts reinforcements in pipes. (Ref: IRC: SP-13)
Textbooks:	
1.	Design of Concrete Bridges- M.G. Aswini, V.N. Vazirani, M.M. Ratwani, Khanna Publishers.
2.	Essentials of Bridge Engineering- Jhonson Victor D, 7e, Oxford IBH Publications.
Reference Books:	
1.	Design of Bridges by N. Krishna Raju, CBS Publishers and Distributors.
2.	Bridge Engineering by S. Ponnuswamy, McGraw-Hill Publications.
3.	IRC 6- 2016 Standard Specifications and Code of Practice for Road Bridges.
4.	IRC 21-2009 Standard Specifications and code of practice for Road Bridges Section III.
e-Resources:	
1.	nptel.ac.in/courses/105105216
2.	NPTEL : NOC:Reinforced Concrete Road Bridges (Civil Engineering)

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25187B1	PE	3	--	--	3	40	60	3 Hrs.

REPAIR AND REHABILITATION OF STRUCTURES

(For Structural Engineering)

Course Objectives:

1.	To provide fundamental knowledge of materials, admixtures, and advanced concretes used in repair, rehabilitation, and modern construction practices.
2.	To develop an understanding of structural strengthening and stabilization techniques including bonded installations, fibre wraps, and other innovative methods.
3.	To enable students to evaluate the properties, performance, and applications of special concretes such as fibre-reinforced, lightweight, fly ash, high-performance, and self-consolidating concretes.

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

S.No	Outcome	Knowledge Level
1.	Recognize the mechanisms of degradation of concrete structures and to design durable concrete structures and conduct field monitoring and non-destructive evaluation of concrete structures.	K3
2.	Design and suggest repair strategies for deteriorated concrete structures including repairing with composites and Understand the methods of strengthening methods for concrete structures	K3
3.	Assessment of the serviceability and residual life span of concrete structures by Visual inspection and in situ tests	K3
4.	Evaluation of causes and mechanism of damage	K3
5.	Evaluation of actual capacity of the concrete structure Maintenance strategies	K3

SYLLABUS

UNIT-I (8 Hrs)	Materials for repair and rehabilitation -Admixtures- types of admixtures-purposes of using admixtures- chemical composition- Natural admixtures- Fibres- wraps- Glass and Carbon fibre wraps- Steel Plates-Non destructive evaluation: Importance- Concrete behavior under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods- Corrosion activity measurement- chloride content – Depth of carbonation- Impact echo methods- Ultrasound pulse velocity methods- Pull out tests.
UNIT-II (8Hrs)	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 (8Hrs)	Bonded installation techniques- Externally bonded FRP- Wet layup sheet, bolted plate, near surface mounted FRP, fundamental debonding mechanisms-intermediate crack debonding- CDC debonding- plate end debonding- strengthening of floor of structures
UNIT-IV (8Hrs)	Fibre reinforced concrete- Properties of constituent materials- Mix proportions, mixing and casting methods-Mechanical properties of fiber reinforced concrete- applications of fibre reinforced concretes- Light weight concrete- properties of light weight concrete- No fines concrete- design of light weight concrete- Flyash concrete-Introduction-classification of flyash- properties and reaction mechanism of flyash- Properties of flyash concrete in fresh state and hardened state- Durability of flyash concretes
UNIT-V (8Hrs)	High performance concretes- Introduction- Development of high performance concretes- Materials of high performance concretes- Properties of high performance concretes- Self Consolidating concrete- properties- qualifications.

Textbooks:	
1.	Maintenance Repair Rehabilitation & Minor works of Buildings- P.C. Varghese, PHI Publications
2.	Repair and Rehabilitation of Concrete Structures – P.I. Modi, C.N. Patel, PHI Publications
	Rehabilitation of Concrete Structures- B. Vidivelli, Standard Publishers Distributors
	Concrete Bridge Practice Construction Maintenance & Rehabilitation- V.K. Raina, Shroff Publishers and Distributors.
Reference Books:	
1.	Concrete Technology Theory and Practice- M.S. Shetty, S Chand and Company
2.	Concrete Repair and Maintenance illustrated- Peter H Emmons
3.	Concrete Chemical Theory and Applications- Santa Kumar A.R. , Indian Society for Construction Engineering and Technology, Madras
4.	Handbook on Repair and Rehabilitation of RC Buildings published by CPWD, Delhi
e-Resources	
1.	https://archive.nptel.ac.in/courses/105/106/105106202/
2.	https://archive.nptel.ac.in/courses/105/105/105105213/

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25187B2	PE	3	--	--	3	40	60	3 Hrs.

ADVANCED REINFORCED CONCRETE DESIGN

(For Structural Engineering)

Course Objectives:

1.	To estimate the crack width and deflection regarding the serviceability.
2.	To analyze and design a grid floor and flat slab system. To analyze and design concrete structures against fire resistance, according to ISO 834 standards

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

S.No	Outcome	Knowledge Level
1.	Estimate the deflection of Concrete beams and slabs.	K4
2.	Estimate crack width and its affects.	K4
3.	Design flat slabs.	K4
4.	Design of RCC chimneys.	K4
5.	Understand the thermal effect on concrete members.	K4

SYLLABUS

UNIT-I (10Hrs)	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, Deflection of continuous beams by IS 456, Deflection of slabs. Estimation of Crack width in Reinforced Concrete Members: Introduction, Factors affecting crack width in beams, Mechanisms of flexural cracking, Calculation of crack width, Simple empirical method, Estimation of crack width in beams by IS 456, Shrinkage and thermal cracking.
UNIT-II (10 Hrs)	Redistribution of Moments in Reinforced Concrete Beams: Introduction, Redistribution of moments in fixed beam, Positions of points of contraflexures, 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 - ψ), Relation of reinforced concrete sections. Approximation Analysis of Grid Floors: Introduction, Analysis of flat grid floors, Analysis of rectangular grid floors by Timoshenko's plate theory. Analysis of grid by stiffness matrix method, Analysis of grid floors by equating joint deflections, Comparison of methods of analysis, Detailing of steel in flat grids.
UNIT-III (10 Hrs)	Design of Flat Slabs: Introduction, Proportioning of Flat Slabs, Determination of Bending moment and Shear Force, Direct Design method, Equivalent Frame method, Slab

	Reinforcement.
UNIT-IV (10 Hrs)	Chimneys: Introduction, Design factors, Stresses due to Self Weight and Wind load, Stress in horizontal reinforcement, Temperature Stresses, Combined effect of Self Weight, Wind load and Temperature, Temperature stresses in Hoop(Horizontal) Reinforcement.
UNIT-V (10 Hrs)	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.

Textbooks:	
1.	Advanced Reinforced Concrete Design by P.C. Varghese Prentice Hall India Limited
2.	Advanced RCC Design (RCC Volume II) by SS Bhavikatti New Age International publications
Reference Books:	
1.	Reinforced Concrete Structures by Robert Park & Thomas Paulay, Wiley Publications.
2.	Design of Reinforced Concrete Structures by N. Subrahmanyam, Oxford Publications
3.	Advanced Reinforced Concrete Design by N. Krishna Raju, CBS Publishers and Distributers Pvt Ltd
4.	Reinforced Concrete Design by Unnikrishna Pillai and Devdas Menon, Tata Mc Graw Hill Limit State Design by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi publications Pvt. Ltd., New Delhi.
5.	Fundamentals of Reinforced concrete design by M.L. Gambhir, Printice Hall of India Private Ltd., New Delhi.
e-Resources	
1.	https://www.nptelprep.in/courses/105106224/materials

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25187B3	PE	3	--	--	3	40	60	3 Hrs.

FRACTURE MECHANICS

(For Structural Engineering)

Course Objectives:

1.	Impart knowledge of fracture behavior in materials under elastic and plastic conditions.
2.	Enable students to apply principles of linear elastic fracture mechanics for design and safety evaluation.
3.	Develop the ability to analyze crack propagation under mixed modes and characterize fracture using CTOD/CMOD.
4.	Equip students with skills to evaluate fatigue crack growth and apply fracture mechanics in structural design.
5.	Introduce applications of fracture mechanics to quasi-brittle materials like concrete, including size-effect laws.

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

S.No	Outcome	Knowledge Level
1.	Predict material failure for any combination of applied stresses.	K3
2.	Estimate failure conditions of a structures	K4
3.	Determine the stress intensity factor for simple components of simple geometry.	K3
4.	Predict the likelihood of failure of a structure containing a defect.	K4
5.	Apply fracture mechanics concepts to concrete by understanding strain-softening behaviour and using Bazant's size-effect law to evaluate strength and failure characteristics of concrete structures.	K3

SYLLABUS

UNIT-I (10Hrs)	**Introduction:** Fundamentals of elastic and plastic behaviour of materials- stresses in a plate with a hole – Stress Concentration factor-modes of failure- Brittle fracture and ductile fracture- history of fracture mechanics-Griffiths criteria for crack propagation cracks- Energy release rate, GI GII and GIII - Critical energy release rate GIc , GIIc and GIIIc – surface energy - R curves – compliance.
UNIT-II (10 Hrs)	**Principles of Linear Elastic Fracture Mechanics:** SOM vs Fracture Mechanics -stressed based Criteria for fracture- Stress Intensity Factors- KI K II and K III – Critical stress Intensity Factors, KIcKIIc and KIIc – crack tip plastic zone – Erwin's plastic zone correction –Critical crack length-Load carrying capacity of a cracked component- Design of components based on fracture mechanics.
UNIT-III	Mixed mode crack propagation- Maximum tangential stress criterion – crack propagation

(10 Hrs)	angle - Material characterisation by Crack Tip Opening Displacements (CTOD)- Crack Mouth Opening Displacement (CMOD)- Critical crack tip opening displacement (CTODc) –critical Crack Mouth Opening Displacement (CMODc).
UNIT-IV (8Hrs)	Fatigue Crack propagation- Fatigue load parameters Fatigue crack growth curve – Threshold stress intensity factor-Paris law- Retardation effects.
UNIT-V (8Hrs)	Applications of fracture Mechanics to concrete- reasons –strain softening behaviour – Bazant's size effect law.
Textbooks:	
1.	Elementary engineering fracture mechanics – David Broek – Sijthoff&Noordhoff – Netherlands
2.	Elements of Fracture Mechanics – Prasanth Kumar, Wiley Eastern Publications
Reference Books:	
1.	Fracture Mechanics: Fundamentals and applications – T. L. Andrason, PhD, CRC publications
2.	Fracture Mechanics of Concrete: Applications of fracture mechanics to concrete, Rock, and other quasi-brittle materials, Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang, John Wiley & Son publication

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2518704	PC	--	1	2	2	40	60	3 Hrs.

ADVANCED CONCRETE TECHNOLOGY LABORATORY

(For Structural Engineering)

Course Objectives: The objectives of this course is to make the student aware of

1	Methods used to evaluate the physical and chemical properties of construction materials through laboratory and field testing.
2	Techniques for assessing the quality and durability of concrete structures using non-destructive testing and strain measurement.

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

S.No	Outcome	Knowledge Level
1	Conduct various laboratory tests on Cement, Aggregates	K3
2	Know strain measurement	K3
3	Non-destructive testing	K3
4	Chemical analysis on concrete and Aggregate and Sand	K3

SYLLABUS

1	Study on Water/Cement Ratios Vs Workability of different concretes
2	Study on Water/Cement Ratios Vs Strength of different concretes
3	Study of variation of Coarse Aggregate to Fine Aggregates on Workability
4	Study of variation of Coarse Aggregate to Fine Aggregates on Strength
5	Strain measurement-Electrical resistance strain gauges
6	Non destructive testing -Impact Hammer test, UPV test
7	QualificationstestsonSelfcompactionconcrete-LBox,JBox,UboxandSlumptests

Reference Books:

1	Concrete Technology by M. S. Shetty. – S. Chand & Co.; 2004
2	Properties of Concrete by A.M. Neville – PEARSON – 4th edition
3	Concrete Microstructure, Properties of Materials by P.K. Mehta and Moterio. McGraw Hill 4th edition 2014

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2518705	PC	--	1	2	2	40	60	3 Hrs.

ADVANCED STRUCTURAL ENGINEERING LABORATORY

(For Structural Engineering)

Course Objectives:

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

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

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	K5
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	K5
5.	Determine the Young's Modulus of Elasticity of Concrete	K5

SYLLABUS

1	Study on Deflection and Cracks on a Under Reinforced Over Reinforced and Balanced Sections
2	Study on Performance of RCC Beams designed for Bending and failing in Shear
3	Study on Performance of RCC Beams designed for Shear and failing in Bending
4	Study on Performance of RCC One way slabs
5	Study on Performance of RCC Two way slabs with simply supported edge conditions
6	Study on Performance of RCC Two way slabs with fixed edge conditions
7	Calculation of Young's Modulus of Elasticity of Concrete
8	Extraction and Study of Concrete Core samples from pavements
	NOTE: A minimum of five experiments from the above set have to be conducted as demonstration to entire class.

Reference Books:

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

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2518706	PR	--	--	2	1	100	--	3 Hrs.
SEMINAR -I								
(For Structural Engineering)								
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 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								

Regulation: R25	**I - M.Tech. II - Semester**

STRUCTURAL ENGINEERING

COURSE STRUCTURE
(With effect from 2025-26 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
D2528701	Finite Element Methods in Structural Engineering	PC	3	1	0	4	40	60	100
D2528702	Earthquake Resistant Design	PC	3	1	0	4	40	60	100
D2528703	Stability of Structures	PC	3	1	0	4	40	60	100
#PE-III	Program Elective-III	PE	3	0	0	3	40	60	100
#PE-IV	Program Elective-IV	PE	3	0	0	3	40	60	100
D2528704	Computer Aided Design Laboratory	PC	0	1	2	2	40	60	100
D2528705	Structural Design Laboratory	PC	0	1	2	2	40	60	100
D2528706	Seminar-II	PR	0	0	2	1	100	--	100
		TOTAL	**15**	**5**	**6**	**23**	**380**	**420**	**800**

	Course Code	Course Name
#PE-III	D25287A0	Analysis of Tall Structures
	D25287A1	Advanced Steel Design
	D25287A2	Analysis of Offshore Structures
	D25287A3	Structural Health Monitoring
#PE-IV	D25287B0	Theory of Plates and Shells
	D25287B1	Precast and Prefabricated Structures
	D25287B2	Earth Retaining Structures
	D25287B3	Industrial Structures

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2528701	PC	3	1	--	4	40	60	3 Hrs.

FINITE ELEMENT METHODS INSTRUCTURAL ENGINEERING

(For Structural Engineering)

Course Objectives:

1.	To develop an understanding of variational principles, energy methods, and weighted residual techniques as the foundation for finite element formulations.
2.	To enable students to formulate and analyse truss elements in 2D and 3D using stiffness methods and finite element formulation for beam and frame elements under various loading and support conditions using Galerkin's method.
3.	To equip students with the ability to model and solve plane stress, plane strain, and axi-symmetric problems using CST and LST elements with convergence and stress interpretation.

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

S.No.	Outcome	Knowledge Level
1.	**Apply** variational principles and weighted residual methods to obtain approximate solutions for structural problems.	K3
2.	**Formulate and analyse** stiffness matrices for 2D and 3D truss elements, including transformations and stress computation under different support conditions.	K3
3.	**Develop and solve** finite element formulations for beams and rigid frames subjected to various loading and support conditions using Galerkin's method.	K3
4.	**Model, solve, and interpret** plane stress, plane strain, and axi-symmetric problems using CST and LST elements with convergence analysis.	K3
5.	**Implement** iso-parametric elements with Gauss quadrature, **evaluate** stiffness matrices and nodal loads, and **verify** stability through patch tests.	K3

SYLLABUS

UNIT-I (8 Hrs)	Introduction: Review of stiffness method- Principle of Stationary potential energy-Potential energy of an elastic body- Rayleigh-Ritz method of functional approximation - variational approaches -weighted residual methods.
UNIT-II (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 3-D truss- Inclined and skewed supports- Galerkin's method for 1-D 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 axi-symmetric problems-Derivation of CST and LST stiffness matrix and equations-treatment of body and surface forces-Finite Element solution for plane stress and axi-symmetric problems- Comparison of CST and LST elements – Convergence of solution- Interpretation of stresses.
UNIT-V (8 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.
Textbooks:	
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
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 AgeInternational (P) Limited.
3.	IRC 6- 2016 Standard Specifications and Code of Practice for Road Bridges.
4.	IRC 21-2009 Standard Specifications and code of practice for Road Bridges Section III.
e-Resources:	
1.	http://kcl.digimat.in/nptel/courses/video/105106051/L01.html
2.	http://www.digimat.in/nptel/courses/video/105107209/L01.html

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2528702	PC	3	1	--	4	40	60	3 Hrs.

EARTHQUAKE RESISTANT DESIGN

(For Structural Engineering)

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

S.No	Outcome	Knowledge Level
1.	To learn the fundamentals of seismology and basic earthquake mechanisms, tectonics types of ground motion, and propagation of ground motion and Understand qualitative and quantitative representations of earthquake magnitude	K3
2.	Determine the natural frequency of a single degree of freedom dynamic system for given mass, stiffness and damping properties.	K4
3.	Determine the maximum dynamic response of an elastic vibrating structure to a given forcing function and Learn the fundamentals of building code based structural design	K4
4.	Determine the static design base shear based on the type of structural system, irregularity, location and occupancy.	K4
5.	Distribute the static base shear to the structure based on vertical distribution of mass horizontal distribution of mass, and centers of rigidity.	K4

SYLLABUS

UNIT-I (8Hrs)	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 (8 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 (8 Hrs)	Cyclic loading behavior of RC, steel and pre- stressed concrete elements - modern concepts- Base isolation – Adaptive systems – case studies
UNIT-V (08 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

Textbooks:	
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
e-Resources	
1.	http://www.digimat.in/nptel/courses/video/105102016/L27.html

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2528703	PC	3	1	--	4	40	60	3 Hrs.

STABILITY OF STRUCTURES

(For Structural Engineering)

Course Objectives:

1.	Provide knowledge of stability concepts in beam-columns and continuous beams subjected to axial and lateral loads and to apply classical and energy methods to analyze elastic buckling of bars and frames.
2.	Evaluate inelastic buckling behavior and formulate stability problems using advanced mathematical approaches.
3.	Impart understanding of torsional and flexural–torsional buckling in thin-walled structural members and analyze and apply stability criteria for lateral buckling of beams under bending.

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

S.No	Outcome	Knowledge Level
1.	Analyze different types of structural instabilities.	K3
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	K3
4.	To be well versed in the lateral buckling, torsional buckling, Flexural torsional buckling of various beams and non-circular sections.	K4
5.	Apply stability criteria to evaluate lateral buckling of beams with rectangular and I-sections subjected to bending.	K3

SYLLABUS

UNIT-I (8Hrs)	**Beam columns:** Differential equation for beam columns – Beams column with concentrated loads – continuous lateral load – couples – Beam column with built in ends – continuous beams with axial load – application of Trigonometric series – Determination of allowable stresses.
UNIT-II (8 Hrs)	**Elastic buckling of bars :** Elastic buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns –Sway & Non Sway mode - Energy methods – Buckling of a bar on elastic foundation – Buckling of bar with intermediate compressive forces and distributed axial loads – Buckling of bars with change in cross section – Effect of shear force on critical load – Built up columns – Effect of Initial curvature on bars – Buckling of frames – Sway & Non Sway mode
UNIT-III (8 Hrs)	**In-elastic buckling:** Buckling of straight bars – Double modulus theory Tangent modulus theory. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae of design – various end conditions – Design of columns

	based on buckling. Mathematical Treatment of stability problems: Buckling problem orthogonality relation – Ritz method –Stiffness method and formulation of Geometric stiffness matrix- Applications to simple frames
UNIT-IV (8 Hrs)	**Torsional Buckling:** Pure torsion of thin walled bars of open cross section – Non uniform torsion of thin walled bars of open cross section - Torsional buckling – Buckling of Torsion and Flexure
UNIT-V (8 Hrs)	Lateral Buckling of simply supported Beams: Beams of rectangular cross section subjected for pure bending, Buckling of I Section subjected to pure bending
Textbooks:	
1.	Principles of Structural Stability Theory by AlexanderChajes, Prentice-Hall, Inc, Engle wood Cliffs, New Jersey.
2.	Theory of Elastic Stability by S. P. Timshenko& J.M. Gere-Mc Graw Hill Publications
3.	Structural Stability Theory and Implementation by W.F.Chen and E.M.Lui, Elsevier science Publishing Co., Inc, New York
Reference Books:	
1.	Fundamentals of Structural Stability by George J Simitses & Dewey H. Hodges, Elsevier Publications
2.	Elastic Stability of Structural Elements, N.G.R. Ayyangar Macmillan Publications
3.	Theory of Elastic Stability byManika Selvam.
e-Resources	
1.	https://nptel.ac.in/courses/105104693

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25287A0	PE	3	--	--	3	40	60	3 Hrs.

ANALYSIS OF TALL STRUCTURES

(For Structural Engineering)

Course Objectives:

1.	Provide knowledge of modern materials and design philosophies for tall structures.
2.	Enable students to apply load considerations including gravity, wind, and earthquake effects on tall structures.
3.	Equip students with the ability to analyze stability and second-order effects influencing tall structures.

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

S.No	Outcome	Knowledge Level
1.	Know design principles and different types of loading	K3
2.	Understand various structural systems used for Tall structures.	K3
3.	Capable of analyzing the tall structures and design of structural elements for secondary effects	K4
4.	Execute stability analysis, overall buckling analysis of frames, Analysis for various secondary effects –such as Creep, Shrinkage and Temperature	K4
5.	Apply stability analysis methods to assess buckling, P–Delta effects, torsional instability, and foundation flexibility in tall structures.	K3

SYLLABUS

UNIT-I (8Hrs)	Design Criteria Philosophy, Materials – Modern concepts – High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self Compacting Concrete.
UNIT-II (8 Hrs)	Gravity Loading – Dead load, Live load, Impact load, Construction load, Sequential loading. Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods. Earthquake Loading – Equivalent lateral Load analysis, Response Spectrum Method, Combination of Loads.
UNIT-III (8 Hrs)	Behavior of Structural Systems- Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, In-filled frames, Shear walls, Coupled Shear walls, Wall–Frames, Tubular, Outrigger braced, Hybrid systems
UNIT-IV (8 Hrs)	Analysis and Design- Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of structures as an integral UNIT, Analysis for member forces, drift and twist. Computerized 3D analysis. Design for differential movement, Creep and Shrinkage effects, Temperature Effects and Fire Resistance.

UNIT-V (8 Hrs)	Stability Analysis- Overall buckling analysis of frames, wall–frames, Approximate methods, Second order effect of gravity loading, P–Delta Effects, Simultaneous first order and P-Delta analysis, Translational instability, Torsional Instability, Out of plumb effects, Effect of stiffness of members and foundation rotation in stability of structures.
Textbooks:	
1.	Bryan Stafford Smith and Alex Coull, "Tall Building Structures - Analysis and Design", John Wiley and Sons, Inc., 1991.
2.	Structural Design of Multistoried Buildings U.H. Varyaani, South Aisna Publishers
Reference Books:	
1.	Structural Analysis and Design of Tall Buildings Bungle S. Taranath, McGraw-Hill, 198
2.	High Tise Building Structures WoflgangShcueller, John Wiley & Sons Inc
3.	Art of the Skyscraper: The Genius of Fazulur R Khan- Ali Mir, Rizzoli International Publications

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25287A1	PE	3	--	--	3	40	60	3 Hrs.

ADVANCED STEEL DESIGN

(For Structural Engineering)

Course Objectives:

1.	Impart knowledge of code provisions for the design of riveted, bolted, and welded connections.
2.	Develop the ability to apply plastic analysis methods to evaluate load-carrying capacity of steel members and frames.
3.	Enable students to analyze and design eccentric and moment-resistant connections.
4.	Provide knowledge for the analysis and design of steel industrial buildings including trusses, purlins, and bracings.

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

S.No	Outcome	Knowledge Level
1.	Apply codal provisions to design riveted, bolted, and welded connections under different loading conditions and evaluate their efficiency.	K3
2.	Analyze beams and frames using plastic theory to determine collapse loads, plastic moments, and shape factors.	K4
3.	Apply design principles to analyze and design beam–column connections subjected to eccentric shear and moments.	K3
4.	CO4: Analyze loading effects and design trusses, purlins, and bracing systems for steel industrial buildings.	K4
5.	Apply codal provisions to design compression members, tension members, and bracings for steel truss girder bridges under various loads.	K3

SYLLABUS

UNIT-I (8 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 (8 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 (8 Hrs)	**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 (8 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 (8 Hrs)	**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.
Textbooks:	
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
	Design Steel Structures Volume-II, Ramachandra &VivendraGehlot, 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 – 201

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25287A2	PE	3	--	--	3	40	60	3 Hrs.

ANALYSYS OF OFFSHORE STRUCTURES

(For Structural Engineering)

Course Objectives:

1.	Provide fundamental knowledge of offshore structural systems, hydrostatics, and stability of floating bodies and apply fluid mechanics principles for wave motion and hydrodynamic analysis
2.	Develop the ability to estimate wave and current forces on offshore structures using analytical methods.
3.	Impart skills to analyze wave–structure interaction for small and large bodies using theoretical approaches and to apply static and dynamic analysis methods for fixed offshore structures under environmental loading.

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

S.No	Outcome	Knowledge Level
1.	Apply hydrostatic principles to determine buoyancy, stability, and motions of floating offshore structures.	K3
2.	Analyze wave characteristics using conservation laws, Euler and Bernoulli's equations, and Airy's wave theory.	K4
3.	Apply Morison's equation to estimate wave and current forces on offshore members including effects of marine growth.	K3
4.	Analyze hydrodynamic forces on large offshore bodies using Froude–Krylov and diffraction theories.	K4
5.	Apply static and dynamic analysis methods to evaluate the response of fixed offshore structures under environmental loads.	K3

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 (8 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 (8 Hrs)	Wave force on large bodies-Froude-krylov theory, Diffraction theory.

UNIT-V (8 Hrs)	Static and dynamic analysis of fixed offshore structures.
Textbooks:	
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.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25287A3	PE	3	--	--	3	40	60	3 Hrs.

STRUCTURAL HEALTH MONITORING

(For Structural Engineering)

Course Objectives:

1.	Provide fundamental knowledge of factors affecting structural health, causes of distress, and the need for regular maintenance.
2.	Enable students to apply structural health monitoring (SHM) and audit techniques for assessing the safety of structures.
3.	Develop the ability to conduct static and dynamic field testing using appropriate instrumentation and measurement systems.

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

S.No	Outcome	Knowledge Level
1.	Diagnose the distress in the structure by understanding the causes and factors	K3
2.	Assess the health of structure using static field methods.	K4
3.	Assess the health of structure using dynamic field tests	K3
4.	Carryout repairs and rehabilitation measures of the structure	K4
5.	Apply repair and rehabilitation techniques, including the use of piezoelectric and smart materials, for structural health improvement	K3

SYLLABUS

UNIT-I (8 Hrs)	Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance
UNIT-II (8 Hrs)	Structural Health Monitoring: Concept, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures
UNIT-III (8 Hrs)	Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.
UNIT-IV (8 Hrs)	Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.
UNIT-V (8 Hrs)	Introduction to Repairs and Rehabilitations of Structures: Case Studies (Site Visits), Piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Textbooks:

1.	Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2.	Health Monitoring of Structural Materials and Components Methods withApplications, Douglas E Adams, John Wiley and Sons, 2007.
Reference Books:	
1.	Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
2.	Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25287B0	PE	3	--	--	3	40	60	3 Hrs.

THEORY OF PLATES AND SHELLS

(For Structural Engineering)

Course Objectives:

1.	To derive and explain governing equations for plate bending and apply Navier's and Levy's methods to solve rectangular plate problems under various loading conditions.
2.	To analyze circular and annular plates, evaluate stress and displacement responses under symmetric loading using appropriate mathematical techniques.
3.	To apply membrane and bending theories to analyze and design shell structures, including cylindrical shells and curved surfaces, using equilibrium equations and design coefficients.

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

S.No	Outcome	Knowledge Level
1.	Have a knowledge about various plate theories due to bending	K1
2.	Gain the knowledge of Navier's solution, Levy's solution and solve for the rectangular and square plates	K3
3.	Analyze circular plates with various boundary conditions.	K4
4.	Focus on the finite difference method of solving plate problems.	K3
5.	Ability to realize the potential energy principle and find the solution of rectangular plates for various loadings	K3

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 (8 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	Beam theory of cylindrical shells: Beam and arch action. Design of diaphragms -

(8 Hrs)	Geometry analysis and design of elliptic Paraboloid, Conoidal and Hyperbolic Paraboloid shapes by membrane theory.
Textbooks:	
1.	Theory of Plates and Shells 2e –S. Timoshenko and S. Woinowsky Krieger, McGraw-Hill book company, INC, New York.
2.	Reinforced Concrete Shells and Folded Plates by P.C. Varghese, Prentice Hall India Publications
3.	Analysis of Thin Concrete Shells by K. Chandrasekhar, New Age International (P) Ltd
Reference Books:	
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
e-Resources	
1.	https://onlinecourses.nptel.ac.in/noc21_ce59/preview
2.	https://www.youtube.com/playlist?list=PLwdnzlV3ogoXQR59FK4dNDzxb5I65IIuu

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25287B1	PE	3	--	--	3	40	60	3 Hrs.

PRECAST AND PREFABRICATED STRUCTURES

(For Structural Engineering)

Course Objectives:

1.	Provide knowledge of principles, materials, and systems used in prefabrication and modular construction and apply design principles for precast structural elements such as beams, columns, slabs, and panels.
2.	Develop the ability to analyze structural behavior and detailing of joints for precast construction and analyze and design precast units for industrial applications considering safety against progressive collapse.

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

S.No	Outcome	Knowledge Level
1.	Analyze the prefabricated load carrying members.	K3
2.	Analyze the production technology of prefabrication.	K4
3.	Design and detailing of precast UNIT for factories.	K3
4.	Design single storied simple frames.	K4
5.	Design precast structural systems for industrial buildings and evaluate safety against progressive collapse.	K3

SYLLABUS

UNIT-I (8 Hrs)	Need for prefabrication – General Principles of Prefabrication - Comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization – Materials – Modular coordination – Systems – Production – Transportation – Erection.
UNIT-II (8 Hrs)	Prefabricated Load Carrying Members-Planning for components of prefabricated structures, disuniting of structures, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses, beams, columns, symmetric frames. Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls.
UNIT-III (8 Hrs)	Joints - Joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction.
UNIT-IV (8 Hrs)	Production Technology - Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening. Hoisting Technology - Equipment for hoisting and erection, techniques for erection of different types of members

	like beams, slabs, wall panels and columns, vacuum lifting pads.
UNIT-V (8 Hrs)	Applications - Designing and detailing of precast UNIT for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns. Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.
Textbooks:	
1.	Precast Concrete Structures- Kim S Elliott, CRC Press
2.	CBRI, Building materials and components, India, 1990
3.	Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994
4.	Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.
Reference Books:	
1.	Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland BetorVerlag, 1978.
2.	Mokk. L, (1964), Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25287B2	PE	3	0	0	3	40	60	3 Hrs.

EARTH RETAINING STRUCTURES

(For Structural Engineering)

Course Objectives:

1.	To equip students with the knowledge of earth pressure theories and their application in the analysis and design of earth retaining structures.
2.	To develop the ability to analyze, design, and ensure stability of conventional retaining walls, sheet piles, reinforced soil walls, braced cuts, and cofferdams.
3.	To apply soil–structure interaction principles and practical design methods for safe and economical retaining structures in different ground conditions.

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

S.No	Outcome	Knowledge Level
1.	Quantify the lateral earth pressures associated with different earth systems, Evaluate the mechanical properties of geosynthetics used for soil reinforcement	K3
2.	Identify the merits and demerits of different earth retaining systems.	K3
3.	Select the most technically appropriate type of retaining wall for the application from a thorough knowledge of available systems.	K3
4.	Design of retaining structures using appropriate design methods, factors of safety, earth pressure diagrams and field verification methods	K3
5.	Aware of current guidelines regarding the design of earth retaining structures. Design retaining structures considering both external and internal stability aspects	K3

SYLLABUS

UNIT-I (8 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 (8 Hrs)	**Conventional Retaining walls**– different types - Type of Failures of Retaining Walls – Stability requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.
UNIT-III (8 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-IV	**Reinforced Soil Retaining Walls** - Soil reinforcement – Reinforced soil - Different

(8 Hrs)	components – their functions – Design principles of reinforced soil retaining walls.
UNIT-V (8 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.
Textbooks:	
1.	Principles of Foundation Engineering 7e by Braja Das, Cengage Learning
2.	Foundation analysis and design by Bowles, J.E. – McGraw Hill
Reference Books:	
1.	Soil Mechanics in Engineering Practice – Terzaghi, K and Ralph, B. Peck 2e. – John Wiley & Sons.
2.	Analysis and Design of Foundations and Retaining Structures, Samsher Prakash, Gopal Ranjan and Swami Saran, Saritha Prakashan, New Delhi
e-Resources	
1.	Geosynthetics and Reinforced Soil Structures - Andhra University IIT Madras Prof. K. Rajagopal Prof. Dali Naidu Arnepalli. https://nptel.ac.in/courses/105106052
2.	Foundation Engineering, IIT Kharagpur, Prof. Kousik Deb. https://nptel.ac.in/courses/105105176

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D25287B3	PE	3	--	--	3	40	60	3 Hrs.

INDUSTRIAL STRUCTURES

(For Structural Engineering)

Course Objectives:

1.	Provide knowledge of planning and functional requirements for industrial structures considering safety and serviceability.
2.	Enable students to apply design principles to industrial buildings including roofs, gantry girders, and machine foundations and behavior of folded plate structures and diaphragm beams.
3.	Impart understanding of design considerations for power plant structures including bunkers, silos, chimneys, cooling towers, and containment structures and analyze and design power transmission structures and their foundations.

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

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.	K4
3.	Realize the basic concepts and design of power plant structures.	K3
4.	Design power transmission structures.	K4
5.	Possess the ability to understand the design concepts of Chimneys, bunkers and silos	K3

SYLLABUS

UNIT-I (8 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)	Industrial buildings- roofs for industrial buildings (Steel)-design of gantry girder- design of corbels and nibs- machine foundations
UNIT-III (8 Hrs)	Design of Folded plates- Design considerations- analysis of folded plates- analysis of multi bay folded plates- design of diaphragm beam
UNIT-IV (8 Hrs)	Power plant structures- Bunkers and silos- chimney and cooling towers-Nuclear containment structures
UNIT-V (8 Hrs)	Power transmission structures- transmission line towers- tower foundations- testing towers

Textbooks:

1.	Advanced Reinforced Concrete design by N. Krishnam Raju, CBS Publications & Distributions
2.	Handbook on Machine Foundations by P. Srinivasulu and C. V. Vaidyanathan, Structural Engineering Research Center
	Tall Chimneys- Design and Construction by S. N. Manohar Tata Mc Grawhill Publishing Company
Reference Books:	
1.	Transmission Line Structures by S. S. Murthy and A. R. Santakumar McGraw Hill
2.	SP 32: 1986, Handbook on functional requirements of Industrial buildings
3.	Analysis of Thin Concrete Shells by K. Chandrasekhar, New Age International (P) Ltd

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2528704	PC	--	1	2	2	40	60	3 Hrs.

COMPUTER AIDED DESIGN LABORATORY

(For Structural Engineering)

Course Objectives:

1	Equip students with the ability to use modern CAD/CAE software (STAAD, STAAD Foundation, ETABS, ANSYS) for analysis and design of structures.
2	Develop programming skills for structural modeling, loading, and analysis automation and evaluation of structural responses for various systems such as beams, trusses, frames, and multistory buildings.

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

S.No	Outcome	Knowledge Level
1	Develop Computer Programs for Analysis and Design of various Structural Elements	K6
2	Use different Structural Engineering software's to solve various civil Engineering programs	K5
3	Create analytical models of plane and space trusses and assess their load-carrying efficiency under different load conditions	K6
4	Evaluate the stability and deformation behavior of plane and space frames using advanced software packages.	K5

SYLLABUS

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

1	Programming for beams subject to different loading
2	Analysis and Design of reinforced concrete multistoried building
3	Analysis of plane and space truss
4	Analysis of plane and space frame
5	Determination of mode shapes and frequencies of tall buildings using lumped mass (stick model) approximation
6	NOTE: **A minimum of Four from the above set have to be conducted.**

Reference Books:

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

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2528705	PC	--	1	2	2	40	60	3 Hrs.

STRUCTURAL DESIGN LABORATORY

(For Structural Engineering)

Course Objectives:

1	Develop competency in using advanced structural engineering software (STAAD, STAAD Foundation, ETABS, ANSYS) for real-life design applications.
2	Foster skills in evaluating structural performance under static, dynamic, wind, and seismic loads. Provide hands-on exposure to the design of special structures such as tall buildings, bridges, shells, and abutments.

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

S.No	Outcome	Knowledge Level
1.	Evaluate the wind effects on tall structures and create optimized design models ensuring stability and serviceability	K5
2.	Create and validate computational models of pre-stressed concrete bridge girders to assess load-carrying capacity and serviceability.	K6
3.	Develop and evaluate analytical models of cylindrical shell structures for stress distribution and deformation under applied loads	K5
4.	Evaluate the structural performance and stability of bridge piers and abutments under different loading and foundation conditions.	K5
5.	Create dynamic models of multistoried buildings and assess natural frequencies, mode shapes, and seismic responses	K6

SYLLABUS

	Analysis and Design using STADD, STADD FOUNDATION, ETABS, ANSYS
1	Wind analysis on tall structure
2	Analysis of pre stressed concrete bridge girder
3	Analysis of Cylindrical shell
4	Analysis of Bridge Pier and Abutment
5	Dynamic Analysis of Multistory structure
	NOTE: A minimum of Four from the above set have to be conducted.

Reference Books:

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

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2528706	**PR**	**--**	**--**	**2**	**1**	**100**	**--**	**3 Hrs.**
SEMINAR -II								
(For Structural Engineering)								
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 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								

Regulation: R25	**II - M.Tech. I - Semester**

STRUCTURAL ENGINEERING

COURSE STRUCTURE
(With effect from 2025-26 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
D2538701	Research Methodology and IPR / Swayam 12 week MOOC course – RM&IPR		3	0	0	3	40	60	100
D2538702	Summer Internship/ Industrial Training (8-10 weeks) *	PR	--	--	--	3	100	--	100
D2538703	Comprehensive Viva#	PR	--	--	--	2	100	--	100
D2538704	Dissertation Part – A$	PR	--	--	20	10	100	--	100
		TOTAL	**3**	**-**	**20**	**18**	**340**	**60**	**400**

* Student attended during summer / year break and assessment will be done in 3rd Sem.

Comprehensive viva can be conducted courses completed upto second sem.

$ Dissertation – Part A, internal assessment

Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2538701	PC	3	--	--	3	40	60	3 Hrs.

RESEARCH METHODOLOGY AND IPR

(For Structural Engineering)

Course Objectives:

1.	To bring awareness on Research Methodology and research ethics.
2.	Familiarize the concepts of IPR.

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Identify the research problem through effective literature review and data analysis	**K3**
2.	Develop a technical paper with essential sections	**K3**
3.	Choose the patents, trade, and copyrights for protecting intellectual creations	**K3**
4.	Identify patents rights and transfer of technology	**K3**
5.	Identify appropriate IPR mechanism for protecting various types of intellectual creations.	**K3**

SYLLABUS

UNIT-I (10Hrs)	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations
UNIT-II (12Hrs)	Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee
UNIT-III (12Hrs)	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
UNIT-IV (12Hrs)	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
UNIT-V (12Hrs)	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies,

	IPR and IITs.
Textbooks:	
1.	Stuart Melville and Wayne Goddard, ―Research methodology: an introduction for science & engineering students'
2.	Wayne Goddard and Stuart Melville, ―Research Methodology: An Introduction
3.	Ranjit Kumar, 2nd Edition, ―Research Methodology: A Step by Step Guide for beginners
Reference Books:	
1.	Halbert, ―Resisting Intellectual Property‖, Taylor & Francis Ltd, 2007.
2.	Mayall, ―Industrial Design‖, McGraw Hill, 1992.
3.	Niebel, ―Product Design‖, McGraw Hill, 1974.
4.	Asimov, ―Introduction to Design‖, Prentice Hall, 1962
5.	Robert P. Merges, Peter S. Menell, Mark A. Lemley, ― Intellectual Property in New Technological Age, 2016.
6.	T. Ramappa, ―Intellectual Property Rights Under WTO‖, S. Chand, 2008

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2538702	PR	--	--	--	3	100	--	3 Hrs.

SUMMER INTERNSHIP

(For Structural Engineering)

Students shall undergo mandatory summer internship / industrial training for a minimum of eight weeks duration at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship/industrial training report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of a Professor of the department and two faculty. The report and the oral presentation shall carry 40% and 60% weightages respectively. For summer internship / industrial training, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2538703	PR	--	--	--	2	100	--	3 Hrs.

COMPREHENSIVE VIVA

(For Structural Engineering)

The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering/Specialization in the PG program. Viva will be conducted in 3rd semester. The duration of the viva will be around 30 min. The examination committee will be constituted by the HoD and consist of Professor of the department and two faculty. For comprehensive viva-voce, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2538704	PR	--	--	20	10	100	--	3 Hrs.

DISSERTATION PART – A

(For Structural Engineering)

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-Part A will be only internal evaluation by PRC for 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

The candidate shall submit a status report to the PRC in two stages, each accompanied by an oral presentation, with a minimum interval of three months between the two

Regulation: R25	**II - M.Tech. II - Semester**

STRUCTURAL ENGINEERING

COURSE STRUCTURE
(With effect from 2025-26 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
D2548701	Dissertation Part – B	PR	--	--	32	16	--	100	100
		TOTAL	**--**	**--**	**32**	**16**	**--**	**100**	**100**

External Assessment

Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2548701	PR	--	--	32	16	--	100	3 Hrs.

DISSERTATION PART B
(Main Project)

(For Structural Engineering)

The student has to continue his/her work from Dissertation Part-A to complete Dissertation Part-B in IV semester.

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

Dissertation Part-B 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.