Department of Civil Engineering
MTech CIVIL COMPUTER AIDED STRUCTURAL ENGINEERING
PROGRAM STRUCTURE (2025-26)

Course Category			I	II	III	IV	Total Credits
Program Courses	Program Core Course (PCC)	-	12	04	04		24
		MOOC		04			
	Program Elective Course (PEC)		06	06			12
Vocational and Skill Education Courses (VSE)	Seminar		01				02
	PG Lab		01				
Humanities, Social Science and Management (HSSM)	Indian Knowledge System (IKS)			02			02
Experiential Learning Courses (EL)	Research Methodology			03			34
	Mini Project			01			
	Project				10	20	
Open Elective Courses (OE)	Open Elective (OE)				03		03
Multi-Disciplinary Minor Courses (MDM)	Multi-Disciplinary Minor (MDM)				03		03
Liberal Learning Courses (LLC)	Co-Curricular Courses (CC)					AU	Audit
Total Credits			**20**	**20**	**20**	**20**	**80**

MTech in CIVIL (COMPUTER AIDED STRUCTURAL ENGINEERING)

Course Category	Credits	% Credits
Program Core Courses **(PCC)**	24	30
Program Elective Courses **(PEC)**	12	15
Vocational & Skill Enhancement **(VSE)**	02	02
Humanity, Social Science & Management (AEC, EM, IKS, VEC) **HSSM**	02	02
Experiential Learning **(EL)**	34	43
Open Electives **(OE)**	03	04
Multi-Disciplinary Minor (MDM)	03	04
Total Credits	**80**	**100 %**

Course Category Wise % Credits

(OE) 4%
(MDM) 4%
(PCC) 30%
(EL) 43%
(PEC) 15%
(AEC, EM, IKS, VEC) HSSM 2%
(VSE) 2%

SEMESTER I

Category	Course Code	Name of the Course	L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	Credits
			Teaching Scheme				Evaluation Scheme					
PCC	PD251001	Theory of Elasticity and Plasticity	4	--	--	4	10	10	20	60	100	4
PCC	PD251002	Matrix Methods of Structural Analysis	4	--	--	4	10	10	20	60	100	4
PCC	PD251003	Numerical Methods	4	--	--	4	10	10	20	60	100	4
PEC	PD2511--	Program Elective I	3	--	--	3	10	10	20	60	100	3
PEC	PD2511--	Program Elective II	3	--	--	3	10	10	20	60	100	3
VSE	PD251401	Seminar	--	--	2	2	15	15		20	50	1
VSE	PD251402	PG Lab	--	--	2	2	15	15		20	50	1
Total			**18**	**0**	**04**	**22**					**600**	**20**

SEMESTER II

Category	Course Code	Name of the Course	L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	Credits
			Teaching Scheme				Evaluation Scheme					
PCC	PD252004	Design of Tall Structures	4	--	--	4	10	10	20	60	100	4
PCC	PD252005	MOOC/SWAYAM	4	--	--	4	10	10	20	60	100	4
PEC	PD2521--	Program Elective III	3	--	--	3	10	10	20	60	100	3
PEC	PD2521--	Program Elective IV	3	--	--	3	10	10	20	60	100	3
EL	PG252601	Research Methodology	3			3	10	10	20	60	100	3
IKS	PG252501	Interdisciplinary Perspective on Indian Science and Technology	2			2	10	10	20	60	100	2
EL	PD252602	Mini Project			2	2	15	15		20	50	1
Total			**22**	**0**	**02**	**21**					**650**	**20**

SEMESTER III

Category	Course Code	Name of the Course	L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	Credits
			Teaching Scheme				Evaluation Scheme					
PCC	PD253006	Finite Element Method	4	--	--	4	10	10	20	60	100	4
OE	PD2533--	Open Elective	3	--	--	3	10	10	20	60	100	3
MDM	PD2532--	Multi-Disciplinary Minor	3	--	--	3	10	10	20	60	100	3
EL	PD253603	Project I			10	10	25	25		50	100	10
Total			**10**	**0**	**10**	**20**					**400**	**20**

SEMESTER IV

Category	Course Code	Name of the Course	L	T	PR	Total	CA-I	CA-II	MSE	ESE	Total	Credits
			Teaching Scheme				Evaluation Scheme					
EL	PD254604	Project II			20	20	50	50		100	200	20
Total					**20**	**22**					**200**	**20**
CC	PG254701	Communication Skills and Technical Writing	2			2	25	25				AU
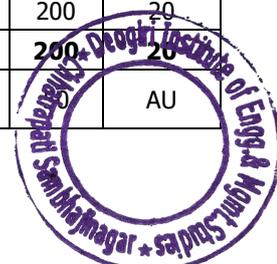
Program Elective Courses (PEC)

Semester	Course Category	No. of Credits				
SEM I	Program Elective I	3	Course Code	PD251101	PD251102	PD251103
			Course	Design of Bridges	Structural Dynamics	Advance Structural Analysis
	Program Elective II	3	Course Code	PD251104	PD251105	PD251106
			Course	Advanced Pre-stressed Concrete	Design of Masonry Structures	Structural Stability
SEM II	Program Elective III	3	Course Code	PD252107	PD252108	PD252109
			Course	Design of Cold Formed Steel Structures	Structural Health Monitoring	Retrofitting of Structures
	Program Elective IV	3	Course Code	PD252110	PD252111	PD252112
			Course	Theory of Plates and Shells	Earthquake Engineering & Design of Earthquake-Resistant Structures	Structural Audits

Open Electives (OE)

Semester	Course Category	No. of Credits		Course Code	Course
SEM III	Open Elective	3		PD253311	Soil Dynamics & Machine Foundations
				PD253312	Solution Procedures in Civil Engineering
				PD253313	Advance Concrete Technology

Multi-Disciplinary Minor (MDM)

Semester	Course Category	No. of Credits	Course Code	Course
SEM III	Multi-Disciplinary Minor	3	PD253201	Student Psychology
			PD253202	Sustainable Power Generation System
			PD253203	Intellectual Property & Rights

Course Title: Theory of Elasticity and Plasticity		
Course Code: PD251001		Course Category: PCC
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite: Students should have prior knowledge of solid mechanics and engineering mathematics, including stress–strain analysis, differential equations, vector calculus, and basic tensor concepts. Background in advanced mechanics of materials or continuum mechanics is helpful but not mandatory.

Course Description: This course intends to provide students a comprehensive knowledge on the theory of elasticity and plasticity. The course focuses on the six topics shown in detailed syllabus.

Course Objectives:

1. To develop a rigorous understanding of stress, strain, and constitutive relations in isotropic and anisotropic materials
2. To formulate and solve boundary value problems in elasticity using analytical and semi-analytical methods
3. To apply theories of elasticity to structural and continuum mechanics problems such as torsion, bending, stress concentrations, and contact stresses.
4. To enable students to analyze elastic-plastic stress–strain states and evaluate failure conditions in engineering components.
5. To prepare students for research and advanced applications of elasticity and plasticity in structural, geotechnical, aerospace, and mechanical engineering
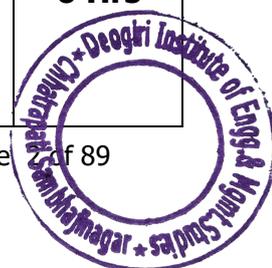
Course Outcomes:		
Cos	**After completion of the course: Student should be able to**	**Bloom's Level**
CO1	Understand concept of stress and strain at a point, Stress equilibrium and Strain compatibility and strain at a point with various perspectives, etc. under in three-dimensional state of strain.	Understand (Level 2)
CO2	Formulate and analyse stress concentration problems due to various complex situations.	Understand (Level 2)
CO3	Formulate and analyse stress concentration problems due to various complex situations.	Apply (Level 3)
CO4	Formulate and analyse members subjected to Torsion using various classical approaches.	Analyze (Level 4)
CO5	Apply elasticity and plasticity principles to advanced problems in structural, geotechnical, aerospace, and mechanical engineering, demonstrating readiness for research or professional practice.	Analyze (Level 4)
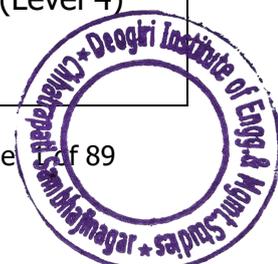
CO-PO-PSO Mapping															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	-	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	2	-	3
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	2	3

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

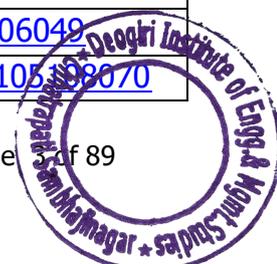| Course Contents		
Unit 1	**Analysis of Stresses and Strains:** Concept of Stress at a Point, Stress Tensor, State of Stress at a Point in Cartesian Coordinate System, Derivation of Stress Equilibrium Equations in Cartesian and Polar Coordinate System, Cauchy's Formula, Normal Stress, Shear Stress and Resultant Stress on any Inclined Plane, Transformation of Stresses, Stress Invariants, State of Pure Shear, Principal Stresses, Maximum Shear Stresses, Octahedral Stresses, Decomposition of State of Stress into Pure Shear and Hydrostatic Stress, Mohr's Circles/ Spheres for Various States of Stress, The State of Strain at a Point, Strain Displacement Relations, Strain Compatibility Condition, Volumetric Strain, Problems on Navier Lame's Equilibrium Equations, Problems on Beltrami - Michell Compatibility Equations, Boundary Value Problems in Elasticity.	7 Hrs
Unit 2	**Stress-Strain Relationship:** Generalized Hooke's Law, Hooke's Law for Isotropic, Orthotropic, Plane Stress, Plane Strain and Axi-Symmetric Problems, Relations between Elastic Constants, Problems in 2D and 3D Cartesian Coordinate System, Airy's Stress Function, Bending of Beams, Straight Beams & Asymmetrical Bending, Euler Bernoulli Hypothesis, Shear Center or Center of Flexure, Shear Center in Thin Walled Open Sections and Other Sections.	6 Hrs
Unit 3	**Stress Concentration Problems:** Stress Concentration Problems such as Stress Concentration due to Circular Hole in Stressed Plate (Kirsch's Problem), Stresses under Concentrated Load such as Concentrated Load acting on the Vertex of a Wedge (Michell's Problem) and Concentrated Load Acting on the Free Surface of a Plate (Flamant's Problem), Axi-symmetric Problems	6 Hrs

	such as Stresses in Thick Cylinders Subjected to Internal and External Uniformly Distributed Pressures (Lame's Problem).	
Unit 4	**Torsion:** Assumptions and Torsion Equation for General Prismatic Solid Bars, Warping of Non-Circular Sections and St.Venant's Theory, Prandtl's Stress Function Approach, Torsion of Circular, Elliptical and Triangular Cross-Sections, Torsion of Thin-Walled Structures by Membrane Analogy, Torsion of Rolled Sections and Shear Flow.	**6 Hrs**
Unit 5	**Plasticity:** Basic Equations, Similarities and Differences when Compared with Elasticity, Idealized Material Behaviour,Mechanical Models, Neck Formation, Failure Theories, Modes of Failure, Failure under Static Equilibrium,Buckling, Vibrations, Yielding, Fracture, Ductile and Brittle Failure, Yield Criteria, Rankine's Theory, Saint Venant's Theory, Tresca Criteria, Beltrami's Energy Criteria, Von Mises and Hencky & Huber's Theory,Comparison of Different Theories under Axial Tension and Torsion, Various Empirical Stress-StrainRelationships	**7 Hrs**
Unit 6	**Application of Theory of Elasticity:** Airy's stress function, Solution of simply supported beams and cantilever beams subjected to different loadings by polynomials. Bending of prismatic bar, Saint-Venant's theory of torsion, Prandtl's theory of torsion, Membrane analogy.	**6 Hrs**

Sr.No.	Text Books
1	L. S. Shrinath, Advanced Solid Mechanics, Tata-McGraw Hill Publications.
2	Timoshenko & Goddier, Theory of Elasticity & Plasticity, Mc-Graw Hill Publications.
3	Martin Sadd, Elasticity Theory, Applications & Numerics, Academic Press.
4	M A Kazami, Solid Mechanics, Tata -McGraw Hill Publications
5	Sadhu Singh, Theory of Elasticity, Khanna Publishers, New Delhi

| Sr.No.	Reference Books
1	Irving Shames, Mechanics of Deformable Solids, Prantice Hall.
2	N K Bairagi, Advanced Solid Mechanics, Khanna Publishers, New Delhi.
3	Wang, Applied Elasticity, Dover Publications.
4	N Dahl and T Lardner, S Crandall, Mechanics of Solids, McGraw Hill Publications.

Sr.No.	Web Resources
1	Theory of Elasticity, NPTEL, https://nptel.ac.in/courses/105105177
2	Advanced Solid Mechanics, NPTEL, https://nptel.ac.in/courses/105106049
3	Applied Elasticity for Engineers, NPTEL, https://nptel.ac.in/courses/105108070

Course Title: Matrix Methods of Structural Analysis		
Course Code: PD251002		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite:

Engineering Mechanics (Statics),Strength of Materials (Mechanics of Materials), Structural Analysis I, Calculus and Differential Equations, Linear Algebra, Numerical Methods or Computational Techniques.

Course Description: This course introduces computer-oriented methods for analyzing determinate and structures using matrix algebra. It covers stiffness and flexibility formulations, coordinate transformations, assembly of structural systems, and application to trusses, beams, and frames. Emphasis is placed on displacement-based methods, influence of support conditions, temperature effects, and second order (P–Δ) behavior. The course also provides a foundation for finite element methods and includes computational practice using MATLAB/Python and commercial structural analysis software.

Course Objectives:

1. To introduce the fundamental principles of matrix algebra as applied to structural analysis.
2. To develop stiffness and flexibility formulations for trusses, beams, and frames.
3. To enable systematic assembly and solution of large structural systems using computer-oriented methods.
4. To analyze the effects of support conditions, temperature changes, and settlement in structures.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Explain methods for analysing slopes and deflections in statically determinate and indeterminate structure	Understand (Level 2)
CO2	Apply flexibility matrix methods to analyse structural systems	Apply (Level 3)
CO3	Apply stiffness matrix methods to determine structural responses	Apply (Level 3)
CO4	Evaluate the effects of material and geometric nonlinearity in structural analysis along with FEM analysis	Evaluate (Level 5)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	–	1	–	–	–	–	–	1	–	1	2	2	
CO2	3	3	2	2	2	–	–	–	–	1	–	1	3		-
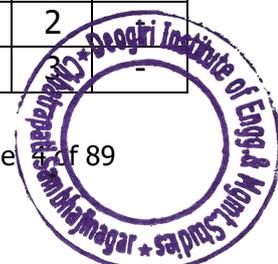
CO3	3	3	2	2	2	–	–	–	–	1	–	1	3	3	-
CO4	2	3	3	3	2	2	2	1	–	1	–	2	2	2	3

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

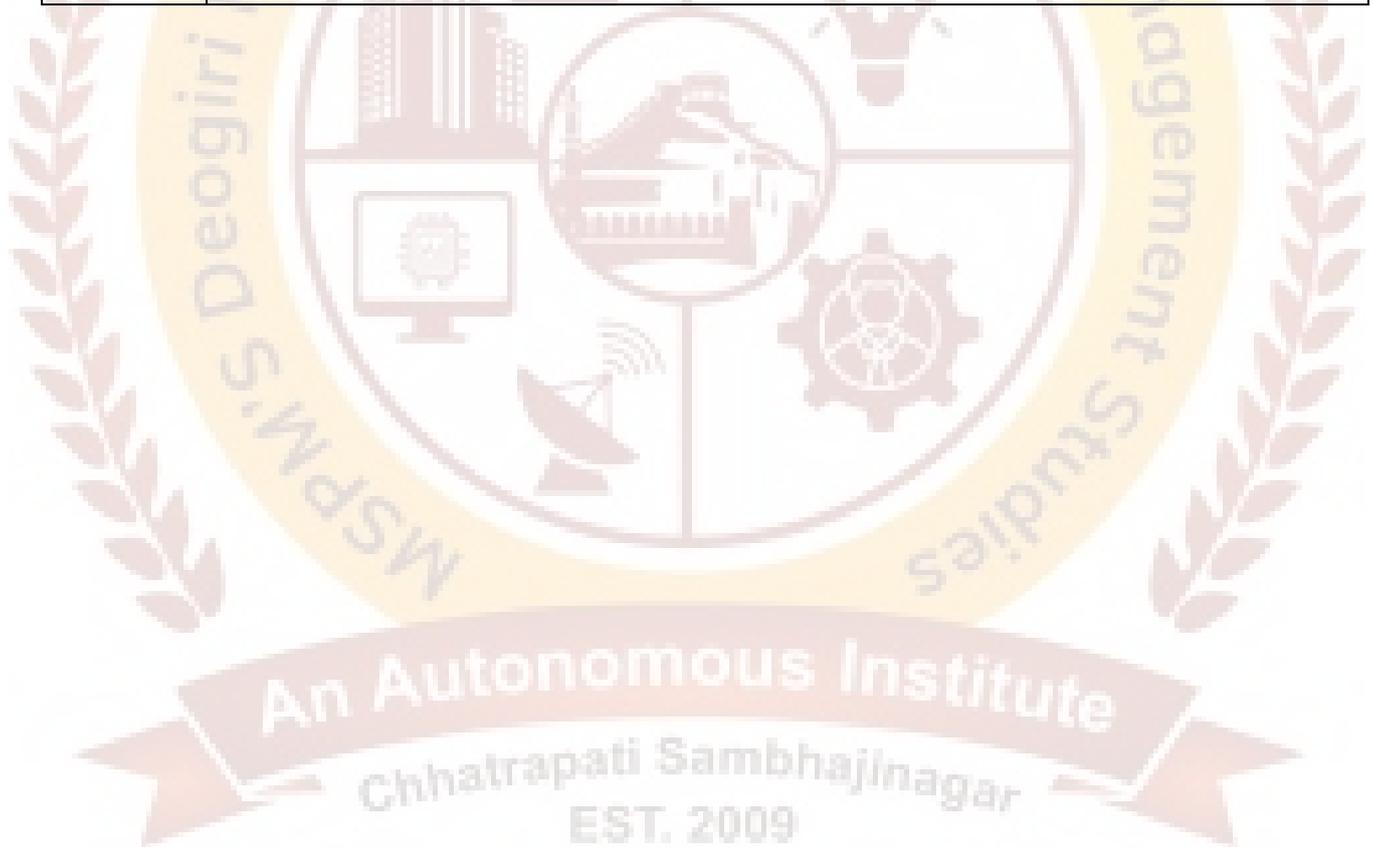| Course Contents		
Unit 1	**Introduction & Direct Flexibility Matrix Method** Introduction and Review of Various Methods for Finding Slopes and Deflections at a Point in Statically Determinate and Indeterminate Structures, Assessment of Deflected Shape of Structures for Different Loading & Support Conditions. Direct Flexibility Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames	**7 Hrs**
Unit 2	**Generalised Flexibility Matrix Method** Generalised Flexibility Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames.	**6 Hrs**
Unit 3	**Direct Stiffness Matrix Method** Direct Stiffness Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames.	**6 Hrs**
Unit 4	**Generalised Stiffness Matrix Method** Generalised Stiffness Matrix Method, Applications to Continuous Beams, Pin Jointed Frames, Rigid Jointed Frames.	**6 Hrs**
Unit 5	**Nonlinear Analysis** Material and Geometric Non-Linearity, Stiffness Method with Material Non- Linearity and Geometric Non-Linearity.	**6 Hrs**
Unit 6	**Finite Element Analysis**: Development of shape functions for different elements-Spring-Truss-Beam Plane elements- Plane stress and plane strain-Assemblage of elements construction of stiffness matrix and loads – boundary conditions –patch test-solution of overall problem.	**7 Hrs**

Sr.No.	Text Books
1	Weaver W, Gere G. M., Matrix Analysis of Framed Structures, Van Nostrand Reinhold, New York.
2	Hibbler R. C., Structural Analysis,
3	Reddy C. S., Basic Structural Analysis, Tata Mc Graw Hill Publications.
4	G. S. Pandit, S. P. Gupta, Structural Analysis – A Matrix Approach, Tata Mc Graw Hill Publications.
5	Devdas Menon, Structural Analysis, Alpha Science.
6	M. Mukhopdhyay, Concept and Application of Finite Element Analysis, Oxford and IBH Publishing Co. Pvt. Ltd.
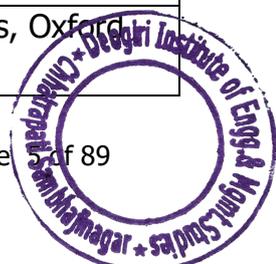
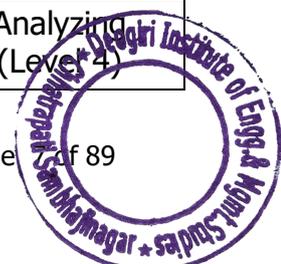| 7	R. D. Cook, Concept and Application of Finite Element Analysis, John Wiley & sons

Sr.No.	Reference Books
1	A. S. Meghare, S. K. Deshmukh, Matrix Methods of Structural Analysis, Charotor Publishing House
2	B. N. Thadani, J. P. Desai, Structural Analysis – A Matrix Approach, Ueinall Publications, Mumbai
3	C. S. Desai & J. F. Abel, Introduction to the Finite Element Method, CBS Pub
4	C. S .Krishnamoorthy, Programming in the Finite Element Method, Tata McGraw Hill
5	T.R.Chandrupatla and Belegundu, Introduction to the Finite Element in Engineering Prentice Hall of India, Pvt.Ltd.

Sr.No.	Web Resources
1	NPTEL IIT Kharagpur -https://nptel.ac.in/courses/105105180
2	https://www.nptelprep.in/courses/105105180/materials
3	https://www.scribd.com

Course Title: Numerical Methods		
Course Code: PD251003		Course Category: PCC
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite: Strong foundation in Calculus, Linear Algebra (matrices, systems of equations, eigenvalues), Some exposure to Differential Equations

Course Description: A Numerical Methods course description typically covers using computational algorithms to approximate solutions to mathematical problems that are analytically difficult or impossible to solve, such as finding roots of equations, solving systems of linear equations, performing numerical differentiation and integration, and approximating differential equations. The course aims to familiarize students with the derivation and application of these iterative numerical techniques using computers, with learning outcomes including the ability to write algorithms, program them, understand their limitations, and solve complex problems by combining methods.

Course Objectives:
1. To introduce the fundamental concepts of numerical methods and highlight their necessity in solving scientific and engineering problems.
2. To develop analytical skills in solving linear and non-linear algebraic equations using direct and iterative numerical techniques.
3. To enable students to apply interpolation, regression, and curve fitting techniques for analyzing discrete data and functional relationships.
4. To provide an understanding of numerical differentiation and integration methods for approximating solutions where analytical approaches are difficult.
5. To impart knowledge of numerical solutions of ordinary differential equations (ODEs) with emphasis on stability, accuracy, and applications in structural and dynamic systems.

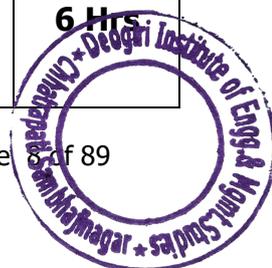| Course Outcomes:		
Cos	**After completion of the course: Student should be able to**	**Bloom's Level**
CO1	Apply numerical methods to represent numbers and analyze associated errors in computation.	Applying (Level 3) Analyzing (Level 4)
CO2	Solve systems of linear and non-linear algebraic equations using appropriate direct and iterative techniques with considerations of accuracy, convergence, and stability.	Applying (Level 3) Analyzing (Level 4)
CO3	Perform interpolation, regression, and curve fitting to model and predict behavior from discrete data sets.	Analyzing (Level 4)
CO4	Implement numerical differentiation and integration techniques for engineering and scientific applications with error	Analyzing (Level 4)

	analysis.	
CO5	Apply numerical algorithms for solving initial value problems and dynamic systems, demonstrating knowledge of stability, stiffness, and advanced Runge-Kutta–based approaches.	Applying (Level 3)

CO-PO-PSO Mapping

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	–	1	2	–	–	–	–	–	–	–	3	1	3
CO2	3	3	2	2	2	–	–	–	–	–	–	–	3	2	3
CO3	3	3	2	2	2	–	–	–	–	–	–	–	3	2	3
CO4	3	3	2	3	2	–	–	–	–	–	–	–	3	2	3
CO5	3	3	3	3	2	–	–	–	–	–	–	–	3	3	3

Assessment

CA-1 (a) (10 Marks)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10 Marks)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20 Marks)	Subjective Test

Course Contents

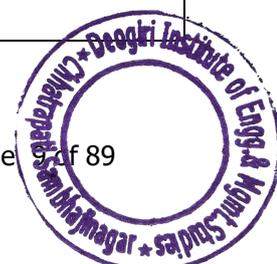| Unit 1	**Introduction to Numerical Methods** Introduction and Necessity of Numerical Methods, Number Representation and Errors, Numbers in Different Bases, Non-Integer & Fraction, Mantissa, Exponent, Normalized Scientific Notations, Errors in Representing Numbers, Inverse Error Analysis, Loss of Significance	7 Hrs
Unit 2	**Solution of Linear Algebraic Equations** Systems of Linear Algebraic Equations: Introduction & Ill-Conditioning, Methods of Solution: Gauss Elimination Method, LU Decomposition Method, Doolittle Decomposition Method, Gauss-Jordon Elimination Method, Gauss Seidel Method, Symmetric & Banded Coefficient Matrices, Pivoting and Diagonal Dominance, Gauss Elimination with Scaled Row Pivoting	6 Hrs
Unit 3	**Solution of Non-Linear Algebraic Equations** Roots of Algebraic & Transcendental Equations, Fixed Point Iteration Method, Iterative Search Method, Bisection Method, Geometrical Approach to Root Finding, Convergence towards Roots of Equation, Secant Method, False Secant / Regula-Falsi Method, Ridder's Method, Newton Raphson Method, System of Non-Linear, Equations (Newton Raphson Method)	6 Hrs
Unit 4	**Regression and Interpolation Methods** Interpolation and Curve Fitting, Discrete Data, Lagrange's Interpolating Polynomial, Newton's Polynomial Method, Limitations of Interpolation with Polynomials, Spline Interpolation, Curve Fitting:	6 Hrs

	Least Square Fit, Fitting with Straight Line & Polynomial Fit, Weighted Linear Regression, Fitting Exponential Function	
Unit 5	**Numerical Differentiation and Integration** Numerical Differentiation and Integration, Taylor's Series, Finite Difference Method, Error in Finite Difference Approximation, Richardson Extrapolation, Derivatives by Interpolation, Cubic Spline Interpolant, Numerical Integration or Quadrature, Newton Cotes Formula, Trapezoidal & Composite Trapezoidal Rule, Simpson Rule, Recursive Trapezoidal Rule, Romberg Integration, Gaussian Integration, Orthogonal Polynomial, Abscissas and Weights for Gaussian Quadrature, Gauss Legendre, Gauss Laguerre & Gauss Hermite Method, Gauss-Chebyshev Quadrature, Gauss Quadrature with Logarithmic Singularity	**7 Hrs**
Unit 6	**Numerical Solution of Differential Equations** Initial Value Problem, Taylor Series Approach, Euler's Method, Runge-Kutta Method (Second Order & Fourth Order), Stability of Euler's Method, Stiffness and Adaptive Runge-Kutta Method, Bulrisch-Stoer Method, Numerical Methods in Structural Dynamics, Implicit and Explicit Method, Central Difference Method, Newmark-Beta Method, Wilson-Theta Method	**6 Hrs**

Sr.No.	Text Books
1	L. Ridgway Scott., Numerical Analysis, Princeton University Press
2	S. D. Conte, Carl de Boor, Elementary Numerical Analysis: An Algorithmic Approach, Mc Graw Hill Publications
3	S. R. Otto, J. P. Deneir, An introduction to Programming and Numerical methods in MATLAB Springer
4	Numerical Methods for Engineers" by Steven C. Chapra and Raymond P. Canale (McGraw Hill, Tata McGraw Hill India Edition)

Sr.No.	Reference Books
1	Jaan Kiusalaas, Numerical Methods in Engineering with MATLAB, Cambridge University Press.
2	5 William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, Numerical Recipes in C, Cambridge University Press
3	"Numerical Methods" by Kandasamy P., Thilagavthy K., and Gunavathi K. (S. Chand & Company Ltd.)

Sr.No.	Web Resources
1	https://www.coursera.org/learn/numerical-methods-engineers
2	https://onlinecourses.swayam2.ac.in/arp19_ap81/preview
3	https://onlinecourses.nptel.ac.in/noc25_ma83/preview

Course Title: Design of Bridges		
Course Code: PD251101		**Course Category: PEC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite: Solid understanding of Structural Analysis, Knowledge of Strength of Materials, Background in Concrete Technology, Prior learning in Design of RCC and Steel Structures, Fundamentals of Transportation Engineering, Knowledge of Soil Mechanics and Foundation Engineering, Basic Engineering Mechanics concepts.

Course Description: Design of bridges focuses on the practical and theoretical principles of planning, analyzing, and constructing bridges to span various obstacles like rivers, roads, and valleys. These courses cover different bridge types (e.g., beam, arch, suspension) and their suitability for different sites, as well as the design of structural components like superstructures, substructures, and foundations. Key areas of study include load analysis, material selection, structural integrity, environmental impact, and the use of specialized software for design and analysis.

Course Objectives:
1. To introduce students to bridge history, classification, components, planning principles, and material selection.
2. To develop the ability to understand and prepare general arrangements and conceptual designs of various bridge types.
3. To enable students to apply IRC/IRS loading standards and evaluate different forces acting on bridges.
4. To build analytical skills for studying the structural behavior of bridges using load distribution theories.
5. To provide knowledge and skills for designing bridge decks, including slabs, girders, culverts, and long-span bridges.
6. To develop the capability to design bridge substructures, foundations, bearings, piers, abutments, and wing walls.

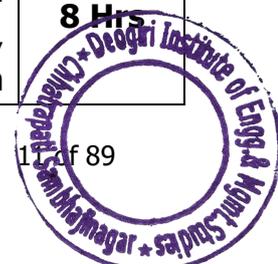| Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Understand bridge history, classification, components, planning, and material selection.	Understand (Level 2)
CO2	Explain general arrangements and conceptual designs of various bridge types	Understand (Level 2)
CO3	Apply IRC/IRS loading standards and evaluate different forces acting on bridges.	Apply (Level 3)
CO4	Analyze structural behavior of different bridges using load distribution theories.	Analyze (Level 4)
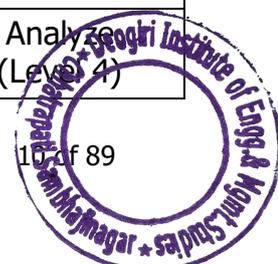
CO5	Design bridge decks including slabs, girders, culverts, and long-span bridges.	Evaluate (Level 5)
CO6	Design substructures, foundations, bearings, piers, abutments, and wing walls.	Create (Level 6)

CO-PO-PSO Mapping															
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	1	2	2	-	-	1	-	1	-	1	-
CO2	3	2	2	1	1	1	2	-	-	1	-	1	3	2	-
CO3	3	3	2	2	2	1	2	-	1	1	-	1	2	2	-
CO4	3	3	3	3	2	1	1	-	1	1	-	1	3	2	1
CO5	3	3	3	2	2	2	2	-	1	1	-	1	3	3	3
CO6	3	3	3	2	2	2	3	-	1	1	-	1	3	3	3

Assessment	
CA-1 (a) (10 Marks)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10 Marks)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction to Bridge Engineering** Historical Perspective of Bridges, Introduction, Layout and Planning, Investigations for Bridges, Classification and Components of Bridges, Choice of Type of Bridges and Choice of Materials.	4 Hrs
Unit 2	**General Arrangement and Conceptual Bridge Design** General Arrangement of Various Types of Bridges including Arch Type, Slab Type, Slab and Beam Type, Plate Girder Type, Open Web Girder, Cable Stayed Type, Suspension Type, etc. Conceptual Bridge Design, Preliminary Drawings and General Layout of Bridges.	4 Hrs
Unit 3	**Loading on Bridges** Loading Standards for Road Bridges as per IRC Standards, Loading Standards for Railway Bridges as per IRS Standards. Analysis of other Loads like Impact Factor, Centrifugal Forces, Wind Load, Earthquake Load, Hydraulic Forces, Longitudinal Forces, Earth Pressure, Buoyancy Effects, etc**.**	6 Hrs
Unit 4	**Analysis of Bridges under Loads** Analysis by Pieguad's Theory and Courbon's Theory. Structural Behaviour of Box Girder Bridges, Arch Bridges, Suspension Bridges, Skew Bridges and Cable Stayed Bridges under various loads.	6 Hrs
Unit 5	**Design of Bridge Decks** Load Distribution in Slab and Bridge, Behaviour, Analysis and Design of Reinforced Concrete Deck Slab, Prestressed Concrete Deck Slab, Longitudinal and Cross Girders. Design of Long Span Bridges, Design	8 Hrs

		of Slab Culverts and Box Culverts	
Unit 6	**Design of Substructure and Foundation** Design of Bearings, Design of Substructure and Foundations, Piers and Abutments of Different Types and Shapes, Shallow and Deep Foundations, Wing Walls and Retaining Structures.		**8 Hrs**

Sr.No.	Text Books
1	Jagadish & Jayaram, Design of Concrete Bridges, Tata McGraw Hill.
2	Victor, Design of Concrete Bridges, Tata McGraw Hill.
3	Ponnuswamy S., Bridge Engineering, Tata McGraw Hill.

Sr.No.	Reference Books
1	Dr. V. K. Raina, Concrete Bridge Practice: Analysis, Design and Economics, Shroff Publishers & Distributors Pvt. Ltd.
2	Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Reinforced Concrete Structures, Vol. II, Laxmi Publications.
3	N. Krishnaraju, Prestressed Concrete Bridges, CBS Publishers & Distributors Pvt. Ltd.
4	Dr. V. K. Raina, Concrete Bridge Practice: Construction, Maintenance & Rehabilitation, Shroff Publishers & Distributors Pvt. Ltd.
5	Dr. V. K. Raina, Field Manual for Highway & Bridge Engineers, Shroff Publishers & Distributors Pvt. Ltd.
6	Dr. V. K. Raina, Handbook for Concrete Bridges, Shroff Publishers & Distributors Pvt. Ltd.
7	Victor D. J., Essentials of Bridge Engineering, Oxford & IBH.

Sr.No.	Web Resources
1	Reinforced Concrete Road Bridges, NPTEL, https://onlinecourses.nptel.ac.in/noc21_ce43/preview
2	Bridge Engineering, NPTEL, https://nptel.ac.in/courses/105105216?utm_source=chatgpt.com

Course Title: Structural Dynamics		
Course Code: PD251102		Course Category: PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite: Students should have prior knowledge of engineering mathematics, mechanics, strength of materials, and basic structural analysis.Basic understanding of vibration fundamentals and numerical methods

Course Description: This course introduces the dynamic behavior of single and multi-degree-of-freedom (SDoF and MDoF) systems under various loading conditions. It covers equations of motion, damping models, free and forced vibration responses, and numerical solution methods. Students learn to analyze structures subjected to dynamic forces such as earthquakes, pulses, and harmonic excitations using analytical and computational approaches. The course also emphasizes modal analysis, spectral response, and damping models, providing a foundation for advanced seismic and vibration engineering applications.

Course Objectives:
1. Develop an understanding of the dynamic behavior of structures under different types of loading.
2. Formulate and solve equations of motion for single- and multi-degree-of-freedom systems.
3. Analyze the effects of damping and energy dissipation in structures.
4. Introduce analytical and numerical methods for dynamic response evaluation.
5. Provide a foundation for seismic and vibration-resistant design of structural systems

Course Outcomes:		
Cos	**After completion of the course: Student should be able to**	**Bloom's Level**
CO1	Understand basics of response of structures to forced vibrations and free vibrations.	Understand (Level 2)
CO2	Analyse response of SDoF systems to general loading and understand various methods of evaluation of dynamic response.	Analyse (Level 4)
CO3	Analyse response of structures to ground excitations, support excitations and torsional excitations.	Evaluate (Level 5)
CO4	Understand and Analyse structures for natural frequency and modal analysis.	Analyse (Level 4)
CO5	Analyse response of structural system by numerical evaluation using various classical approaches.	Apply (Level 3)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	–	3	–	–	2	–	–	2	–	–	3		

CO2	3	3	–	2	–	2	–	–	2	–	–	3	3	2	3
CO3	3	2	–	2	2	–	–	2	–	–	2	–	3	2	3
CO4	3	3	–	3	–	–	2	–	–	2	–	3	3	–	3
CO5	3	3	-	3	–	2	–	–	2	–	–	–	3	–	3

Assessment	
CA-1 (a) (10 Marks)	Subjective Test / Open book test / Assignment.
CA-2 (b) (10 Marks)	Assignment / Presentation/ Case Study
MSE (c) (20 Marks)	Mid Sem Examination

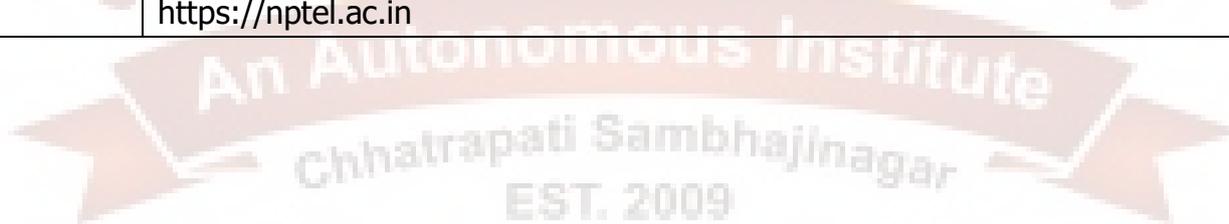| Course Contents		
Unit 1	**SDoF Systems** Simple Structures, SDoF System, Force -Displacement Relation, Damping Force, Equation of Motion,External Force, Mass Spring Damper System, Equation of Motion: Earthquake Excitation, Combining Static & Dynamic Responses, Methods of Solution of the Differential Equation, Free Vibration: Un-damped &Viscously Damped Free Vibration, Energy in Free Vibration, Coulomb Damped Free Vibration, Response to Harmonic & Periodic Excitations, Viscously Damped Systems, Systems with Non Viscous Damping.	**6 Hrs**
Unit 2	**SDoF System under General Loading** Response to Unit Impulse, Arbitrary Time Varying Force, Response to Step and Ramp Forces, Response to Pulse Excitations, Rectangular Pulse, Half Sine wave Pulse, Triangular Pulse, Response to Ground Motion, Numerical Evaluation of Dynamic Responses, Time Stepping Methods, Interpolation Methods, Newmark's Beta Method.	**6 Hrs**
Unit 3	**Generalised SDoF System** Generalised SDF Systems, Rigid Body Assemblages, Systems with Distributed Mass & Elasticity, Lumped Mass System, Natural Vibration Frequency by Rayleigh's method, Shape Functions	**6 Hrs**
Unit 4	**MDoF Systems** Simple Systems, Two Storey Shear Buildings, General Approach for Linear Systems, Static Condensation, Symmetric and Asymmetric systems subjected to Ground Motion, Symmetric Systems subjected to Torsional Excitations, Multiple Support Excitations, Methods for Solving Equations of Motion.	**6 Hrs**
Unit 5	**Dynamic Analysis and Response of Linear Systems** Systems without Damping, Natural Vibration Frequencies and Modes, Modal & Spectral Matrices, Orthogonality of Modes, Normalisation of Modes, Modal Expansion of Displacements, Free Vibration Response of Damped and Undamped and Classically Damped Systems, Damping in Structures, Classical Damping Matrix, Non Classical Damping Matrix, Two DoF Systems, Modal Analysis, Modal Response Contributions.	**6 Hrs**

Unit 6	**Numerical Evaluation of Dynamic Response** Time Stepping Method, Analysis of Linear and Non Linear Systems, Systems with Distributed Mass and Elasticity, Undamped motions due to Applied Forces, Undamped motion due to Support Excitation, Natural Vibration Frequencies and Modes, Modal, Analysis of Forced Dynamic Response, Rayleigh Ritz Method, Formulation using Conservation of Energy, Virtual Work, Finite Difference Method, Finite Element Method, Element Degree of Freedom and Interpolation Functions, Element Stiffness, Mass and Force Matrix, Comparison of FE Solution with Exact Solution.	**6 Hrs**

Sr.No.	Text Books
1	R. W. Clough & Joseph Penziene, Dynamics of Structures, Mc-Grew Hill Publications.
2	A. K. Chopra, Dynamics of Structures: Theory & Application to Earthquake Engineering, Prentice Hall Publications.
3	Mario Paz, Structural Dynamics, CBS Publication.
4	Roy Craig, Structural Dynamics, John-Wiley & Sons.

Sr.No.	Reference Books
1	Jaikrisna, A. R. Chandrashekharan, Elements of earthquake Engineering, South Asian Publishers.
2	Mukhopadhayay Madhujit, Structural Dynamics: Vibration and systems, Ane Books India Publisher.
3	Patrick Paultre, Dynamics of Structures, Wiley India
4	Jagmohan L. Humar, Dynamics of Structures, Swets and Zeitlinger, Netharlands.

Sr.No.	Web Resources
1	National Information Center of Earthquake Engineering (NICEE), IIT Kanpur – https://www.nicee.org
2	National Program on Technology Enhanced Learning (NPTEL), IITs & IISc – https://nptel.ac.in

Course Title: Advanced Structural Analysis		
Course Code: PD251103		**Course Category: PEC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite: Fundamentals of Structural Analysis (determinacy, indeterminacy, influence lines), Knowledge of Strength of Materials (stress, strain, bending, shear, torsion), Basics of Structural Mechanics & Elasticity (differential equations of beams/columns), Familiarity with Matrix Methods of Structural Analysis (stiffness/moment distribution), Basic understanding of Mathematics (linear algebra, differential equations, numerical methods).

Course Description: This course covers advanced topics in structural analysis including influence line diagrams for indeterminate structures, beams curved in plan, beams on elastic foundations, beam-columns with geometric and material nonlinearity, shear center and unsymmetrical bending, as well as the analysis of cables and suspension bridges. Emphasis is placed on analytical formulations, structural behavior under complex loading, and applications to practical engineering problems.

Course Objectives:
1. To develop the ability to model and analyze beams (including curved-in-plan) and beams on elastic foundations.
2. To introduce behaviour and analysis of beam–columns including geometric and material nonlinearity.
3. To teach shear-center location, unsymmetrical bending and combined-stress assessment for practical cross-sections.
4. To explain the mechanics and analysis of cable systems and suspension/stiffened bridges under static and moving loads.
5. To enable students to understand and apply advanced finite element modeling techniques, specifically static condensation and sub-structuring, for the efficient analysis of large and complex structural systems.

| Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Draw ILD for indeterminate structures	Understand (Level2)
CO2	Analyze the beams curved in plan.	Analyze (Level3)
CO3	Analyze the structure resting on elastic foundation.	Analyze (Level3)
CO4	Analyze the skeleton structures using stiffness method.	Analyze (Level3)
CO5	Analyze the suspension bridges.	Analyze (Level3)
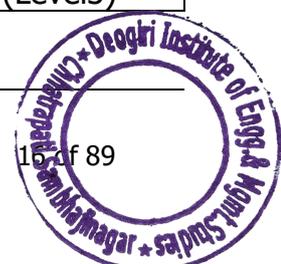
CO-PO-PSO Mapping

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	–	2	–	–	–	–	–	–	–	1	3	-	1
CO2	3	3	–	2	2	2	1	–	–	–	–	1	3	2	2
CO3	3	3	–	2	2	2	1	–	–	–	–	1	3	2	2
CO4	3	3	–	3	2	2	1	–	–	–	–	1	3	1	2
CO5	3	3	–	2	2	2	1	–	–	–	–	1	3	2	2

Assessment

CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents

Unit 1	**Influence Line Diagrams for Indeterminate Structures** Continuous beams, portal frames and two hinged arches. Muller-Breslau's Principle and Moment Distribution Method.	**6 Hrs**
Unit 2	**Beams** Beams curved in plan: Determinate and indeterminate beams curved in plan. Beams on elastic foundations: Analysis of infinite, Semi-infinite and finite beams.	**6 Hrs**
Unit 3	**Beam columns** Concept of geometric and material non linearity, Governing differential equation, Analysis of beam columns subjected to different loadings and support conditions, Stiffness and carry-over factors for beam-columns, fixed end actions due to various loads.	**6 Hrs**
Unit 4	**Shear center and Unsymmetrical bending** Position of shear center, shear flow, shear center of various sections, unsymmetrical bending, Z polygon, combined stresses.	**6 Hrs**
Unit 5	**Cables and suspension bridges** Shape of cable, anchor cable, temperature stresses, moving loads, two hinged and three hinged stiffened bridges.	**6 Hrs**
Unit 6	**Special analysis procedures** - static condensation and sub structuring - initial and thermal stresses.	**6 Hrs**

Sr.No.	Text Books
1	Structural Analysis by Negi and Jangid.
2	Analysis of structure by Vazirani and Ratwani, Vol. II
3	Advanced Theory of Structures by Vazirani and Ratwani.

Sr.No.	Reference Books
1	Theory of Elastic Stability by Timoshenko and Gere.
2	Matrix Analysis of Framed structures by Gere and Weaver
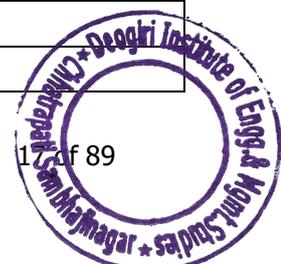
3	Structural Analysis – A Matrix approach by Pandit and Gupta.
4	Mechanics of Structures Vol. I, II and III by Junnarkar and Shah.
5	Basic structural Analysis by C. S. Reddy.

Sr.No.	Web Resources
1	Matrix Analysis with Applications, NPTEL, https://nptel.ac.in/courses/111107112
2	Calculus – II, NPTEL, https://nptel.ac.in/courses/111104125
3	Engineering Mathematics – I, NPTEL, https://nptel.ac.in/courses/111105121

Course Title: Advanced Prestressed Concrete		
Course Code: PD251104		Course Category: PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite: Knowledge of Reinforced Concrete Design (RCC) fundamentals. Basics of Strength of Materials (stress–strain, bending, shear, torsion).Understanding of Structural Analysis (bending moment, shear force, deflection). Exposure to Concrete Technology (properties of concrete & steel).

Course Description: This course deals with the principles and design of prestressed concrete (PSC) structures. It covers methods of prestressing, analysis and design of beams, slabs, pipes, poles, and other PSC members. Topics include anchor block design, composite construction, losses of prestress, shear and flexural strength, cable profiles, and pressure lines. The course also addresses common defects in PSC structures and their remedies, preparing students for practical applications in modern infrastructure.

Course Objectives:

1. To introduce the principles, methods, and systems of prestressing and their applications in structural engineering.

2. To develop analytical and design skills for prestressed concrete members subjected to flexure, shear, and deflection.
3. To familiarize students with anchor block design, cable profiles, pressure/thrust lines, and losses of prestress.
4. To provide knowledge of composite construction.
5. To provide knowledge of design of various prestressed concrete structures.
6. To identify defects in prestressed concrete structures and suggest suitable remedial measures.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Understand the preliminary concept, terminologies and methodologies related to prestressed concrete	Understand (Level 2)
CO2	Analyse and design of the anchor blocks.	Analyze (Level 3)
CO3	Analyse the PSC member for flexural, shear strength and deflection.	Analyze (Level 3)
CO4	Analyse and design composite section and various slabs	Apply (Level 3)
CO5	Design of special types of PSC structures like pipes, poles, tanks, sleepers.	Analyze (Level 3)
CO6	Understand causes of defects in PSC structure and remedies for it.	Analyze (Level 3)
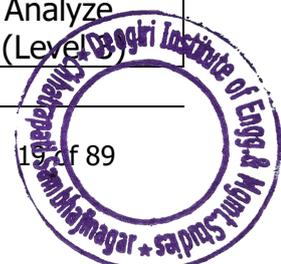
CO-PO-PSO Mapping															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	-	-	1	1	-	2	-	1	1	1	2	2	1
CO2	3	3	2	2	2	1	1	2	-	-	2	1	3	3	2
CO3	3	3	2	2	2	1	1	2	-	1	2	2	3	3	2
CO4	3	3	3	2	2	1	2	2	1	2	2	2	3	3	2
CO5	3	2	3	1	2	1	2	2	1	2	2	2	3	3	3
CO6	3	3	-	1	1	1	-	3	-	2	2	2	3	3	3

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction to Prestressed Concrete** Basic Principle of Prestressing, Methods and Systems of Prestressing, Material Requirements, Losses of Prestressing, Analysis of Rectangular, Symmetrical and Unsymmetrical, Flanged Beams, Concept of Cable Profile, Pressure Line, Thrust Lines, etc.	5 Hrs
Unit 2	**Design of Anchor Blocks** Design of Anchor Blocks using Magnel's Method, Guyon's Method and IS Code Method.	6 Hrs
Unit 3	**Analysis and Design of PSC Members** Analysis of PSC section for Flexural Strength, Shear Strength and Deflection, Design of Prestressed Concrete section for Flexural Strength by Analytical procedure and Magnel's Graphical method, Shear Strength and Deflection, Design of Statically Indeterminate Beams and Single Story Portal Frame, Concordant Cable Profile.	6 Hrs
Unit 4	**Composite Section** Analysis and Design of Composite Construction of Prestressed and in-situ Concrete Structures, Design of One way and Two-way Slab, Grid Slab.	6 Hrs
Unit 5	**Design of Various PSC Structures** Design of Cylindrical and Non cylindrical Pipes, Design of Poles, Circular Prestressing for Water Tanks, Design of Sleepers.	5 Hrs
Unit 6	**Causes and Remedies of Various Defects in PSC** Causes of various Defects in Prestressed Concrete like Cracking, Buckling, Deflection, Deterioration, Corrosion of Prestressing Steel, and Concrete Crushing at End Anchorages, Grouting of Post Tensioned Tendons, Congested Connections, Dimensional Tolerances etc., and Remedial Measures.	6 Hrs
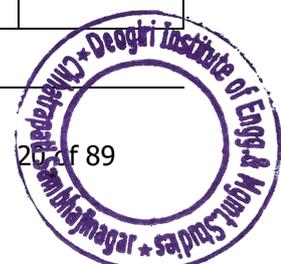
Sr.No.	Text Books
1	N. Krishnaraju, Prestressed Concrete, Tata Mc Graw-Hill Publishing Company.
2	R.I. Gilbert and N.C. Mickleborough, "Design of Prestressed Concrete" Unwin Hyman
3	Pandit and Gupta, "Prestressed concrete", CBS, 2002

Sr.No.	Reference Books
1	T. Y. Lin & Nedbhurns, Design of Prestressed Concrete Structures, John Wiley & Sons
2	S.Ramamruthm, Pretsressed Concrete, Dhanpat Rai and Sons.
3	Sinha and Roy, Fundamentals of Prestressed Concrete, S. Chand Ltd.
4	N. Rajagopalan, Prestressed Concrete, Narosa Publishing House
5	James R. Libby, Modern Prestressed Concrete, CBS Publishers & Distributors Pvt. Ltd.
6	IS 1343: 2012, Indian Standard Code of Practice for Prestressed Concrete.
7	IS 784: 2001, Indian Standard Code for Circular Prestressing in prestressed concrete pipes

Sr.No.	Web Resources
1	https://www.youtube.com/watch?v=9y6q8XzYd24
2	https://nptel.ac.in/courses/105106117

Course Title: Design of Masonry Structures		
Course Code: PD251105		**Course Category: PEC**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite: Fundamental knowledge of Strength of Materials, Structural Analysis, and Concrete Technology., Basics of Building Materials and Structural Design principles

Course Description: This course introduces the behavior, strength, and design of masonry structures. It covers masonry materials and units, compressive, flexural, shear and bond strength, design of load-bearing walls and multistory masonry buildings, earthquake-resistant masonry, and the structural aspects of historical monuments and ancient construction practices

Course Objectives:
1. Provide fundamental understanding of masonry units, materials, and mortars.
2. Develop knowledge of strength characteristics of masonry under compression, flexure, shear, and bond.
3. Impart analytical and practical skills for design of load-bearing masonry buildings as per BIS codes.
4. Introduce principles of earthquake-resistant masonry construction.
5. Expose students to the structural aspects of monuments and ancient masonry structures.
6. Develop fundamental understanding of prestressed masonry concepts, materials, and construction techniques.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Understand the preliminary information of various masonry structures including materials of construction, basic properties and parameters	Understand (Level 2)
CO2	Understand the compressive strength of masonry structures under various conditions and situation.	Understand (Level 2)
CO3	Determine strength of masonry structure in flexure, shear, bond and factors affecting.	Apply (Level 3))
CO4	Design the load bearing masonry buildings.	Evaluate (Level 4)
CO5	Design the earthquake resistant masonry structures.	Evaluate (Level 5)
CO6	Describe stability concepts for prestressed walls	Understand (Level 2)

CO-PO-PSO Mapping														
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	2	-
CO2	3	3	-	2	1	-	-	-	-	-	-	1	2	2	1
CO3	3	3	2	2	1	-	-	-	-	-	-	1	2	2	2
CO4	3	3	3	-	2	-	-	-	-	-	-	-	3	3	1
CO5	3	3	3	-	2	2	-	-	-	-	-	-	3	2	2
CO6	2	3	2	2	2	-	-	-	-	-	-	2	3	3	2

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction** Masonry units, Materials and Types, History of Masonry Characteristics of Brick, Stone, Clay Block, Concrete Block, Stabilized Mud Block Masonry units –Strength, Modulus of Elasticity and Water Absorption. Masonry materials, Classification and Properties of Mortars, Selection of Mortar..	**6 Hrs**
Unit 2	**Strength of Masonry in Compression** Behaviour of Masonry under Compression, Strength and Elastic Properties, Influence of Masonry unit and Mortar Characteristics, Effect of Masonry unit Height on Compressive Strength, Influence of Masonry Bonding Patterns on Strength, Prediction of Strength of Masonry in Indian Context, Failure Theories of Masonry under Compression. Effects of Slenderness and Eccentricity, Effect of Rate of Absorption, Effect of Curing, Effect of Ageing, Effect of Workmanship on Compressive Strength.	**6 Hrs**
Unit 3	**Flexural, Shear and Bond Strength** Flexural Strength and Shear Strength of Masonry, Bond between Masonry unit and Mortar, Tests for determining Flexural, Shear and Bond strengths, Factors affecting Bond Strength, Effect of Bond Strength on Compressive Strength, Orthotropic Strength Properties of Masonry in Flexure, Shear Strength of Masonry.	**6 Hrs**
Unit 4	**Design of Load Bearing Masonry Buildings** Permissible Compressive Stress, Stress Reduction and Shape Reduction Factors, Increase in Permissible Stresses for Eccentric Vertical and Lateral Loads, Permissible Tensile and Shear Stresses, Effective Height of Walls and Columns, Opening in Walls, Effective Length, Effective Thickness, Slenderness Ratio, Eccentricity, Load Dispersion, Arching action, Lintels, Wall Carrying Axial Load,	**6 Hrs**

	Eccentric Load with Different Eccentricity Ratios, Wall with Openings, Free standing Wall, Design of Load Bearing Masonry for Buildings up to 3 to 8 Storey's using BIS Codal Provisions	
Unit 5	**Earthquake Resistant Masonry Buildings** Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS Codal provisions. Masonry arches, domes and vaults: Components and classification of masonry arches, domes and vaults, historical buildings, construction procedure. Structural Aspects of Monuments & Ancient Structures- Evolution of Construction Practices, Materials of Construction, Choice of Structural Framing, Form Design, Geometric Proportions, Choice of Foundations, Footprint Ratio, Study of any Four Historical Monuments from Structural point of view.	6 Hrs
Unit 6	**Prestressed Masonry** Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.	6 Hrs

Sr.No.	Text Books
1	Hendry A.W., "Structural masonry", Macmillan Education Ltd., 2nd edition
2	Sinha B.P & Davis S.R., "Design of Masonry structures", E & FN Spon
3	Dayaratnam P, "Brick and Reinforced Brick Structures", Oxford & IBH
4	Curtin, "Design of Reinforced and Prestressed Masonry", Thomas Telford
5	Sven Sahlin, "Structural Masonry", Prentice Hall

Sr.No.	Reference Books
1	Jagadish K S, Venkatarama Reddy B V and Nanjunda Rao K S, "Alternative Building Materials and Technologies", New Age International, New Delhi & Bangalore
2	IS 1905: 1987 Indian Standard Code of Practice for Structural Use of Unreinforced Masonry, Bureau of Indian Standards, New Delhi.
3	SP20 (S&T): 1991, Handbook on Masonry Design and Construction
4	Design of Reinforced Masonry Structures, NarendraTaly, ICC, 2nd Edn.
5	Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
6	Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.

Sr.No.	Web Resources
1	https://onlinecourses.nptel.ac.in/noc20_ce55
2	https://nptel.ac.in/courses/105106197

Course Title: Structural Stability		
Course Code: PD251106		Course Category: PEC
Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester I)	ESE	60 Marks

Course Prerequisite: Strength of Materials / Structural Analysis, Matrix Methods of structural Analysis, Strain Energy Methods and Deflections.
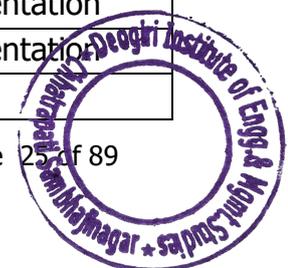
Course Description: This course provides a comprehensive study of stability problems in structural elements and systems. It focuses on the principles and analysis of buckling behaviour in beams, columns, frames, and plates. Emphasis is placed on understanding critical load, post-buckling behaviour, and the influence of various parameters (boundary conditions, load eccentricity, geometry). The course combines classical analytical methods with modern computational approaches to evaluate the stability of elastic structures.

Course Objectives:
1. Understand the fundamental concepts of structural instability and buckling.
2. Analyze the critical buckling load for columns, beams, and frames using Euler's and energy methods.
3. Evaluate lateral-torsional buckling, plate buckling, and frame instability and Recognize the effects of imperfections, boundary conditions, and material properties.
4. Apply methods such as the Rayleigh-Ritz method, finite difference, or Galerkin method.

Course Outcomes:		
Cos	**After completion of the course: Student should be able to**	**Bloom's Level**
CO1	Determine stability of columns and frames	Understand (Level 2)
CO2	Determine stability of beams and plates	Understand (Level 2)
CO3	Use stability criteria and concepts for analysing discrete and continuous system.	Apply (Level 3)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	2	1	-	1	-	-	-	-	1	3	2	2
CO2	3	3	2	1	-	1	-	-	-	-	1	3	2	2
CO3	3	3	2	1	-	1	-	-	-	-	1	3	2	2

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction** Concept of stability, Static, dynamic and energy criterion of stability. Flexibility and stiffness criteria, Snap-through & post buckling behaviour.	**6 Hrs**
Unit 2	**Stability of columns** Critical load for standard boundary conditions, elastically restrained perfect Columns, effect of transverse shear in buckling, columns with geometric imperfections, eccentrically loaded columns. Orthogonality of buckling modes. Large deformation theory for columns.	**6 Hrs**
Unit 3	**Stability of continuous Beams and Frames** Moment distribution and stiffness methods for stability analysis of continuous beam & frames. Differential equations for lateral bucking, lateral buckling of beams in pure bending, lateral buckling of beams subjected to concentrated and uniformly distributed forces.	**6 Hrs**
Unit 4	**In-elastic stability of Columns** In-elastic buckling, double modulus theory, tangent modulus theory, Shanleys theory of in- elastic buckling, eccentrically loaded in-elastic columns.	**6 Hrs**
Unit 5	**Dynamic Stability of Structure** Discrete systems, Lagrange-Hamilton formulation for continuous systems, Stability of continuous system, general method for conservative and non-conservative systems.	**6 Hrs**
Unit 6	**Energy Methods in Stability** Total potential energy, Principle of stationary potential energy, Rayleigh-Ritz method, Galerkin's method, Applications to column and beam buckling	**6 Hrs**

Sr.No.	Text Books
1	Concrete Technology & Design by R. N. Swamy, Surrey University Press.

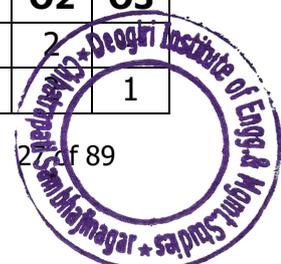| Sr.No.	Reference Books
1	Special Structural Concrete by Rafat Siddique, Galgotia pub. Pvt. Ltd.
2	Fiber Reinforced Cement Composites by P.N.Balaguru, S.P.Shah, Mc-Graw Gill
3	Fiber Cement and Fiber Concrete by John Wiley and sons.
4	Fracture Mechanics and Structural Concrete by Bhushan L. Karihal Longman Scientific and Technical John Wiley and sons.

Sr.No.	Web Resources
1	https://nptel.ac.in/courses/105103140

Course Title: Seminar		
Course Code: PD251401		**Course Category: VSE**
Teaching Scheme	**Examination Scheme**	
Practical's/Sessions: 02 Hours/Week	CA-1	15 Marks
Credits: 01	CA-2	15 Marks
Semester: F Y M.Tech. (Semester I)	ESE	20 Marks

Course Prerequisite: Basic understanding of core subjects in specialization, Ability access, and interpreting scientific literature, Exposure to technical report writing and presentation.

Course Description: The M.Tech Seminar course is designed to enhance student ability to identify, analyze and present research-oriented or industry-relevant topics related to their field of specialization. It provides a platform to review recent literature, critically analyze methodologies, and effectively communicate technical concepts written and oral forms. The course emphasizes independent learning, analytical thinking presentation and interaction with peers and faculty to prepare students for research and professional careers.

Course Objectives:
1. To enhance the ability to conduct a comprehensive literature review on a selected research/technical topic.
2. To develop skills in critical analysis, organization, and synthesis of technical information.
3. To improve proficiency in technical report writing and formatting.
4. To strengthen communication skills through oral presentation and discussion.
5. To build confidence in defending technical ideas and responding to queries effectively.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Identify and select a relevant research topic in Computer Aided Structural Engineering through a literature survey.	Apply (Level-3)
CO2	Analyze and summarize state-of-the-art developments in the chosen area.	Analyze (Level-4)
CO3	Prepare a well-structured seminar report following technical writing standards.	Evaluate (Level-5)
CO4	Deliver an effective oral presentation with clarity and professionalism.	Create (Level-6)
CO5	Demonstrate the ability to answer questions, engage in discussions, and defend ideas confidently.	Evaluate (Level-5)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	2	
CO2	3	3	-	2	1	-	-	-	-	-	-	1	2		1

CO3	3	3	2	2	1	-	-	-	-	-	-	1	2	2	2
CO4	3	3	3	-	2	-	-	-	-	-	-	-	3	3	1
CO5	3	3	3	-	2	2	-	-	-	-	-	-	3	2	2

Course Contents

The seminar requires each candidate to prepare a report on a topic that they and their supervisor have mutually agreed upon. This topic must be a current problem in the field of in Computer Aided Structural Engineering and should have a strong research orientation. The candidate is expected to demonstrate a thorough understanding of the recent developments related to their chosen topic. Once the report is complete, the candidate will present it to an examining committee, as well as to other faculty members from the department. The PG coordinator and the Head of the Civill Engineering Department will form this committee to evaluate the seminar.

Assessment

Evaluation and Examination

The seminar will be evaluated out of a total of 50 marks, with 30 marks for internal assessment and 20 marks for the semester-end examination. The semester-end examination will be conducted by a committee of three faculty members. Students must submit their completed reports, which should be authenticated by both their guide and the Head of the Department. Each student will individually present their work to the committee, who will then evaluate them and award marks.

CA-I (a) (15 M)	Review-I: 15 Marks (Concept/knowledge in the topic:10 marks, Literature: 05 marks)
CA-II (b) (15 M)	Review-II: 15 Marks (Report writing & Presentation: 15 Marks)
ESE (Practical/viva voce (c)) (20 M)	20 Marks (Individual evaluation through viva voce/test:20 marks)
Total (d)	50 Marks

Course Title: PG Lab		
Course Code: PD251402		Course Category: VSE
Teaching Scheme	**Examination Scheme**	
Practicals/Sessions: 02 Hours/Week3	CA-1	15 Marks
Credits: 01	CA-2	15 Marks
Semester: F Y M.Tech. (Semester I)	ESE	20 Marks
Course Prerequisite: Fundamentals of structural analysis.		
Course Description: Not Applicable		

Course Objectives:
To make the students aware and understand
  1. Application of various software for analysis & design of civil engineering structures
  2. Develop design charts for MS Excel for common structural elements
  3. Application of seismic analysis to multistory buildings		

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Model & analyze different structural elements using different structural analysis softwares .	Understand (Level-2)
CO2	Perform Analysis & Design of Multi storied structure using software tools.	Apply (Level-3)
CO3	Analyze seismically civil Engineering structures.	Analyze (Level-4)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	3	3	-	-	-	-	-	-	-	-	3	-	2
CO2	2	2	3	3	-	-	-	-	-	-	-	-	-	2	3
CO3	2	2	3	3	-	-	-	-	-	-	-	-	3	2	3

Assessment	
CA-I (a)	Laboratory performance and attendance – 10Maks, Lab records and technical reporting – 05Marks.
CA-II (b)	conduction, observation, and data collection – 10 Marks Viva-voce (during lab sessions) – 05 Marks
Practical (d)	Particular Experiment number

Sr. No.	List of Experiments/Activities
1	Modeling & analysis of structural components for various loading conditions (slabs, beams, columns , footings , trusses , girders etc) using different structural analysis software
2	Perform Analysis & Design of Multi-storied structure using software tools
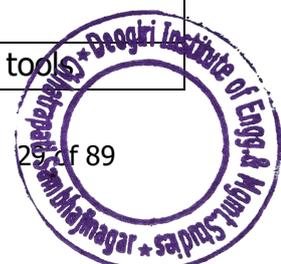
3	Apply seismic analysis concept to civil engineering structures using SAP/STRAD PRO/ETAB/ etc.Software
4	Development of design charts for structural components using MS Excel

Sr.No.	Text Books
1	Design Aids for Reinforced Concrete – M.L. Gambhir
2	Structural Engineering Reference Manual – Alan Williams
3	Simplified Engineering for Architects and Builders – James Ambrose

Sr.No.	Reference Books
1	John Boxall, Arduino Workshop-A Hands-on Introduction with 65 Projects, No Starch Press, 2nd Edition.
2	Theory & Practical seismic design -Chopra / Agarwal & Shrikhande

| Sr.No.	Web Resources
1	Arduino Playlist by Arduino, https://www.youtube.com/c/arduino

Course Title: Design of Tall Structures		
Course Code: PD252004		**Course Category: PCC**
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Prerequisite: Strength of Materials, Structural Analysis (including instability / P-Delta concepts), Foundation Engineering (basic bearing capacity & settlement), Reinforced Concrete & Steel Design (IS/Eurocode/AISC familiarity), Basic knowledge of wind loading and dynamics (desirable)

Course Description: Covers design loads and load combinations for special/tall structures, behavior and selection of structural systems (rigid/braced/infills/shear walls/tubular & hybrid systems), detailed analysis and design issues for tall buildings (approximate & detailed analysis, P-delta, buckling, drift control), and design of chimneys, cooling towers and transmission towers including thermal effects, foundations and safety/access provisions.

Course Objectives:

To make the students aware and understand

1. Load combinations and modern design philosophies for tall/special structures.
2. Behaviour of different structural systems used in tall buildings and their implication on design.
3. Approximate and detailed analysis of tall buildings (including instability effects, P-Delta and dynamic considerations).
4. Principles for chimneys, cooling towers and transmission towers (including thermal stresses and safety features).

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Identify and calculate magnitude of various loads acting on tall buildings	Apply (Level 3)
CO2	Understand various forms of structures, moment and force resisting systems in a structure.	Analyze (Level 4)
CO3	Identify various factors causing movements /twists in the building and their analysis and design	Evaluate (Level 5)
CO4	Understand various types of chimneys, their components, Analyse and design of chimneys.	Evaluate (Level 5)
CO5	Analyze, design, and detail the RC Chimney	Analyze (Level 4)
CO6	Analyse &design tall buildings subjected to different loading conditions using relevant codes	Analyze (Level 4)

CO-PO-PSO Mapping

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	3	1	1	1	1	2	-	-	-
CO2	3	2	-	-	-	2	-	-	-	2	-	2	2	1	2
CO3	3	3	2	3	2	2	2	1	2	2	2	3	2	1	2
CO4	3	-	3	3	-	2	2	1	2	2	2	-	2	1	2
CO5	3	3	3	-	3	3	-	1	2	-	2	-	-	-	-
CO6	3	-	2	3	3	1	1	1	1	2	1	2	2	1	2

Assessment

CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents

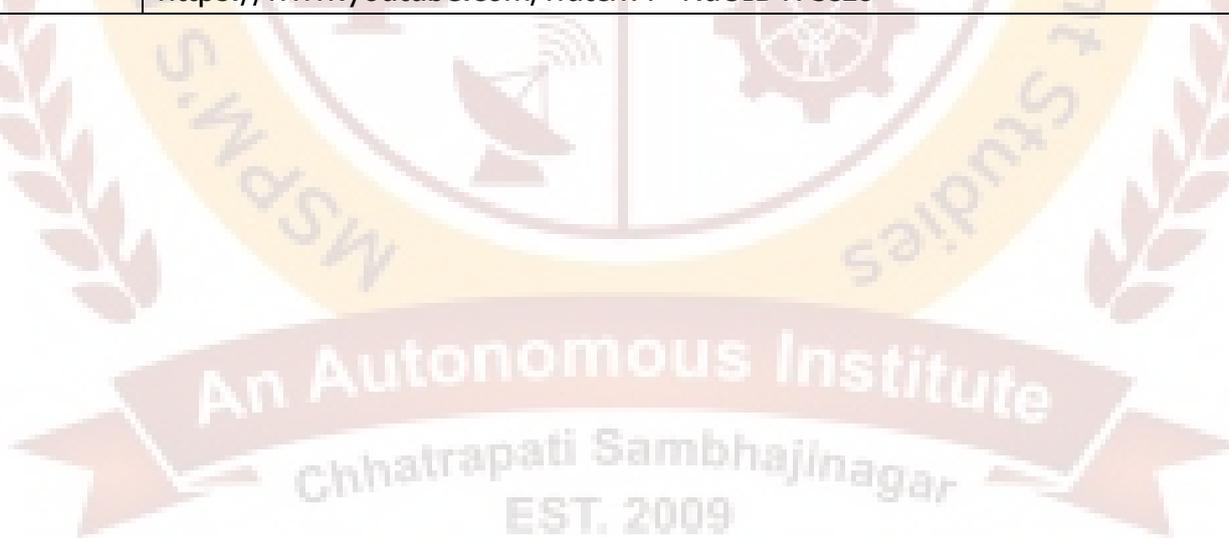|		
Unit 1	**Design Loads:-** Gravity Loads, Dead Load and Live Load Reduction, Construction Loads, Wind Load, Equivalent Lateral Force, Combination of Loadings, Design Philosophy: Working Stress Design and Limit State Design.	7 Hrs
Unit 2	**Structural Systems and its Behaviour :-** Height and Structural Forms, Rigid Frames, Braced Frames, In-Filled Frames, Shear Walls, Coupled Shear Walls, Tubular Structures, and Hybrid Mega Systems	6 Hrs
Unit 3	**Tall Buildings :-**Approximate Analysis, Detail Analysis and Reduction Techniques, Analysis of Member Forces, Drift, and Twist, Buckling Analysis, P-Delta Analysis, Translational and Torsional Instability, Design for Differential Movements,Creep and Shrinkage, Structural Control and Energy Dissipation Devices.	7 Hrs
Unit 4	**Chimneys** Design Factors, Thermal Stresses, Components, Platform and Safety Ladders, Steel Stacks, Refractory Linings, Caps and Foundations	6 Hrs
Unit 5	**Cooling & Transmission Towers** Types, Components, Analysis and Design. Types of Loads, Tower Configuration, Analysis and Design.	6 Hrs
Unit 6	**Analysis and Design of RC and Steel Chimney** Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata	6 Hrs

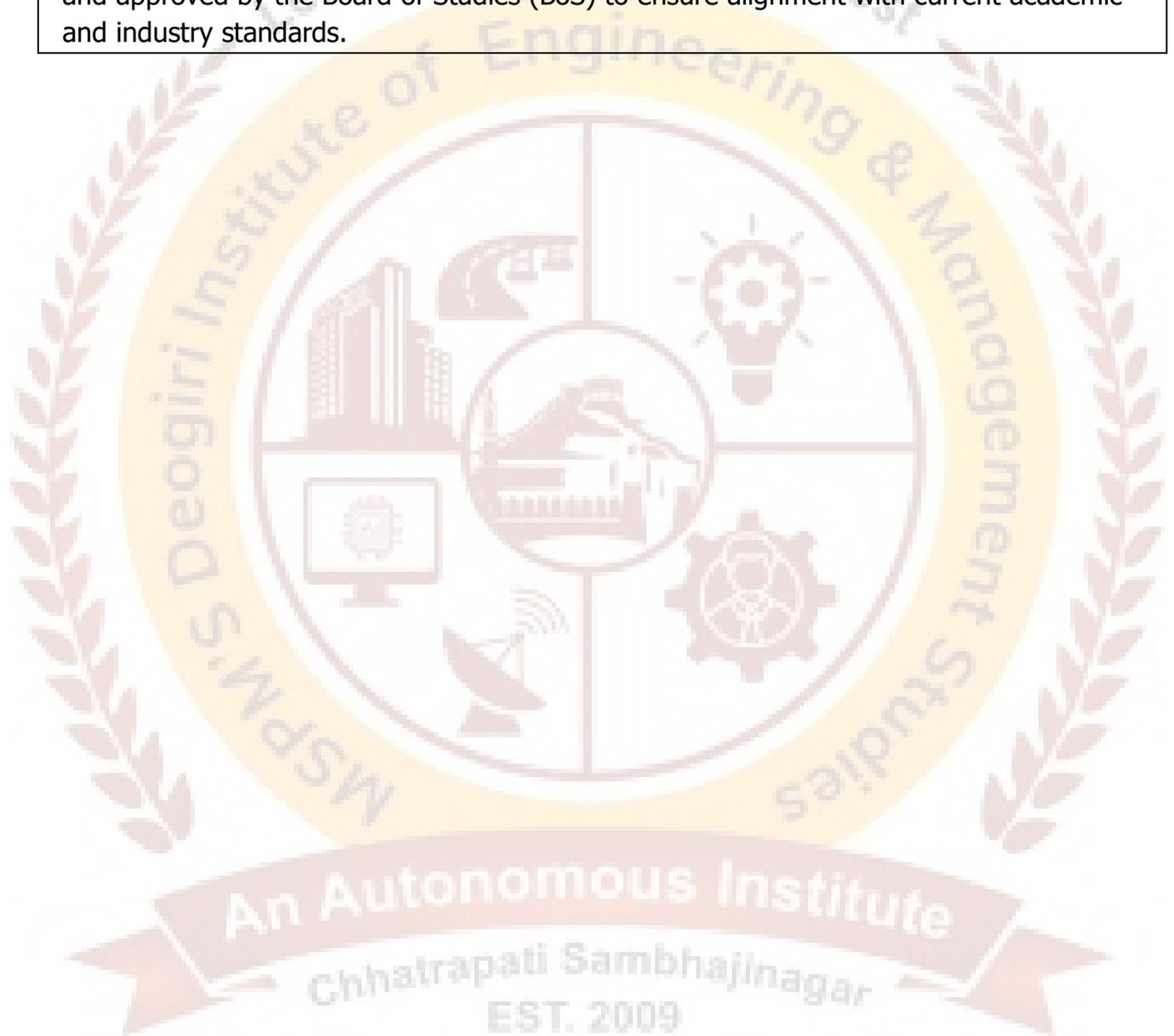| Sr.No.	Text Books
1	B. S. Taranath, Structural Analysis and Design of Tall Building, CRC press, 2011.
2	B. S. Smith and A. Coull, Tall Building Structures: Analysis and Design, Wiley, 1991.
3	S. N. Manohar, Tall Chimneys: Design and Construction, Tata Mcgraw-Hill,
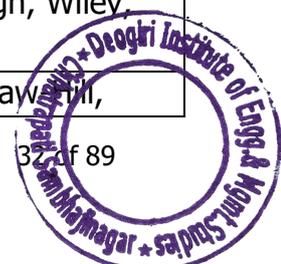
	1985.
4	A. R. Shanthakumar and S. S. Murthy, Transmission Line Structures, Tata Mcgraw-Hill, 1990.

Sr.No.	Reference Books
1	Structural Design of Multi-storied Buildings, Varyani U. H., 2nd Ed., SouthAsianPublishers,New Delhi, 2002
2	Structural Analysis and Design of Tall Buildings, Taranath B. S., McGraw Hill, 1988
3	Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R., Structures Publications, Pune, 2013.
4	Design of Multi Storied Buildings, Vol. 1 & 2, CPWD Publications, 1976.
5	IS: 6533 (Part 2): 1989, - Code of Practice for Design and Construction of Steel Chimneys
6	Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991
7	High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
8	Tall Chimneys, Manohar S. N., Tata McGraw Hill Publishing Company, New Delhi
9	IS 4998 (Part 1): 1992, -Criteria for Design of Reinforced Concrete Chimneys

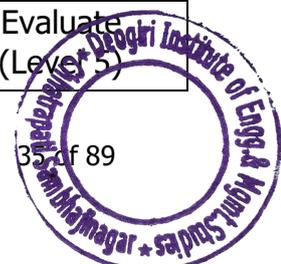| Sr.No.	Web Resources
1	High-Rise Structures, NPTEL, https://youtu.be/-syqppgcoVE?si=93x7zXxzxAEjBjYL
2	Structural Design of tall building, NPTEL https://www.youtube.com/watch?v=NdUIDYF3sz8

Course Title: MOOC/SWAYAM		
Course Code: PD252005	Course Category: PCC	
Teaching Scheme	**Examination Scheme**	
Lectures: 04 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Description:

This course is part of a curated set of MOOCs offered, with the specific courses selected and approved by the Board of Studies (BoS) to ensure alignment with current academic and industry standards.

Course Title: Design of Cold Formed Steel Structures		
Course Code: PD252107		Course Category:PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Prerequisite: Knowledge of Strength of Materials and Structural Analysis Fundamentals of Steel Structures Design (IS 800 / AISC specifications) Basics of Structural Mechanics: Buckling, Tension, Compression, Flexure.

Course Description: This course covers the theory, design, and applications of cold-formed steel sections used in modern construction. Topics include mechanical properties of cold-formed steel, design criteria for thin elements, buckling and strength of axially loaded and flexural members, and combined axial and bending effects. Emphasis is given to North American/AISI design specifications, economic design considerations, and the design of welded, bolted, and screw connections. Practical examples and case studies prepare students for real-world applications in industrialized housing and standardized metal buildings.

Course Objectives:
1. Understand the properties, types, and applications of cold-formed steel sections and standardized metal buildings.
2. Analyze the mechanical behavior of thin steel elements, including stress–strain relations, buckling, and residual stresses.
3. Design axially loaded tension and compression members, considering buckling, distortional effects, and bracing.
4. Design flexural members (beams) for bending, deflection, torsion, and combined loading conditions.
5. Apply design principles for members under combined axial and bending loads, including second-order effects and North American criteria.
6. Understand and design connections, including welded, bolted, screw, and other fasteners, ensuring structural integrity of cold-formed steel assemblies

Course Outcomes:		
Cos	**After completion of the course: Student should be able to**	**Bloom's Level**
CO1	Explain the mechanical properties of cold-formed steel and their influence on design.	Understand (Level 2)
CO2	Analyze the strength of thin plate elements and predict buckling behavior	Analyze (Level 4)
CO3	Design axially loaded members considering local, torsional, and distortional buckling using code provisions.	Evaluate (Level 5)
CO4	Design flexural members subjected to bending, torsion, and deflection requirements	Evaluate (Level 5)
CO5	Evaluate beam–columns under combined axial load and bending using second-order analysis..	Evaluate (Level 5)

		Design and detail welded, bolted, and screw connections for cold-formed steel members	Create (Level 6)
CO6			

CO-PO-PSO Mapping

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	-	2	1	1	1	3	1	1	1	1	-	1	1	2	-
CO2	3	3	-	2	2	1	1	1	-	1	1	2	1	-	-
CO3	-	3	3	-	2	2	2	1	1	1	2	2	1	2	-
CO4	3	3	-	2	2	-	2	1	1	1	-	2	1	2	-
CO5	-	3	3	2	2	2	-	1	-	1	2	2	1	-	-
CO6	3	2	-	2	3	2	2	1	2	2	-	2	1	2	3

Assessment

CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents

Unit 1	**Introduction** General, Types of Cold-Formed Steel Sections and Their Applications, Standardized Metal Buildings and Industrialized Housing, Methods of Forming, Research and Design Specifications, General Design Considerations of Cold-Formed Steel Construction, Economic Design and Optimum Properties, Yield Stress, Tensile Strength, and Stress–Strain Curve, Modulus of Elasticity, Tangent Modulus, and Shear Modulus, Ductility, Weld ability, Fatigue Strength and Toughness, Influence of Cold Work on Mechanical Properties of Steel, Utilization of Cold Work of Forming, Effect of Temperature on Mechanical Properties of Steel, Testing of Full Sections and Flat Elements, Residual Stresses Due to Cold Forming, Effect of Strain Rate on Mechanical Properties	**6 Hrs**
Unit 2	**Strength of Thin Elements & Design Criteria** Definitions of Terms, Design Basis, Serviceability, Structural Behaviour of Compression Elements and Design Criteria, Perforated Elements and Members, Plate Buckling of Structural Shapes, Design Examples.	**6 Hrs**
Unit 3	**Design of Axially Loaded Members** Design of axially loaded tension members, Flexural Column Buckling, Torsional Buckling and Flexural–Torsional Buckling, Effect of Local Buckling on Column Strength, Distortional Buckling Strength of Compression Members, Effect of Cold Work on Column Buckling, North American Design Formulas for Concentrically Loaded Compression Members, Effective Length Factor K, Built-Up Compression Members, Bracing of Axially	**5 Hrs**

	Loaded Compression Members, Design Examples.	
Unit 4	**Design of Flexural Members** Bending Strength and Deflection, Design of Beam Webs, Bracing Requirements of Beams, Torsional analysis of Beams and Combined Bending and Torsional Loading, Design Examples.	**6 Hrs**
Unit 5	**Design of Members under Combined Axial Load & Bending** Combined Tensile axial load and Bending, Combined Compressive axial load and Bending (Beam–Columns), North American Design Criteria, Design Examples, Second-Order Analysis.	**6 Hrs**
Unit 6	**Design of Connections**: Types of Connectors, Welded Connections, Bolted Connections, Types of Connectors, Welded Connections, Bolted Connections, Screw Connections, Other Fasteners, Rupture Failure of Connections, I or Box-Shaped Compression Members Made by Connecting Two C-Sections, I-Beams Made by Connecting Two C-Sections, Spacing of Connections in Compression Elements.	**6 Hrs**

Sr.No.	Text Books
1	Wei-Wen Yu & Roger A. LaBoube – *Cold-Formed Steel Design*, 4th Edition, Wiley, 2010.

Sr.No.	Reference Books
1	American Iron and Steel Institute (AISI) – North American Specification for the Design of Cold-Formed Steel Structural Members (NAS 2007 & 2016 editions).
2	Rondal, J. – Cold-Formed Steel Structures, Elsevier Applied Science, 1987.
3	Rhodes, J. – Design of Cold-Formed Steel Members, Elsevier, 4th Edition, 1991
4	Winter, G. & Peköz, T. – Design of Cold-Formed Steel Structural Members, McGraw-Hill, 1987.
5	AS/NZS Standards & Eurocode 3 (Part 1.3) – if you want exposure beyond North America, Eurocode 3 Part 1.3 covers cold-formed steel design in Europe.
6	AISI S100 – North American Specification for the Design of Cold-Formed Steel Structural Members
7	IS 801: 1975 – Code of Practice for Use of Cold-Formed Light Gauge Steel Structural Members in General Building Construction
8	BS 5950 (Part 5) – Older British standard for cold-formed members

Sr.No.	Web Resources
1	https://nptel.ac.in/courses/105105162
2	https://onlinecourses.nptel.ac.in/noc24_me61

Course Title: Structural Health Monitoring		
Course Code:PD252108		Course Category: PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Prerequisite: Fundamentals of Vibrations and Modal Analysis, Mechanics of Materials / Solid Mechanics, Basics of Sensors & Instrumentation, Signal Processing (undergraduate level), Elementary knowledge of wave propagation and finite element modelling (desirable)

Course Description: Introduces principles and methods of Structural Health Monitoring (SHM) and smart materials used as sensors/actuators. Topics include piezoelectric, electrostrictive, magnetostrictive materials and fiber-optic sensing, vibration-based damage detection, electrical impedance and wave-propagation based diagnostics, and advanced signal processing (wavelets, neural nets, SVM). Applications to aerospace, civil infrastructure, pipelines and rotating machinery are covered with hands-on/analytical examples.

Course Objectives:
1. Introduce smart material fundamentals and sensing/actuation mechanisms for SHM.
2. Each vibration-based and modal method for damage diagnosis.
3. Explain electrical-impedance and wave-propagation techniques for local and global damage detection.
4. Explain Wave propagation Patterns in SHM.
5. Develop skills in advanced signal processing and ML methods for SHM.
6. Demonstrate SHM applications in aerospace, civil, pipeline and rotating systems.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Understand concepts in structural health monitoring and acquire knowledge of smart materials.	Understand (Level 2)
CO2	Understand vibration control methods in structural health monitoring.	Understand (Level 2)
CO3	Understand electrical impedance methods in structural health monitoring.	Understand (Level 2)
CO4	Understand wave propagation methods in structural health monitoring.	Understand (Level 2)
CO5	Understand advanced signal processing techniques in structural health monitoring.	Understand (Level 2)
CO6	Understand applications of structural health monitoring in different structural systems.	Understand (Level 2)
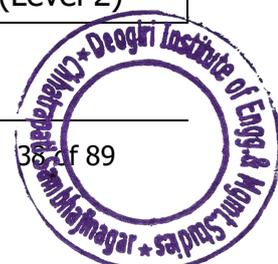
CO-PO-PSO Mapping															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	1	-	-	1	1	-	-	-	1	1	1	1	-
CO2	3	3	2	2	-	1	1	-	-	-	1	1	2	2	1
CO3	3	3	2	1	-	1	1	-	-	-	1	1	2	2	1
CO4	3	3	2	1	-	1	1	-	-	-	1	1	2	2	1
CO5	3	3	2	1	-	1	1	-	-	-	1	1	2	2	1
CO6	3	3	2	1	1	1	1	1	1	1	1	1	2	2	1

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction to SHM & Smart Materials** Motivation and objectives of structural health monitoring, Working principles of smart materials used for sensors and actuators, Structural Health Monitoring verses Non Destructive Testing, Piezoelectric materials (Constitutive relation, unimorph, bi-morph, Electromechanical coefficient, resonance/anti-resonance), Electrostrictive materials (Constitutive relation, sensor, actuator, figures of merit), Magnetostrictive materials (Constitutive relation, sensor, actuator, figures of merit), Optical Fiber (Fiber Bragg grating, strain sensing, ultrasonic sensing).	6 Hrs
Unit 2	**Vibration Control & SHM** Damage Diagnostic methods based on vibration response, Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method	6 Hrs
Unit 3	**Electrical Impedance Methods in SHM** Damage Diagnostic methods based on electrical impedance method, Beam model, Plate Model, Design Examples.	6 Hrs
Unit 4	**Wave Propagation Methods in SHM** Damage Diagnostic methods based on wave propagation methods; Bulk waves/Lamb waves, Reflection and transmission, Wave tuning/mode selectivity, Migration imaging, Phased array imaging, Focusing array/SAFT imaging.	6 Hrs
Unit 5	**Advanced signal processing methods in SHM** Wavelet, Neural networks, Vector support machine	6 Hrs
Unit 6	**Applications of SHM** Applications of structural health monitoring in aerospace including sandwich composite structures, civil infrastructures, pipelines,	6 Hrs

	rotating machinery.	

| Sr.No.	Text Books
1	V. Giurgiutiu, Structural Health Monitoring with Piezoelectric Wafer Active Sensors, Academic Press.
2	B. Culshaw, Smart Structures & Materials, Artech House, Boston.

Sr.No.	Reference Books
1	A. V. Srinivasan, D. M. Macfarland, Smart Structures: Analysis & Design, University Press, Cambridge, UK.
2	Fu Ko Chang, Structural Health Monitoring: Current Status and Perspectives,
3	Philip, W., Industrial sensors and applications for condition monitoring, MEP.
4	Armer, G.S.T (Editor), Monitoring and assessment of structures, Spon, London.
5	Wu, Z.S. (Editor), Structural health monitoring and intelligent infrastructure, Volumes 1 and 2, Balkema.
6	Harris, C.M., Shock vibration handbook, McGraw-Hill.
7	Rao, J.S., Vibratory condition monitoring of machines, Narosa Publishing House, India.

Sr.No.	Web Resources
1	Health Monitoring, IIT Madras, NPTEL, https://nptel.ac.in/courses/114106046

Course Title: Retrofitting Structures		
Course Code: PD252109		Course Category: PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Prerequisite: Strength of Materials / Structural Analysis, Concrete Technology and Steel Structures fundamentals, Basic NDT (Non-Destructive Testing) and Materials Engineering concepts (desirable)

Course Description: This course Covers serviceability, deterioration mechanisms and diagnosis of concrete, steel and masonry structures; non-destructive testing and distress monitoring; materials and techniques for repair (polymer, epoxy, fiber-reinforced systems); corrosion mitigation; and strategies for maintenance, strengthening and rehabilitation (jacketing, overlays, underpinning, injection methods, shotcrete). Emphasis on diagnosis, material selection and practical repair detailing

Course Objectives:
1. Explain mechanisms of deterioration in concrete, steel and masonry and how environment and construction defects influence service life.
2. Teach diagnostic techniques (visual inspection, NDT methods like ultrasonic/rebound hammer, moisture assessment) for condition assessment.
3. Familiarize students with repair materials and their field application (polymers, epoxy, Fiber reinforced systems, coatings).
4. Develop design/selection skills for appropriate repair and strengthening strategies (jacketing, overlays, injection, underpinning).
5. Equip students to prepare inspection reports, rehabilitation plans and to evaluate life cycle and safety implications of repair choices.

	Course Outcomes:	
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Describe causes and mechanisms of distress in concrete, steel and masonry, and the effects of environmental and construction factors sensors	Understand (Level 2)
CO2	Use appropriate non-destructive testing and inspection techniques (ultrasonic, rebound hammer, moisture/condensation assessment) to assess condition and estimate residual strength.	Apply (Level 3)
CO3	Diagnose crack types, moisture/dampness problems and corrosion mechanisms; prioritize failure causes and recommend remedial action	Analyze (Level 4)
CO4	Select and justify repair materials and protection systems (polymer concrete, epoxy, coatings, cathodic protection) for given field conditions, considering performance and durability	Apply (Level 3)
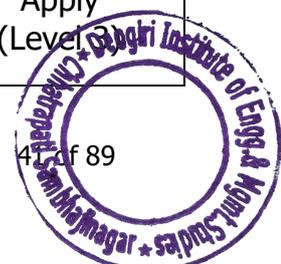
CO5	Understand maintenance of RC structures and design process of strengthening of degraded beams, slabs, columns, footings	Understand (Level 2)

CO-PO-PSO Mapping															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	1	-	1	2	1	1	-	1	-	1	3	2	2
CO2	2	1	-	1	2	2	1	-	-	-	1	1	1	2	1
CO3	2	2	2	1	-	-	2	-	-	2	1	-	2	1	2
CO4	2	-	1	2	-	1	-	-	-	2	1	-	1	2	1
CO5	2	1	1	-	2	2	-	-	-	-	1	-	3	2	1

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Serviceability and Durability** Needs for repair, rehabilitation and strengthening of RC structures, Distress Monitoring, Causes for Distress, Degradation of RC structures: major causes and signs; cracking type, causes and characteristics Design and Construction Errors, Non-Destructive Testing: Ultrasonic and Sonic Test, Rebound Hammer Test, Strength Evaluation of Existing Structures.	6 Hrs
Unit 2	**Cracks in Structures** Causes, Thermal and Shrinkage cracks, Cracks due to Vegetation and Trees, Foundation Movements, Types and their Fatality, Diagnosis Techniques for Repair. Moisture Penetration Sources of Dampness, Moisture Movement from Ground, Reasons for Ineffective Damping, Leakage in Concrete Slabs, Pitched Roofs, Dampness in Solid Walls, Condensation, Remedial treatments, Chemical Coatings.	6 Hrs
Unit 3	**Materials for retrofitting and strengthening** Materials, their physical and chemical properties, used in retrofitting and strengthening of RC structures: cement base, polymer modified, resin base, micro concrete and composites; compatibility of old and new materials	6 Hrs
Unit 4	**Materials for Repairs** Essential Parameters for Repair Material, Premixed Cement Concrete and Mortar, Sulphur Infiltrated Concrete, Fiber Reinforced Concrete, Special Elements for Accelerated Strength Gain, Expansive Cement, Polyester Resin. Polymer Concrete: Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application Polymer Modified Concrete: Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application, Epoxy Concrete	6 Hrs

	and		
Unit 5	**Maintenance of RC structures** Quality control in concrete construction, maintenance, water leakage-detection and mitigation, fire damage-detection and reparation, corrosion-detection and mitigation, demolition of concrete structures and structural health monitoring.	**6 Hrs**	
Unit 6	**Design of strengthening of RC members** Strengthening of RC elements such as beams, slabs, columns, footings due to degradation: degradation due to aging, corrosion, earthquake, fire, blast; and change in use.	**6 Hrs**	

Sr.No.	Text Books
1	Johnson. S.M., "Deterioration, maintenance and repair of structures", McGraw-Hill book company, New York, 1965
2	M. S. Shetty, "Concrete Technology- Theory and Practice", S. Chand and Company, New Delhi, 1992
3	Denison Campbell, Allen and Harold Roper, "Concrete structures", Materials, Maintenance and Repair, Longman Scientific and technical UK, 1991.

Sr.No.	Reference Books
1	SP25-84, "Handbook on causes and prevention of cracks on buildings", Indian standards
2	Santhakumar, A.R., " Training Course notes on Damage Assessment and repair in Low Cost Housing "," RHDC–NBO " Anna University, July 1992.
3	Raikar, R.N., "Learning from failures – Deficiencies in Design ", Construction and Service – R & D Centre (SDCPL), Raikar Bhavan, Bombay, 1987
4	R. T. Allen and S. C. Edwards, "Repair of Concrete Structures", Blakie and Sons, UK, 1987.

Sr.No.	Web Resources
1	https://onlinecourses.nptel.ac.in/noc26_ce45/preview

Course Title: Theory of Plates and Shells		
Course Code: PD252110	**Course Category: PEC**	
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Prerequisite: Fundamentals of Strength of Materials, Structural Analysis (indeterminate structures, matrix methods), Mechanics of Materials, Basic Solid Mechanics

Course Description: This course Covers theory and analysis of plates, circular plates and thin shell structures. Topics include small/large deflection plate theory, governing differential equations, Navier's and Levy's analytical solutions, axis-symmetric circular plate analysis, and membrane/bending behavior of shell structures. Emphasis on solving practical problems (including shells under self- weight, fluid pressure, and common boundary conditions) and on using modern computational tools and Excel for design charts and verification.

Course Objectives:
1. To understand the fundamentals of thin and thick plate theory, including assumptions, stress resultants, and governing equations.
2. To analyze bending behavior of rectangular plates using Navier's and Levy's solution techniques under different loading and boundary conditions.
3. To study the structural response of circular plates subjected to axisymmetric and non-axisymmetric loading conditions.
4. To introduce shell structures, their classification, geometry, and basic thin shell theory concepts.
5. To perform membrane analysis of synclastic and cylindrical shells under various loading conditions.
6. To understand the concept of isoparametric formulation and develop element stiffness and load matrices for finite element analysis

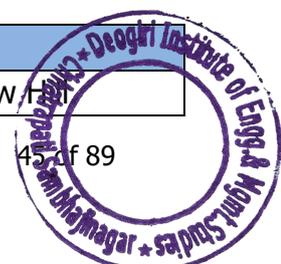| Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Explain Fundamental Concepts of Plate Theory	Understand (Level 2)
CO2	Derive and Apply Governing Equations for Thin Plates	Apply (Level 3)
CO3	Implement Boundary Conditions and Solution Methods	Apply (Level 3)
CO4	Analyse Rectangular Plates Under Specific Loads	Analyze (Level4)
CO5	Solve Circular Plate Problems Under Axis-Symmetric Loading	Analyze (Level4)
CO6	Evaluate and Analyse Shell Structures and higher order elements by FEM	Evaluating (Level 5)
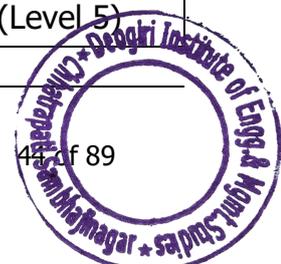
CO-PO-PSO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	-	-	-	-	-	1	-	1	3	1	1
CO2	3	3	2	2	1	-	-	-	-	1	-	1	3	2	1
CO3	3	3	2	2	2	-	-	-	-	1	-	1	3	3	1
CO4	2	3	3	3	2	1	1	1	-	1	-	1	3	3	1
CO5	2	3	3	3	2	1	1	1	-	1	-	1	3	3	1
CO6	2	3	3	3	2	2	2	1	-	1	-	2	1	3	3

Assessment

CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents

Unit 1	**Introduction to Plate Theory** Thin and Thick Plates, Small and Large Deflection Theory of Thin Plate, Assumptions in Analysis of Thin Plates, Slope Curvature Relations, Moment - Curvature Relations, Stress Resultants, Governing Differential Equations for Bending of Plates, Various Boundary Conditions	**6 Hrs**
Unit 2	**Navier's and Levy's Solution** Rectangular Plates Subjected to Uniformly Distributed Load, Sinusoidal Load for Different Boundary Conditions.	**6 Hrs**
Unit 3	**Circular Plates** Analysis of Circular Plates under Axis-Symmetric Loading, Moment Curvature Relations, Governing Differential Equation in Polar Co-Ordinates, Simply Supported and Fixed Edges, Distributed Load, Ring Load, a Plate with Hole at Center.	**6 Hrs**
Unit 4	**Introduction to Shell Structures** Classification of Shells on basis of Geometry, Thin Shell Theory, Equation of Shell Surfaces, Stress Resultants, Stress- Displacement Relations, Compatibility and Equilibrium Equations	**6 Hrs**
Unit 5	**Membrane Analysis** Equation of Equilibrium for Synclastic Shells, Solution for Shells Subjected to Self Weight and Live Load, Cylindrical Shells - Equation of Equilibrium, Open Shells With Parabolic, Circular, Elliptical Directrix, Simple Problems, Shells With Closed Directrix-Circular, Elliptical-	**6 Hrs**
Unit 6	**Isoperimetric Formulation**: Concept of Isoperimetric element – One- and Two-D	**6 Hrs**

Sr.No.	Text Books
1	S. Timoshenko and W. Krieger, Theory of Plates and Shells, Mc Grew Hill

2	Ansel C. Ugural, Stresses in Plates and Shells, Mc Graw Hill.
3	G. S Ramaswamy, Design and Construction of Concrete Shell Roofs, CBS Publications.
4	Chandrashekhara K., Analysis of Concrete Shells, New Age International Edition.

Sr.No.	Reference Books
1	Reddy, J. N.; Theory and Analysis of Elastic Plates and Shells, Taylor & Francis
2	O. C. Zeinkiewicz, Finite Element Method: Its Basic and Fundamentals, Butterworth Heinemann, 2007, 6th Edition.
3	P. Seshu, Textbook of Finite Element Analysis, PHI Pub., 2003

Sr.No.	Web Resources
1	https://onlinecourses.nptel.ac.in/noc23_ce103
2	https://onlinecourses.nptel.ac.in/noc24_me61

Course Title: Earthquake Engineering & Design of Earthquake-Resistant Structures		
Course Code: PD252111		Course Category: PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Prerequisite Basic knowledge of Structural Mechanics, Strength of Materials, and Structural Analysis, Fundamentals of Reinforced Concrete Design, Exposure to Engineering Mathematics (differential equations, vibrations).

Course Description: This course introduces the fundamental concepts of seismology and earthquake engineering with emphasis on the behavior of structures under seismic loading. Students will learn about seismic waves, earthquake effects, response spectrum theory, seismic risk analysis, and IS code provisions for earthquake-resistant design. The course also covers analysis of seismic forces, ductile detailing, retrofitting methods, and modern techniques such as base isolation systems.

Course Objectives:
1. Introduce the fundamentals of seismology, earthquake causes, and seismic wave characteristics.
2. Develop understanding of structural dynamics and earthquake response of single and multi-degree of freedom systems.
3. Familiarize students with earthquake effects on structures, seismic risk analysis, and IS code provisions.
4. Train students in seismic force analysis using Equivalent Static, Response Spectrum, and Time History methods.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Understand Engineering Seismology and Seismic zones in India	Remember (Level 1)
CO2	Understand earthquake response of SDOF linear systems and instrumentation in measurement.	Understand (Level 2)
CO3	Perform Seismic Analysis of buildings as per IS 1893.	Apply (Level 3)
CO4	Understand, Analyse and Design structural elements and ductile detailing as per IS 13920	Analyze (Level 4)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	-	-	2	-	2	-	1	2	-	2	-		
CO2	3	3	-	-	-	-	2	-	-	1	-	1	2		-
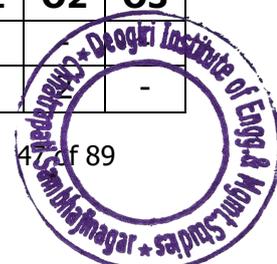
CO3	3	3	2	2	1	1	2	-	2	2	-	2	-	-	1
CO4	3	2	2	2	1	2	1	-	2	2	-	2	1	1	2

Assessment	
CA-1 (a) (10 Marks)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10 Marks)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction to Seismology** Elements of Seismology, Terminology, structure of Earth, Causes of an earthquake, seismic waves, magnitude and intensity, seismograph, strong motion earthquake, strong motion earthquake, accelerogram, Elastic Rebound Theory, Theory of Plate Tectonics and Movement of Indian Plate, Seismic Zoning Maps of Department of Civil Engineering, India and Comparative Study, Response Spectra, Strong Motion Characteristics.	**6 Hrs**
Unit 2	**Earthquake Response of Systems** Structural dynamics: Free and forced vibrations of single degree of freedom systems, un-damped and viscously damped vibrations, equations of motion, Duhamel integral. Response Spectrum Theory: construction of Design Response Spectrum, effect of foundation and structural damping on design spectrum, design spectrum of IS 1893, evaluation of lateral loads	**6 Hrs**
Unit 3	**Earthquake Risk Analysis** Earthquake Effects on the Structures, Classification of Loads, Seismic Methods of Analysis, Seismic Design Methods, Seismic Damages during Past Earthquakes and Effect of Irregularities and Building Architecture on the Performance of RC Structures, Mathematical Modeling of Multi-Storied RC Buildings with Modeling of Floor Diaphragms and Soil-Foundation, Winkler model.	**6 Hrs**
Unit 4	**Analysis of Seismic Forces** Analysis of Seismic Forces on Building as per latest IS: 1893 by Equivalent Static Lateral Load Method and Response Spectrum Method, Introduction to Time History Method and Performance Based Analysis. Seismic Retrofitting, Sources of Weakness in RC Framed Buildings, Classification of Retrofitting Techniques, Conventional and Non-Conventional Methods, Comparative Study of Various Methods and Case Studies,	**6 Hrs**
Unit 5	**Ductility in Structures** Introduction to Ductility, Factors Affecting Ductility, Ductility Requirements, Types of Ductility, Provisions as per latest IS 13920, Seismic Design and Ductile Detailing of Beam, Column, Beam Column Joint, Shear Wall, Elevated RC Circular Water Tanks Introduction to Base Isolation Systems, IS Code Provisions for Retrofitting of	**6 Hrs**

	Masonry Structures, Failure Modes of Masonry Structures and Repairing Techniques.	
Unit 6	**Seismic Design and Retrofitting of Structures** Introduction to Seismic Design, Seismic Design Codes and Standards, Seismic Load Calculation, Design of Reinforced Concrete and Steel Structures, Effect of Structural Irregularities, Retrofitting Techniques for Existing Structures, Soil-Structure Interaction in Retrofitting.	**6 Hrs**

Sr.No.	Text Books
1	P. Agarwal and M. Shrikhande – Earthquake Resistant Design of Structures, Prentice-Hall Publications.
2	IS:13920 – Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic.
3	Clough and Penzin – Dynamics of Structures, Mc-Graw Hills Publications.

Sr.No.	Reference Books
1	Jai Krishna, A.R. Chandrashekharan and B Chandra – Elements of Earthquake Engineering, South Asian Publishers Pvt. Ltd.
2	Joshi P S et al. - Design of Reinforced Concrete Structures for Earthquake.
3	Resistance Published by Indian Society of Structural Engineers, 2001.
4	IS:13935 – Repair and Seismic Strengthening of Buildings – Guidelines, 1993
5	IS:4326 – Earthquake Resistant Design and Construction of Buildings – Code of Practice, 1993
6	IS:13828 – Improving Earthquake Resistance of Low Strength Masonry Buildings, 1993
7	IS:13827 - Improving Earthquake Resistance of Earthen Buildings, 1993

Sr.No.	Web Resources
1	Introduction to Earthquake Engineering, NPTEL, https://nptel.ac.in/courses/105101004
2	Earthquake Seismology, NPTEL, https://nptel.ac.in/courses/105105225

Course Title: Structural Audits		
Course Code: PD252112		Course Category: PEC
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Prerequisite: Basic knowledge of Structural Engineering, Concrete and Steel Structures, and Building Materials, Familiarity with Structural Design and Building Construction practices.

Course Description: This course introduces the concepts, procedures, and methodologies of structural audit of buildings. It covers the objectives, importance, byelaws, deterioration causes, non-destructive testing (NDT) techniques, strength evaluation, and audit reporting procedures as per statutory guidelines. Students will learn to assess structural health, serviceability, safety, and durability of RC, masonry, and steel structures.

Course Objectives:
1. To understand the importance, objectives, and legal aspects of structural audits.
2. To identify causes and types of deterioration in concrete, masonry, and steel structures.
3. To apply non-destructive and chemical testing methods for condition assessment.
4. To evaluate the strength and residual life of existing structures.
5. To develop skills for preparing structural audit reports for different conditions and hazards.

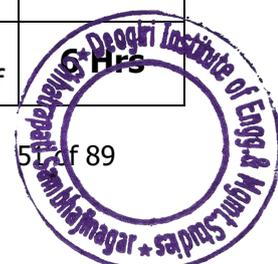| Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Gain the knowledge of Byelaws, procedure of Structural audit and study the typical problems in structures	Understand (Level 2)
CO2	Aware of causes and types of deterioration in structures.	Analyze (Level 4)
CO3	Develop skills for use of various Non-destructive tests required during auditing of structures.	Analyze (Level 4)
CO4	Strength evaluation of existing structures.	Evaluate (Level 5)
CO5	Acquire knowledge of legal procedures to conduct structural audits and report preparation	Creating (Level 6)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	–	–	–	–	–	–	–	–	–	2	2	1	2
CO2	3	2	2	–	–	–	–	–	–	–	–	–	2	2	2
CO3	–	2	2	–	3	–	–	–	–	–	–	-	2	2	3

CO4	–	2	2	3	–	–	–	–	–	–	–	-	2	2	3
CO5	–	–	–	–	–	3	2	–	–	–	–	2	-	-	-

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction to Structural Audit** Introduction to Structural Audit, Objectives, Byelaws, Importance, Various Stages involved, Visual inspection: scope, coverage, limitations, Factors to be keenly observed. Detailed Study of: RC frame and Masonry building: Structural and non-structural system, Structural elements concrete and its texture, sag and deflection in members, cracks: types and its fatality, Architectural features like balconies, cornices, etc their vulnerabilities, Probable damages in Structural and non-structural walls, Plaster and paint Leakages and seepages, Plinth importance and how it affects suitability of building, Electric wiring: various damages and their fatality. Steel Structures: Corrosion, Connection defects, Connection strength, yielded member.	6 Hrs
Unit 2	**Causes and types of deterioration in Structures** Causes of deterioration in RC frame and Masonry building: Permeability of concrete, capillary porosity, air voids, Micro cracks and macro cracks, corrosion of reinforcing bars, sulphate attack, alkali silica reaction, Causes of deterioration in Steel Structures: Uniform deterioration, pitting, crevice, galvanic, laminar, Erosion, cavitations, fretting, Exfoliation, Stress, Causes of corrosion in various members, causes of defects in connection (bolted and welded), Cracks	6 Hrs
Unit 3	**Non-Destructive Testing** Concrete Strength Assessment: Rebound hammer, Ultrasonic Pulse velocity, Penetration resistance, Pull out test, Chemical test: Carbonation test, Chloride test, Corrosion potential assessment: Cover meter survey, half-cell potential, resistivity measurement, Fire damage assessment: Differential thermal analysis, X ray diffraction, Structural Integrity and soundness assessment: Radiography, Impact echo test, Interpretation and evaluation of test results.	6 Hrs
Unit 4	**Strength Evaluation of Existing Structure** Reserve strength, identification of critical sections, structural system and its validation, evaluation of damage in concrete and reinforcement, evaluation of building configuration	6 Hrs
Unit 5	**Approach to conduct Structural Audits** Guidelines of Statutory Bodies, Legal aspects, Responsibility of	6 Hrs

	calling Structural Audit, Scope of Investigation, Involvement of Original Consultants & Representatives of Statutory Bodies, Frequency of Structural Audits.	
Unit 6	**Report preparation** Draft Structural audit report for up-gradation of existing building, Audit for continuation of usage of old Buildings, Audit for Buildings damaged due to Flood, Earthquakes, Fire, Storms/cyclones, Landslides, Cloud Burst, Tsunamis and accidental events such as blasts/ wilful damages.	**6 Hrs**

Sr.No.	Text Books
1	Indian Standard codes related with non-destructive testing.
2	Government Resolutions related to Structural Audits (BMC Act, etc.)
3	Field manuals and reports by Expert Consultants

Sr.No.	Reference Books
1	Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, John Wiley and Sons, 2006.
2	Douglas E Adams, Health Monitoring of Structural Materials and Components Methods with Applications, John Wiley and Sons, 2007
3	J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and Intelligent Infrastructure, Vol- 1, Taylor and Francis Group, London, U.K, 2006.
4	Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007

Sr.No.	Web Resources
1	Introduction to Structural Audit, https://www.youtube.com/watch?v=6c6idcWVc4w
2	Causes and types of deterioration in Structures, https://www.youtube.com/watch?v=xlmiCWaYHXk
3	Non-Destructive Testing, https://www.youtube.com/watch?v=3SEAf18n61s
4	Approach to conduct Structural Audits & Report preparation, https://www.youtube.com/watch?v=PojJX4VSnbc

Course Title: Research Methodology		
Course Code: PG252601		Course Category: EL
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks

Course Prerequisite: Basic knowledge of engineering fundamentals, Familiarity with undergraduate-level mathematics and statistics, Ability to use computers and standard engineering software tools

Course Description: This course introduces postgraduate engineering students to the principles, processes, and practices of research methodology. It emphasizes problem identification, literature review, research design, data collection, analysis, and interpretation. The course also covers ethical practices, mathematical modeling, computational tools, and scientific communication through thesis, research papers, and presentations. It aims to equip students with essential skills to undertake independent research projects and contribute effectively to the advancement of science and technology.

Course Objectives:
1**.** To provide a clear understanding of the fundamentals and process of research in engineering.
2. To develop the ability to identify research problems through literature review and formulate hypotheses.
3. To impart knowledge of research ethics, integrity, and professional responsibility.
4. To familiarize students with research design, data collection, analysis, and interpretation techniques.
5. To introduce mathematical modelling and computational tools relevant to engineering research.
6. To develop effective academic writing and presentation skills for disseminating research outcomes.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Recall the meaning, objectives, and types of research, along with problem identification and hypothesis formulation.	Remember (Level 1)
CO2	Demonstrate understanding of ethical issues, research integrity, plagiarism, and intellectual property rights.	Understand (Level 2)
CO3	Design appropriate research methodologies, select data collection methods, and apply suitable statistical techniques for analysis.	Applying (Level 3)
CO4	Develop and validate mathematical and computational models for engineering applications using appropriate tools/software.	Analyzing (Level 4)
CO5	Write and present research outputs in the form of proposals, reports, papers, and presentations adhering to academic standards.	Evaluate (Level 5)

CO-PO-PSO Mapping

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	1	2	1	1	–	–	1	1	–	2	2	1	1
CO2	2	2	2	2	2	3	–	–	3	2	–	2	2	1	2
CO3	3	3	3	3	3	2	–	–		2	–	2	1	2	2
CO4	3	3	3	1	3	1	–		2	2	–	2	3	1	2
CO5	2	2	2	2	2	2	–	–	3	2	–	2	2	1	1

Assessment

CA-1 (a) (10 Marks)	Subjective Test / Open book test / Assignment.
CA-2 (b) (10 Marks)	Assignment / Presentation/ Case Study
MSE (c) (20 Marks)	Mid Sem Examination

Course Contents

Unit 1	**Introduction to Research:** meaning, objectives, motivation, types, Research process, Criteria of good research, Importance of literature review in defining a problem, Literature review: primary and secondary sources, Critical literature review, Identifying gap areas from literature and research database, Research problem: selection, necessity and formulation, Technique Involved in Defining a Problem, Hypothesis formation, Problems Encountered by Researchers	6 Hrs
Unit 2	**Research Ethics:** Ethical considerations in research, Plagiarism, Intellectual Property, Research Integrity, and misconduct, Ethical issues in data collection, experimentation, and analysis, Ethical considerations in publication and peer review, Case studies of ethical dilemmas in engineering research, Conflict of interest, Ethics in Emerging Technologies like AI	6 Hrs
Unit 3	**Research Design, Experimentation, Analysis And Data Analysis and Interpretation:** Experimental and non-experimental research designs, Sampling techniques, and sample size determination, Data collection methods: Surveys, interviews, and observation, Instrumentation and measurement techniques, Reliability and validity in research, Design of experiments and analysis of results, Data processing and cleaning, Statistical analysis: Descriptive and inferential statistics, Advanced data analysis techniques: Regression, ANOVA, and multivariate analysis, Interpretation of results. Reporting and presenting data	6 Hrs
Unit 4	**Mathematical Modeling in Engineering Research, Use of Computer Technology and Software:** Introduction to mathematical modeling, Types of models: Deterministic and probabilistic, Model development and validation, Applications of mathematical Modeling, Introduction to computational tool, Data analysis software: Usage and applications	6 Hrs

Unit 5	**Writing and Presenting Research: Writing a thesis and project report:** Structure and content, Writing progress reports and project updates, Structuring a research paper, Writing research proposals and grants, Writing for journals and conferences, Incorporating references and citations: APA, MLA, IEEE styles, Managing references with citation management software (e.g., End Note, Zotero), Preparing and delivering oral presentations, Creating effective visual aids (charts, graphs, tables), Poster presentations: Design and delivery, The publication process and peer review, Communicating research to non-specialists and stakeholders	**6 Hrs**	
Unit 6	**Case Studies and Applications:** Case studies of successful engineering research, Application of research methodologies to real-life projects, Problem-solving through interdisciplinary approaches, Integration of ethical, technical, and methodological aspects, Emerging trends in engineering research.	**6 Hrs**	

Sr.No.	Text Books
1	C. R. Kothari, Research Methodology, New Age Publishers.
2	Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners
3	Herman Tang, Engineering Research: Design, Methods, and Analysis
4	Douglas C. Montgomery, Design and Analysis of Experiments

Sr.No.	Reference Books
1	Cooper, D.R. & Schindler, P.S. – Business Research Methods, McGraw Hill.
2	Montgomery, D.C. – Design and Analysis of Experiments, Wiley.
3	Krishnaswamy, K.N., Sivakumar, A.I., Mathirajan, M. – Management Research Methodology, Pearson.
4	Deborah Rumsey – Statistics for Dummies, Wiley.

Sr.No.	Web Resources
1	MIT OpenCourseWare: Research Methods (https://ocw.mit.edu)
2	NCBI – PubMed Central (https://www.ncbi.nlm.nih.gov/pmc/)
3	https://researcheracademy.elsevier.com/
4	https://link.springer.com/

Course Title: Interdisciplinary Perspective on Indian Science and Technology		
Course Code: PG252501		**Course Category: IKS**
Teaching Scheme		**Examination Scheme**	
Lectures: 02 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 02	MSE	20 Marks
Semester: F Y M.Tech. (Semester II)	ESE	60 Marks
Course Prerequisite: None			

Course Description: The course Interdisciplinary Perspective on Indian Science and Technology introduces students to India's rich contributions in mathematics, astronomy, architecture, metallurgy, textiles, and agriculture. It emphasizes the scientific principles embedded in traditional practices, tracing their historical development and global impact. Students will explore how ancient Indian innovations such as the number system, astronomical instruments, town planning, metallurgy, and sustainable farming shaped modern science and engineering. The course bridges theoretical understanding with practical relevance, enabling appreciation of indigenous knowledge systems and their applications in contemporary contexts.

Course Objectives:
1. To understand the foundational concepts and necessity of the Indian Knowledge System.
2. To identify key historical contributions of Indian scholars in mathematics, astronomy, architecture, metallurgy, textiles, and agriculture.
3. To interpret the scientific principles and techniques underlying traditional Indian practices.
4. To analyze the relevance of IKS in modern scientific and technological contexts.
5. To appreciate the global influence and sustainability of Indian innovations throughout history.
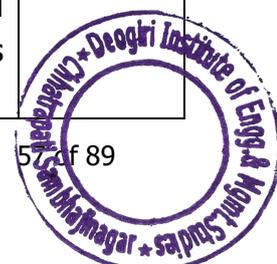
Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Recall key concepts, terminologies, historical developments, and contributions in Indian Mathematics, Astronomy, Architecture, Metallurgy, Textiles, and Agriculture.	Remember (Level 1)
CO2	Explain the principles, methods, and scientific basis of Indian Knowledge Systems in various domains such as mathematics, astronomy, architecture, metallurgy, textiles, and agriculture.	Understand (Level 2)
CO3	Use traditional Indian scientific and technological methods to address contemporary or theoretical problems in relevant fields.	Applying (Level 3)
CO4	Examine the relevance, strengths, and limitations of Indian Knowledge Systems in addressing contemporary scientific, environmental, technological, and societal challenges.	Analyzing (Level 4)
CO5	Write and present research findings effectively.	Creating (Level 6)

CO-PO-PSO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	2	-	1	2	-	2	-	-	-
CO2	3	3	-	-	-	-	2	-	-	1	-	1	2	2	-
CO3	3	3	2	2	1	1	2	-	2	2	-	2	-	-	1
CO4	3	2	2	2	1	2	1	-	2	2	-	2	1	1	2
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Assessment

CA-1 (a) (10 Marks)	Subjective Test / Assignment/ MCQ Test etc.
CA-2 (b) (10 Marks)	Subjective Test / Assignment/ MCQ Test etc.
MSE (c) (20 Marks)	Subjective Test

Course Contents

Unit 1	**Indian Mathematics** Necessity of Indian Knowledge System, Defining Indian Knowledge System, Contributions of Indian Mathematicians, Historical Evidence and features of Indian Numerical Number System, The Idea of Zero and Infinity, Decimal System, Representation of Large Numbers, Global Spread and Adoption of Indian Numericals, Arithmetic (Square of a Number, Square Root, Series and Propagation), Geometry (Simple Constructions from Sulba-Sutras,e.g, Right Angle Triangle, The Value of Pi), Trigonometry and Algebra in IKS, Modern Indian Contributions to Mathematics	4 Hrs
Unit 2	**Indian Astronomy** Historical Development of Indian Astronomy, Astronomy for Timekeeping, Solar and Lunar Motions, The Celestial Coordinate System, Various Regional Indian Calendar Systems, Planetary Model of Aryabhata and Nilakantha, Astronomical Instruments, Various Royal Endeavors for Astronomy (e.g., Jaisingh's Jantar Mantar), Modern Indian Contributions to Astronomy	4 Hrs
Unit 3	**Indian Architecture and Town Planning** Sthapatya-Veda and Vastu-Shastra, Historical Features of Indian Town Planning, Water Management and Drainage Systems, Town Town Planning of Harappan Cities, Temple Architecture, Features and Examples of Cave, Rock Cut, Nagara, Dravida, Kalinga, Vesara, Deccan, Rajput, Mughal, Indo-Saracenic Architecture Styles, Modern Indian Contributions to Architecture and Town Planning	4 Hrs
Unit 4	**Indian Metallurgy** Ancient Mining and Ore Extraction Technologies, Mining and Manufacture of Zinc, Copper and its Alloys, Silver, Gold, Mercury and Lead, Iron Extraction from Biotite, Steel Manufacturing, Global Influence of Wootz Steel, Wax Casting, Modern Indian Contributions to Metallurgy	4 Hrs

Unit 5	**Indian Textile** Textile Traditions in Ancient India, The Variety and Diversity of Indian Textiles, Types of Fabrics and Materials, Cotton and Silk, Weaving Techniques and Looms, Dyeing Process and Natural Colors, Major Textile Centers, Significance of Indian Textile in Historical Global Trade, Fall of Indian Textile in Colonial Era, Modern Indian Contributions to Textile	3 Hrs
Unit 6	**Indian Agriculture** Importance of Agriculture in Ancient India, Traditional Crops (Grains, Fruits, Vegetables Spices), Significance of Indian Agricultural Products in Historical Global Trade, Significance of Agriculture and Irrigation for the Indian Kings, The Ery System of South India, Traditional Farming Techniques (Land Preparation, Sowing Techniques, Weeding and Pest Management, Harvesting and Storage), Irrigation Techniques and Rainwater Harvesting, Modern Indian Contributions to Agriculture	3 Hrs

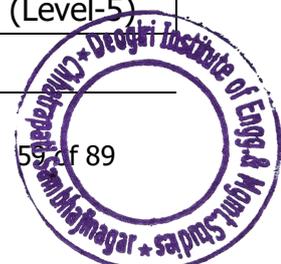| Sr.No.	Text Books
1	D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.
2	B. Mahadevan, Nagendra Pavana, Vinayak Rajat Bhat, Introduction to Indian Knowledge System: Concepts and Applications, PHI Learning, 2022
3	Kapil Kapoor, Awadhesh Kumar Singh, Indian Knowledge Systems, D.K. Print World Ltd; First Edition (15 October 2005)
4	Bhag Chand Chauhan, IKS: The Knowledge system of Bharata, Garuda Prakashan (13 March 2023)
5	Science in India: A Historical Perspective by B V Subbarayappa, Rupa & Co (2013)

Sr.No.	Reference Books
1	G. G. Joseph, Indian Mathematics Engaging the World from Ancient to Modern Times, World Scientific, London, 2016
2	History of Astronomy: A Handbook, Edited by K. Ramasubramanian, Aniket Sule, andbMayank Vahia, SandHI, IIT Bombay, and T.I.F.R. Mumbai, 2016.
3	History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ramkrishna Mission Institute of Culture, Kolkata (2014).
4	Christopher Tadgell, History of Architecture in India, Architecture Design and Technology Press (1990)
5	Bindia Thapar, Introduction to Indian Architecture, Periplus Asian Architecture Series

Sr.No.	Web Resources
1	Indian Knowledge System Division, Ministry of Education, Government of India, https://iksindia.org/lectures-and-videos.php

Course Title: Mini Project		
Course Code: PD252602		**Course Category: EL**
Teaching Scheme	**Examination Scheme**	
Practical's/Sessions: 02 Hours/Week	CA-1	15 Marks
Credits: 01	CA-2	15 Marks
Semester: F Y M.Tech. (Semester II)	ESE	20 Marks

Course Prerequisite: Basic understanding of core subjects in specialization, Ability to access, and interpret scientific literature, Exposure to technical report writing and presentation.

Course Description: The Mini Project course provides students with an opportunity to apply theoretical knowledge gained during coursework to a small-scale practical problem in Computer Aided Structural Engineering. It enables students to experience the process of identifying a problem, reviewing literature, formulating objectives, and developing solutions using experimental, analytical, or simulation-based approaches. The course emphasizes independent learning, teamwork, critical thinking, innovation, and technical communication.

Course Objectives:

1. Develop the ability to identify, analyze, and solve engineering problems using modern tools and techniques.
2. Encourage creativity, innovation, and research aptitude in addressing mechanical engineering challenges.
3. Provide hands-on exposure to design, modeling, analysis, and/or experimental work on a defined problem.
4. Strengthen teamwork, project management, and professional ethics in executing engineering tasks.
5. Enhance technical writing and oral presentation skills through project documentation and seminars.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Identify and define a relevant problem in the domain of Civil Engineering.	Apply (Level-3)
CO2	Conduct a literature survey and establish research/technical objectives.	Understand (Level-2)
CO3	Apply appropriate engineering methods, tools, and techniques to develop and implement solutions.	Analyze (Level-2)
CO4	Work independently or in a team, demonstrating project management, ethical practices, and leadership.	Apply (Level-2)
CO5	Demonstrate the ability to answer questions, engage in discussions, and defend ideas confidently.	Understand (Level-5)

CO-PO-PSO Mapping

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	1	1	1	1	2	3	3	-
CO2	2	3	2	3	2	1	1	1	1	2	1	2	2	2	2
CO3	3	3	3	3	3	1	2	1	2	2	2	3	3	3	-
CO4	2	2	3	2	2	2	1	2	3	2	3	3	3	-	2
CO5	1	2	2	1	1	1	1	2	2	3	2	2	2	3	-

Course Contents

The mini project is designed to help students identify, analyze, and solve real-world problems in Civil (Computer Aided Structural Engineering).This project also aims to improve their overall skills and capabilities. Each student should choose a topic they are interested in. The project's content must be relevant to emerging areas within the field, address current issues with a research focus, or be based on industrial visits. Students can also select a practical problem from the field of Civil Engineering to work on. By the end of the semester, each student must submit a final report to the Head of the Department. The report must be authenticated by their guide.

Assessment

The mini project is worth a total of 50 marks, with 30 marks for the internal assessment and 20 marks for the semester-end examination. The semester-end examination will be conducted by a committee of three faculty members. Students must bring their completed reports, which should be duly authenticated by their guide and the Head of the Department. Each student will individually present their work to the committee, who will then evaluate them and award marks accordingly.

CA-I (a) (15 M)	Review-I: 15 Marks (Concept/knowledge in the topic = 10 marks, Literature-05 marks)
CA-II (b) (15 M)	Review-II: 15 Marks (Report writing & Presentation =15 Marks)
ESE (Practical/viva voce (c)) (20 M)	20 Marks (Individual evaluation through viva voce / test (20 marks)
Total (d)	50 Marks

Course Title: Finite Element Method		
Course Code: PD253006		Course Category: PCC

Teaching Scheme	Examination Scheme	
Lectures: 04 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 04	MSE	20 Marks
Semester: S Y M.Tech. (Semester III)	ESE	60 Marks

Course Prerequisite: Knowledge of Engineering Mathematics (Differential Equations, Linear Algebra, Variational Calculus).Fundamentals of Mechanics of Solids, Structural Analysis, and Theory of Elasticity.

Course Description: This course provides a comprehensive understanding of the Finite Element Method (FEM) and its application to structural engineering problems. It covers approximate methods, variational principles, 1-D, 2-D, and 3-D FEM formulations, direct approaches, isoparametric elements, numerical integration, and computer implementation. Applications using FEM software such as ANSYS are also introduced for both static and dynamic structural analysis.

Course Objectives:To make the students aware and understand
1. To understand the fundamental principles of FEM and approximate solution methods.
2. To formulate and solve 1-D, 2-D, and 3-D structural problems using FEM.
3. To apply variational principles, weighted residual methods, and shape functions for FEM analysis.
4. To analyze stress, displacement, and boundary value problems using FEM formulations.
5. To gain exposure to computer implementation and commercial FEM software (ANSYS) for structural applications.

Course Outcomes:		
Cos	After completion of the course: Student should be able to	Bloom's Level
CO1	Understand the different energy methods in structural analysis and basic concepts of finite element method	Understand (Level 2)
CO2	Analyse 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach	Analyze (Level 4)
CO3	Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method	Apply (Level 3)
CO4	Solve 2-D problems using knowledge of theory of elasticity	Analyze (Level 4)
CO5	Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics	Evaluate (Level 5)
CO6	Understand the different energy methods in structural analysis and basic concepts of finite element method	Understand (Level 2)

CO-PO-PSO Mapping

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	-	2	1	-	-	-	-	-	-	-	2	-	2
CO2	3	3	-	2	2	-	-	-	-	-	-	-	3	-	3
CO3	3	3	-	2	2	-	-	-	-	-	-	-	3	-	3
CO4	3	2	-	2	1	-	-	-	-	-	-	-	2	2	-
CO5	3	3	-	2	2	-	-	-	-	-	-	-	3	-	3
CO6	3	2	-	2	1	-	-	-	-	-	-	-	2	-	2

Assessment

CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents

|		
Unit 1	**Introduction to FEM & Approximate Methods** Introduction, Overview of Various Methods to Solve Integral & Differential Equations (Point Collocation Method, Method of Least Square, Weighted Residual Method, Galerkin's Method), Variational Calculus (Hamilton's Variational Principle, Minimum Potential Energy Principle, Euler Lagrange Equation), Partial FEM (Kentorvich Method/ Finite Strip Method/ Semi-Analytical Method), Local & Global Finite Element Methods (Rayleigh-Ritz Method), Stepwise Procedure in FEM	7 Hrs
Unit 2	**One Dimensional FE Analysis** Application of FEM to Solve various 1-D problems (Shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials), C0 Continuity, 1-D FE Analysis (Discretization, Selection of Shape Function, Defining Gradients of Primary Unknowns & Constitutive Equations, Derivation of Element Equations, Assembly & Application of Boundary Conditions, Computation of Primary and Secondary Unknowns), Direct Approach for Assembly, Boundary Conditions (Geometric, Natural), Concept of Sub-Structuring (Static Condensation), Stiffness Matrix for Basic Bar & Beam Element, Representation of Distributed Loading, The Assembly Process within the PMPE Approach, Element Stresses), FE Analysis of 1-D Non-Prismatic Members, Solution of Differential Equation using FEM, Solution of BIVP using Galerkin's MWR (1-D Transient Analysis).	6 Hrs
Unit 3	**FE Analysis by Direct Approach** C1 Continuity, Formulation of 1-D Beam Element, Classical Beam Theory, Element Equation Formulation (Galerkin's Approach, Rayleigh-Ritz approach), Derivation of Scalar Functional from	7 Hrs

	Differential Equation and Vice Versa, Application to Fixed and Continuous Beams.	
Unit 4	**Two Dimensional FE Analysis** Conditions of Symmetry & Anti Symmetry (Applications), 2-D FE Analysis, Review of Theory of Elasticity, CST Element (3- Node Triangular Element), Pascal's Triangle and Pyramid, Area Co-ordinate, Stepwise Formulation, Equivalent Load Vector, Plane Stress Problems using CST Elements, 2-D Stress Analysis using 4-noded Rectangular Element, Stepwise Formulation, Effect of Aspect Ratio, Explicit & Implicit Isoparametric Formulation, Iso-parametric Elements for Plane Problems (Quadrilateral Element, Bilinear Element, Para-linear Element, Bi-Quadrilateral Element, Serendipity Elements, Lagrange Element), Numerical Integration, (1-D Domain, 2-D Domain, n-point Gauss Rule), Formulation of Transition Element	**6 Hrs**
Unit 5	**Three Dimensional FE Analysis & Computer Implementation of FEM** 3-D Stress Analysis using FEM, Iso-parametric Formulation, 3-D Brick Element, Application to 3-D Analysis, FEA of Axi- symmetric Solids Subjected to Axi-symmetric and Asymmetric Loads (Application of Partial FEM).	**6 Hrs**
Unit 6	**Computer Implementation of FEM** Computer Implementation of FEM, Application of FEM to Time Dependent Problems, Partial FEM h-version of FEM, p-version of FEM, Adaptive Meshing, Exposure to Hybrid FEM (Mixed/ Hybrid Formulation, Unidirectional Composites), Introduction to ANSYS, Static & Dynamic Analysis of 1-D, 2-D and 3-D structures using ANSYS	**6 Hrs**

Sr.No.	Text Books
1	O. C. Zienkiewicz & R. L. Taylor, The Finite Element Method Vol. I & II, Tata McGraw Hill
2	J. N. Reddy, An introduction to the Finite Element Method, Tata McGraw Hill Pub.
3	R. D. Cook, Concept and Application of Finite Element Analysis, John Wiley & sons
4	Hutton D.V., Fundamentals of Finite Element Analysis, Tata McGraw Hill Pub

Sr.No.	Reference Books
1	C. S. Desai & J. F. Abel, Introduction to the Finite Element Method, CBS Pub.
2	C. S. Krishnamoorthy, Programming in the Finite Element Method, Tata McGraw Hill
3	Bathe K.J., Finite Element Procedures, PHI learning Pvt. Ltd
4	Y. M. Desai, T.I Eldho, Finite Element Method with application in Engineering, Pearson, Delhi
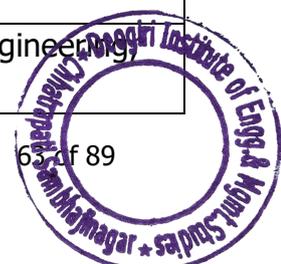
Sr.No.	Web Resources
1	NPTEL – Finite Element Analysis (IITs & IISc) https://nptel.ac.in
2	MIT OpenCourseWare – Finite Element Procedures https://ocw.mit.edu
3	Coursera – Introduction to Finite Element Analysis https://www.coursera.org

| Course Title: Soil Dynamics & Machine Foundations		
Course Code: PD253311		**Course Category:OE**
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: S Y M.Tech. (Semester III)	ESE	60 Marks

Course Prerequisite: Basic knowledge of soil mechanics, Dynamic properties of soil, such as dynamic shear modulus and elastic modulus, Vibration theory (including free and forced vibrations, and damping)

Course Description: A course on Soil Dynamics and Machine Foundations explores how soils behave under dynamic loads, such as those from earthquakes and machinery, and teaches students how to design foundations for such conditions. Key topics include the principles of vibration, wave propagation, dynamic properties of soil, liquefaction potential, and the design of machine foundations for different types of machines. The course is suitable for undergraduate, postgraduate, and research students in civil and geotechnical engineering, as well as practicing engineers

Course Objectives:
To make the students aware and understand
1. To introduce the fundamental concepts of wave propagation in soil media and enable students to understand how soil responds to dynamic disturbances.
2. To develop the ability to apply vibration theory for solving real-world dynamic soil problems and determining essential dynamic properties of soils.
3. To equip students with analytical skills to evaluate the behavior of machine foundations resting on both surface and embedded conditions under dynamic loading.
4. To provide in-depth understanding of block foundation behavior and enable analysis of different modes of vibration affecting soil–foundation interaction.
5. To familiarize students with design principles and IS Code provisions for foundations subjected to dynamic loads from reciprocating and impact machines.

| Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Understand the fundamentals of wave propagation in soil media.	Remember (Level1)
CO2	Apply theory of vibrations to solve dynamic soil problems & to calculate the dynamic properties of soil	Apply (Level3)
CO3	Analyze the behaviour a machine foundation resting on the surface and embedded foundation.	Analyze (Level4)
CO4	Analyze the block foundation under different modes of vibrations.	Analyze (Level4)
CO5	Understand the principles of design of foundations for reciprocating and impact machines as per IS Code	Understand (Level2)
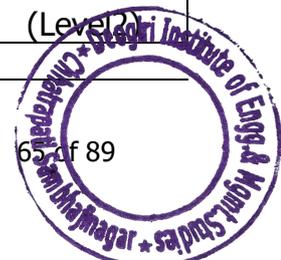
CO-PO-PSO Mapping															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	-	1	1	-	-	-	-	-	-	-	3	-	1
CO2	2	2	-	2	2	-	-	-	-	-	-	-	3	-	2
CO3	2	2	3	1	1	1	-	-	-	-	-	-	3	1	2
CO4	2	2	3	1	1	1	-	-	-	-	-	-	3	-	2
CO5	2	1	3	-	1	1	-	-	-	-	-	-	2	1	1

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Theory of Vibrations** Basic Definitions- Free and Forced Vibrations with and without Damping for Single Degree Freedom Systems- Resonance and its Effect, Magnification, Logarithmic Decrement, Transmissibility, Natural Frequency of Foundation – Soil system, Barkan's and IS methods, pressure bulb concept, Pauw's Analogy	6 Hrs
Unit 2	**Wave Propagation** Elastic Waves in Rods, Waves in Elastic Half Space, Dynamic Soil Properties, Field and Laboratory Methods of Determination – Up hole, Down Hole and Cross Hole Methods, Cyclic Plate Load Test, Block Vibration Test, Determination of Damping Factor	6 Hrs
Unit 3	**Machine Foundations** Machine Foundations: Types, Design criteria, permissible amplitudes and bearing pressure	6 Hrs
Unit 4	**Block Foundation** Block foundation: Degrees of freedom - analysis under different modes of vibration.	6 Hrs
Unit 5	**Two DoF Systems** Analysis of Two Degree freedom systems under free and forced vibrations -Principles of Design of Foundations for reciprocating and impact machines as per IS code	6 Hrs
Unit 6	**Vibration Isolation** Vibration Isolation: Types and methods, Isolating materials and their properties.	6 Hrs

Sr.No.	Text Books
1	P.Srinivasulu, G.V.Vaidyanathan, Handbook of Machine Foundations, Tata McGraw Hill.
2	Barken, Dynamics of Bases and Foundations, McGraw Hill Publishing Co. New York
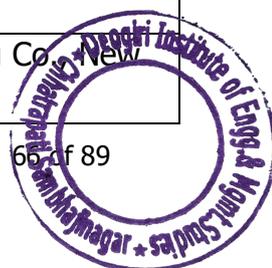
3	Richart, Hall and Woods, Vibration of Soils and Foundations, Prentice Hall, Eaglewood Cliffs, New Jersy, USA.

Sr.No.	Reference Books
1	Swami Saran, Soil Dynamic and Machine Foundation, Second edition, Galgotia Publication, 2009.
2	N. S. V. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Meeler Pub.,1998.
3	Samsher Prakash and V. K. Puri, Foundation for Machines: Analysis and Design, John Wiley & Sons., 1998.
4	Soil Dynamics, Samasher Prakash, MGH, 1981.

Sr.No.	Web Resources
1	Soil Dynamics, NPTEL- https://nptel.ac.in/courses/105101005
2	Soil Dynamic, NPTEL- https://nptel.ac.in/courses/105105221

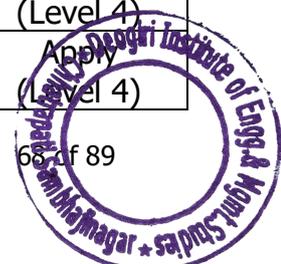| Course Title: Solution Procedure in Civil Engineering		
Course Code: PD253312		Course Category: OE
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: S Y M.Tech. (Semester III)	ESE	60 Marks

Course Prerequisite: Basic knowledge of engineering mechanics and structural analysis, including concepts of equilibrium, stability, and strength of materials, Familiarity with matrix algebra, differential equations, and numerical methods for solving engineering problems, Prior exposure to basic concepts of finite element methods (FEM) and computational tools used in engineering analysis, Understanding of fundamental computer operations and programming concepts, preferably in Fortran, C, C++, or MATLAB.

Course Description: This course covers classical, numerical, computational, and experimental methods for advanced structural analysis. It includes classical stability and equilibrium approaches, numerical computations, finite element analysis, and experimental stress analysis techniques. Emphasis is placed on computer implementation of algorithms and use of modern software tools to analyze linear, nonlinear, and dynamic structural problems.

Course Objectives:

To make the students aware and understand

1. Understand classical analysis procedures and modeling assumptions.

2. Use advanced computational tools for linear and nonlinear analysis.

3. Apply numerical methods for solving structural engineering problems.

4. Implement finite element analysis (FEM) for stress and structural evaluation.

5. Analyse nonlinear and dynamic structural behavior using FEM.

6. Conduct experimental stress analysis and structural modelling.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Explain classical structural analysis procedures and modelling assumptions.	Understand (Level 2)
CO2	Compare and utilize computational tools for linear and nonlinear analysis.	Apply (Level 3)
CO3	Apply numerical methods to solve structural engineering problems.	Apply (Level 3)
CO4	Implement finite element analysis (FEM) for structural discretization and stress evaluation.	Apply (Level 3)
CO5	Analyze geometrically and materially nonlinear problems and perform dynamic analysis.	Analyze (Level 4)
CO6	Conduct experimental stress analysis and structural modeling using computer-based algorithms.	Apply (Level 4)

CO-PO-PSO Mapping															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	1	–	1	–	–	–	–	–	–		1	-	-
CO2	3	3	2	–	3	–	–	–	–	–	–	–	1	3	-
CO3	3	3	3	–	3	–	–	–	–	–	–	-	1	-	-
CO4	3	3	3	–	3	–	–	–	–	–	–	-	1	2	2
CO5	3	3	3	–	3	–	–	–	–	–	–	-	1	-	-
CO6	3	3	3	3	3	–	–	–	–	–	–	-	1	-	3

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Classical Analysis Procedures** Basics of equilibrium and stability, Basic assumptions of Analysis, Concepts of Modelling, Basis of Idealization, Limitations of hand computations	6 Hrs
Unit 2	**Advanced Computational Tools** Comparative study of various engineering software available, Limitations and strengths, Linear, Nonlinear analysis provisions, Data Processing using Spread sheet Applications, Statistical Computational Tools, Interpretation of results.	6 Hrs
Unit 3	**Numerical Computations** Basis of Computations, Operations on Computer, Solution of Simultaneous Equations, Methods for Roots of Equations, Solution of Ordinary Differential Equations, Numerical Integration.	6 Hrs
Unit 4	**Finite Element Analysis** Discretization, Implementation of FEM -Calculation of Element Stiffness, Mass and Equivalent Nodal Loads, Assemblage of Structures Matrices, Boundary Conditions, Solutions of the overall problem, Calculations of Element Stresses, Computer Program Organization	6 Hrs
Unit 5	**Introduction to Non Linear Analysis by FEM,** Formulation of a Geometrically Non-linear Problem, Non-linear material behaviour, General Formulation of a Physically Nonlinear Problem**.** **Introduction to Dynamic Analysis by FEM**, Formulation of Dynamic Properties, Free Vibration, Steady-State and Transient Response Analysis for simple Problems	6 Hrs
Unit 6	**Experimental stress analysis**	6 Hrs

| | Model Analysis, Structural similitude, Use of models, Scale effect, Structural and Dimensional analysis, Buckingham Pi Theorem, Indirect model analysis, Use of Begg's and Eney's Deformeters, Moment indicators, Design of models for direct and indirect analysis, Structural modelling and testing. Computer Implementation of Solution Procedures Implementation of above methods by algorithm development leading to programming in Fortran / C / C++ / Matlab or any other suitable platform. | |

Sr.No.	Text Books
1	Reddy, C. S. Basic Structural Analysis, Tata McGraw-Hill.
2	Wang, C. K. Statically Indeterminate Structures, McGraw-Hill.
3	Chapra, S. C. & Canale, R. P. Numerical Methods for Engineers, Tata McGraw-Hill.
4	Krishnamoorthy, C. S. Finite Element Analysis, Tata McGraw-Hill.

Sr.No.	Reference Books
1	Scheid, F. Numerical Analysis (Schaum's Outline Series), Tata McGraw-Hill.
2	Hetenyi, M. Handbook of Experimental Stress Analysis, John Wiley & Sons.
3	Sienkiewicz, O. C. Finite Element Method in Engineering Science, McGraw-Hill Book Co.
4	Cook, R. D., et al.Concepts and Applications of Finite Element Analysis, John Wiley & Sons (Asia) Pvt. Ltd.

Sr.No.	Web Resources
1	https://nptel.ac.in/
2	https://swayam.gov.in/

Course Title: Advanced Concrete Technology		
Course Code: PD253313		Course Category: OE
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: S Y M.Tech. (Semester III)	ESE	60 Marks

Course Prerequisite: Basics of Materials Science and Construction Materials, Elementary knowledge of Cement–Concrete nomenclature and laboratory testing.

Course Description: This course covers the constituents, production and properties of concrete in fresh and hardened states, mix proportioning methods, admixtures and mineral additives, durability issues and deterioration mechanisms, non-destructive assessment techniques, and special concretes. Emphasis is on linking material behavior to practical mix design, quality control and long-term performance of concrete structures.

Course Objectives:

To make the students aware and understand

1. Provide thorough knowledge of ingredients of concrete (aggregates, cements, admixtures) and their influence on performance.
2. Explain fresh concrete behaviour (workability, mixing, placement, curing) and standard mix-proportioning approaches.
3. Teach mechanical and time-dependent properties of hardened concrete (strength, elasticity, creep, shrinkage).
4. Introduce durability concepts, common deterioration mechanisms (corrosion, ASR, sulphate attack, freeze–thaw) and mitigation strategies.
5. Provide thorough knowledge of Non-destructive test
6. Provide knowledge about special concrete and new techniques used in construction.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Understand the testing of concrete materials as per IS code.	Understand (Level 2)
CO2	Know the procedure to determine the properties of fresh and hardened of concrete.	Understand (Level 2)
CO3	Design the concrete mix using ACI and IS code methods.	Apply (Level 3)
CO4	Select and Design special concretes depending on their specific applications.	Apply & Create (Level 3 & 5)
CO5	Gain ideas on non-destructive testing of concrete	Understand (Level 2)
CO6	Gain ideas on special concrete and new techniques in construction	Understand (Level 2)
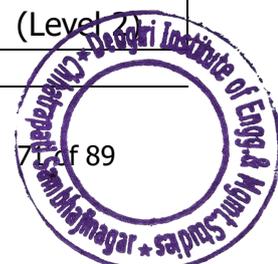
CO-PO-PSO Mapping															
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	1	-	1	2	2	2	-	2	-	2	2	3	-
CO2	3	3	2	-	1	1	2	2	-	2	-	2	2	3	2
CO3	3	3	3	3	2	1	2	2	-	2	2	2	3	3	2
CO4	3	3	3	2	2	1	3	2	-	2	2	2	3	3	2
CO5	3	2	2	3	2	1	2	2	-	2	-	2	2	2	3
CO6	3	2	2	2	2	2	1	2	-	2	-	2	2	3	3

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

| Course Contents		
Unit 1	**Ingredients of concrete** Aggregates: Review of types; sampling and testing; effects on properties of concrete, production of artificial aggregates. Cements: Review of types of cements, chemical composition; properties and tests, chemical and physical process of hydration, Blended cements.	**6 Hrs**
Unit 2	**Properties of fresh concrete** Basics regarding fresh concrete – mixing, workability, placement, consolidation, and curing, segregation and bleeding Chemical Admixtures: types and classification; actions and interactions; usage; effects on properties of concrete. Mineral Admixtures: Fly ash, ground granulated blast furnace slag, met kaolin, rice- husk ash and silica fume; chemical composition; physical characteristics; effects on properties of concrete; advantages and disadvantages. Proportioning of concrete mixtures: Factors considered in the design of mix BIS Method, ACI method.	**6 Hrs**
Unit 3	**Properties of hardened concrete** Strength- compressive tensile and flexure - Elastic properties - Modulus of elasticity - Creep-factors affecting creep, effect of creep - shrinkage- factors affecting shrinkage, plastic shrinkage, drying shrinkage, autogenous shrinkage, carbonation shrinkage.	**6 Hrs**
Unit 4	**Durability of concrete** Durability concept; factors affecting, reinforcement corrosion; fire resistance; frost damage; sulphate attack; alkali silica reaction; concrete in seawater, statistical quality control, acceptance criteria as per BIS code. Non-destructive testing of concrete: Surface Hardness, Ultrasonic, Penetration resistance, Pull- out test, chemical testing for chloride and carbonation- core cutting - measuring	**6 Hrs**

	reinforcement cover	
Unit 5	**Special concretes** Lightweight concrete- description of various types -High strength concrete - Self compacting concrete -Roller compacted concrete – Ready mixed concrete – Fibre reinforced concrete - polymer concrete.	**6 Hrs**
Unit 6	**New Techniques in Constructions** Sprayed concrete; underwater concrete, mass concrete; 3d concrete printing, self-healing concrete.	**6 Hrs**

Sr.No.	Text Books
1	Neville A.M., "Properties of Concrete", Trans-Atlantic Publications, Inc.; 5e, 2012
2	Job Thomas., "Concrete Technology", Cenage learning
3	R. Santhakumar„ Concrete Technology", Oxford Universities Press, 2006
4	Shetty M. S., Concrete Technology", S. Chand & Co., 2006

Sr.No.	Reference Books
1	Mehta and Monteiro, „Concrete-Micro structure, Properties and Materials", McGraw Hill Professional
2	Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education, 2010
3	Lea, Chemistry of Cement and Concrete", Butterworth-Heinemann Ltd, 5e, 2017
4	Bungey, Millard, Grantham – Testing of Concrete in Structures- Taylor and Francis, 2006

Sr.No.	Web Resources
1	https://nptel.ac.in/
2	https://swayam.gov.in/

Sr.No.	IS Codes
1	IS:10262(2009) CONCRETE MIX PROPORTIONING - GUIDELINES
2	IS:456 (2009), Plain and Reinforced Concrete
3	IS 4926: 2003 Code of Practice Ready-Mixed Concrete
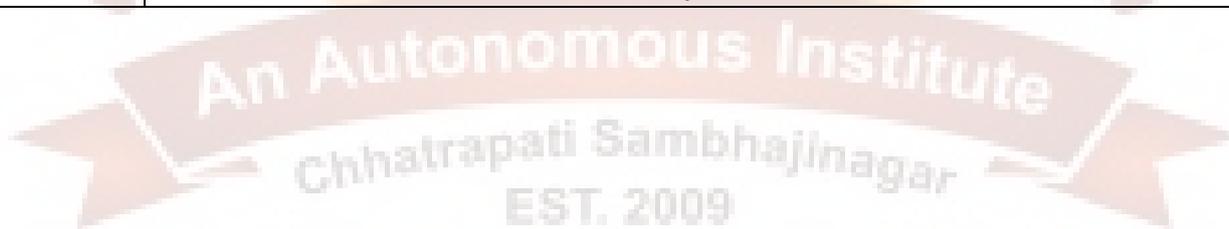
| Course Title: Student Psychology		
Course Code: PD253201		Course Category: MDM
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: S Y M.Tech. (Semester III)	ESE	60 Marks

Course Prerequisite: Basic understanding of the teaching–learning process and general classroom practices. Fundamental knowledge of human behavior gained through prior schooling or introductory education courses, Ability to read and interpret simple educational concepts, case studies, and examples, Interest in understanding learners, their developmental stages, and common classroom problems, Basic communication skills to participate in discussions, counseling activities, and practical exercises.

Course Description: This course provides a comprehensive understanding of learner behavior, development, and the psychological principles that support effective teaching. Through six structured modules, students explore the foundations of educational psychology, characteristics and problems of learners, the use of psychological tests, cognitive and developmental processes, and essential counseling skills. The course equips future educators, counselors, and professionals with the knowledge and tools needed to identify student needs, address behavioral and emotional challenges, and enhance the overall teaching–learning environment. Emphasis is placed on practical application, motivation strategies, and basic counseling methods, including an introduction to Neuro-Linguistic Programming (NLP).

Course Objectives:

To make the students aware and understand

1. Understand the basic principles of educational psychology.
2. Identify student characteristics and learning differences.
3. Recognize and address common student problems.
4. Use psychological tests and motivation techniques effectively.
5. Explain cognitive, emotional, and social development in learners.
6. Apply basic counselling skills and NLP strategies in educational settings.

| Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Describe key concepts of educational psychology and their role in teaching–learning.	Understand (Level 2)
CO2	Identify learner characteristics and factors affecting student behavior.	Understand (Level 2)
CO3	Analyze common academic and behavioral problems among students.	Analyze (Level 3)
CO4	Apply psychological tests and motivation strategies in educational settings.	Apply / (Level 3)
CO5	Explain stages of cognitive, emotional, and social development in	Understand
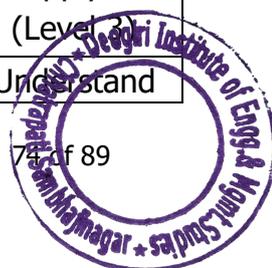
			(Level 2)
CO6	Demonstrate basic counseling skills and use NLP techniques to support students.	Apply (Level 3)	

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	–	–	2	–	–	–	–	–	–	–	-	–	-
CO2	3	3	-	–	2	–	–	–	–	–	–	–	3	–	-
CO3	3	3	2	-	2	–	–	2	–	2	–	-	-	2	-
CO4	3	2	3	2	3	–	–	–	–	–	–	–	2	–	2
CO5	3	3	2	-	2	–	–	–	–	–	–	-	-	3	-
CO6	3	3	3	2	3	–	–	–	–	–	–	-	2	–	3

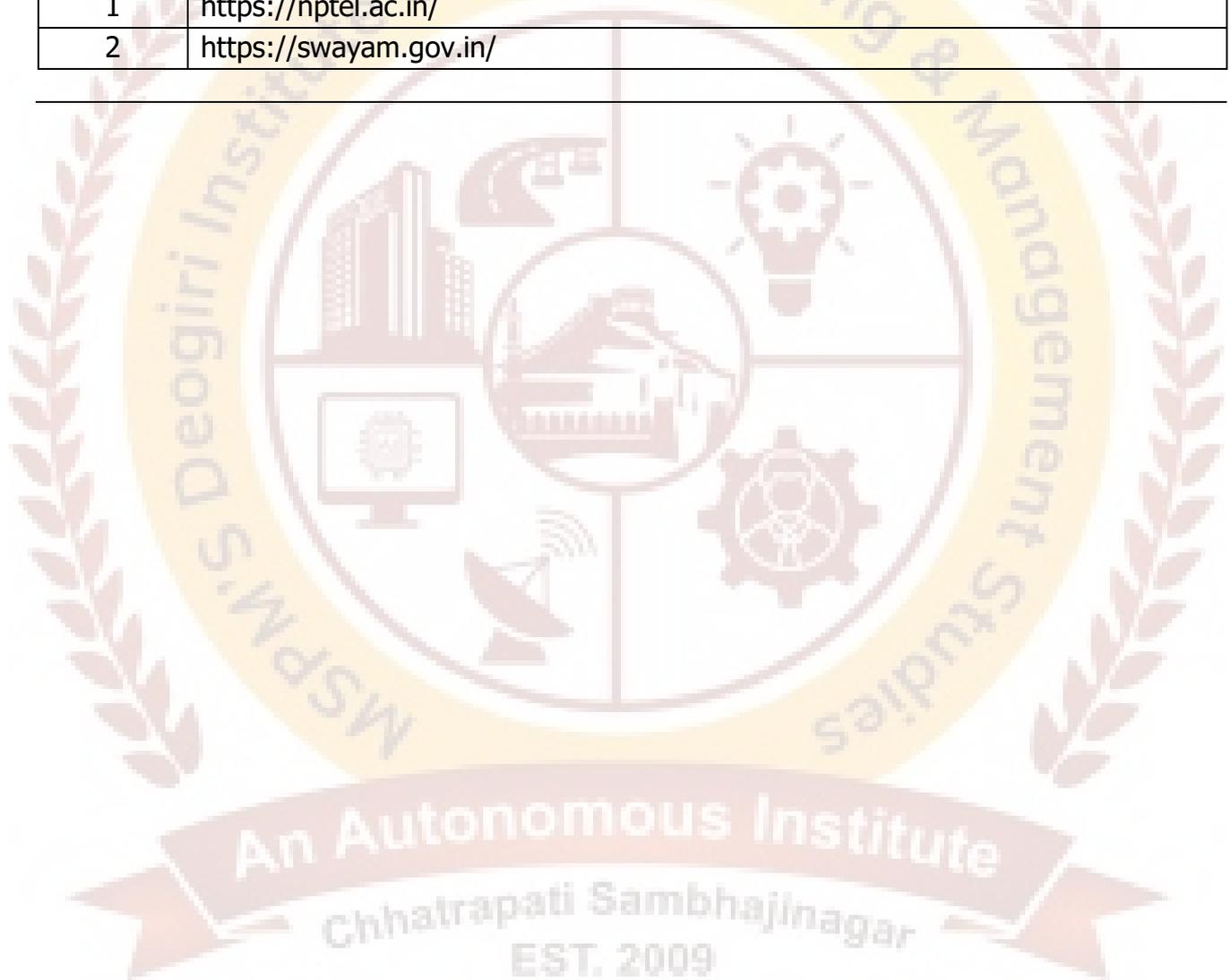| Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction to Educational Psychology:** Meaning, scope, and importance of educational psychology, Role of teachers and learners, Teaching–Learning process and influencing factors	**6 Hrs**
Unit 2	**Student Characteristics:-** Types of learners, Individual differences, Student behaviour patterns and learning styles	**6 Hrs**
Unit 3	**Student Problems:** Academic, emotional, behavioural, and social problems, Identification of student difficulties, Classroom management related to student issues	**6 Hrs**
Unit 4	**Psychological Tests & Motivation:** Types of psychological tests and inventories, Use of tests for assessment and guidance, Student motivation and motivational strategies	**6 Hrs**
Unit 5	**Cognitive & Developmental Psychology:** Physical and cognitive development, Emotional and social development, Impact of developmental stages on learning	**6 Hrs**
Unit 6	**Counseling Skills & NLP:** Basics of counselling and communication skills, Counselling techniques for student support, Introduction to Neuro-Linguistic Programming (NLP), Summary and integration of all modules	**6 Hrs**

Sr.No.	Text Books
1	Woolfolk, A. (2013). Educational Psychology. New Delhi: Pearson Education..
2	Mangal, S.K. (2012). Educational Psychology. Ludhiana: Prentice Hall India.
3	Passi, B.K. (2001). Advanced Educational Psychology. Delhi: Anmol Publications.
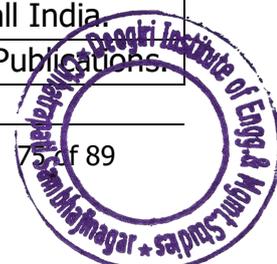
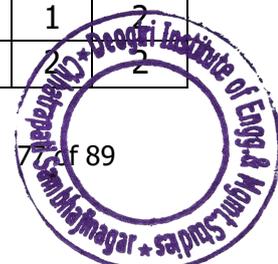| Sr.No.	Reference Books
1	Hurlock, E.B. (2001). Child Development. New Delhi: McGraw-Hill.
2	Bhatia, H.R. (2005). Psychology for Teachers. Delhi: Doaba House.
3	Nabhi, R.K. (2004). Counselling Skills and Techniques. Delhi: R.K. Publications.
4	O'Connor, J., & Seymour, J. (1990). Introduction to NLP. London: Thorsons.
5	Santrock, J.W. (2011). Developmental Psychology. New Delhi: Tata McGraw-Hill.
6	Sharma, R.A. (2007). Training Technology. Meerut: Surya Publications.
7	Mukhopadhyay, B. (1997). Motivation in Educational Management. New Delhi: Sterling Publishers.

Sr.No.	Web Resources
1	https://nptel.ac.in/
2	https://swayam.gov.in/

Course Title: Sustainable Power Generation System		
Course Code: PD253202		Course Category: MDM
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: S Y M.Tech. (Semester III)	ESE	60 Marks

Course Prerequisite: Thermodynamics and Heat Transfer, Basic Electrical Engineering Concepts, Basic knowledge of environmental science and the principles of sustainability, with a focus on the impact of energy systems on the environment, Familiarity with fluid dynamics and mechanical systems, especially in the context of wind turbines, hydroelectric power generation, and other renewable energy systems.

Course Description: This course provides an introduction to renewable power generation systems, including solar, wind, hydroelectric, and bioenergy. Students will explore various sustainable power generation technologies, their design, operation, and integration into existing power grids, while focusing on their environmental and economic impacts.

Course Objectives:To make the students aware and understand

1. Introduce renewable power generation systems and their environmental benefits.
2. Understand the design and working principles of various renewable energy technologies.
3. Analyze the integration of renewable systems into the power grid.
4. Evaluate the sustainability and environmental impacts of different energy systems.
5. Equip students with the skills to design, optimize, and implement sustainable energy systems for real-world applications.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Understand the principles of sustainability and the global energy transition.	Remember (Level 1)
CO2	Identify and assess various renewable energy technologies, such as solar, wind, hydro, geothermal, and biomass.	Understand (Level 2)
CO3	Design and analyze the potential for power generation from renewable sources.	Apply (Level 3)
CO4	Compare and contrast the advantages and limitations of conventional and sustainable energy technologies.	Analyze (Level 4)
CO5	Analyze the environmental, social, and economic impacts of renewable energy systems and evaluate their contributions to mitigating climate change.	Analyze (Level 4)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	2	2	2	1	1	-	-	-	-	1	1	2
CO2	3	3	3	2	2	2	2	1	-	-	-	-	2	2	2

CO3	3	3	3	3	3	3	3	2	-	-	-	-	2	2	2
CO4	3	3	3	2	3	2	2	1	-	-	-	-	2	1	2
CO5	3	2	3	2	2	2	2	1	-	-	-	-	3	2	2

Assessment	
CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents		
Unit 1	**Introduction to power generation** Global and Indian Context: An Examination of Current Power Generation Technologies and Renewable Energy Concepts Introduction to Renewable Energy-Based Power Plants Solar Thermal Power Generation: Exploring the Basics of Solar Thermal Energy Conversion, Design, and Analysis of Solar Thermal Power Plants (including flat plate and concentrator technologies), Overview of Organic Rankine Cycle (ORC), Rankine Cycle (RC), and Stirling Engine Applications.	6 Hrs
Unit 2	**Solar Photovoltaic Power Generation** Solar Photovoltaic (PV) Energy Conversion: Understanding PV Fundamentals, PV Power Plant Design, Performance Analysis of Standalone and Grid-Connected PV Systems. Wind Power Generation: Introduction to Wind Turbines, Component Classification and Analysis, Design and Theory of Wind Turbines (Horizontal and Vertical Axis), and Wind Farm Analysis.	6 Hrs
Unit 3	**Hydro Power Generation** 00Hydropower Plants: Introduction to Hydro Power Plants, Micro, Mini, and Small Hydro Plants, Hydraulic Turbines, Selection and Design Criteria for Pumps and Turbines, Brief Theory, Design, and Analysis of Hydro Power Plants. Biomass Power Generation: Fundamentals of Bioenergy Production Technologies, Design and Analysis of Biochemical and Thermochemical Reactors for Clean Power Generation and Value-Added Products, Introduction to Integrated Gasification Combined Cycle (IGCC).	6 Hrs
Unit 4	**Hydrogen energy and fuel cells** Hydrogen Generation: Importance and Various Generation Routes, Basic Principles and Design of Fuel Cells, Applications, Prospects, and Introduction to Integrated Gasification Fuel Cell (IGFC). Geothermal Energy: Fundamentals, Classification, Theory, Design, and Analysis of Geothermal Power Plants.	7 Hrs
Unit 5	**Ocean Thermal Energy** Ocean thermal power plant principles, categorization, theory, design, and analysis Tidal and Wave Energy, Understanding the	5 Hrs

	Fundamentals, Classification, Theory, Design, and Analysis of Wave and Tidal Power Plants. Energy Storage,	
Unit 6	**Energy Storage Technologies**: Overview of Thermal, Mechanical, and Electrochemical Energy Storage Systems; Design and Analysis of Various Storage Technologies. Energy Economics Cost Analysis, Financial Metrics (Interest, Accounting Rate of Return, Payback, Discounted Cash Flow, Net Present Value, Internal Rate of Return), Inflation, and Life Cycle Analysis for Energy Systems	**5 Hrs**

Sr.No.	Text Books
1	J. Twidell, T. Weir, Renewable Energy Resources, Taylor and Francis, 4th Edition, 2021
2	G. Boyle (Editor), Renewable Energy: Power for a Sustainable Future, Oxford University press
3	G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.

Sr.No.	Reference Books
1	J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 4th Edition
2	R. Gasch, J. Twele, Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer, 2nd Edition, 2012
3	P. Breeze, Hydropower, Elsevier, 1st Edition, 2018.
4	S. C. Bhattacharyya, Energy Economics Concepts, Issues, Markets and Governance, springer, 2nd Edition, 2019
5	S.P. Sukhatme and J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata Mc-Graw Hill Education Private Limited, 3rd Edition, 2010.

Sr.No.	Web Resources
1	NPTEL, https://onlinecourses.nptel.ac.in/noc23_ge47/preview

| Course Title: Intellectual Property & Rights	
Course Code: PD253203	Course Category: MDM

Teaching Scheme	Examination Scheme	
Lectures: 03 hrs/ week	CA-1	10 Marks
Tutorial: -----	CA-2	10 Marks
Credits: 03	MSE	20 Marks
Semester: S Y M.Tech. (Semester III)	ESE	60 Marks

Course Prerequisite: :   Students should have a basic understanding of legal concepts, along with foundational knowledge in the student's academic discipline. Familiarity with research methods and good communication skills are also recommended to help students grasp the principles of intellectual property, innovation, and related legal processes.

Course Description: This course intends to provide students a comprehensive knowledge on the Intellectual Property & Rights. The course focuses on the six topics shown in detailed syllabus.

Course Objectives:

To make the students aware and understand

1. To introduce the fundamental concepts, nature, and importance of Intellectual Property Rights (IPR) and their international framework under TRIPS and WTO
2. To understand various forms of intellectual property such as patents, copyrights, trademarks, designs, and geographical indications
3. To explain the procedures for registration, rights and duties of owners, and legal remedies in cases of infringement.
4. To acquaint students with the legal provisions of the Information Technology Act, 2000, and issues related to cyber laws and e-governance.
5. To develop awareness of contemporary challenges and ethical issues in protecting intellectual property in the digital era.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Explain the meaning, scope, and significance of Intellectual Property Rights and their international context under TRIPS and WTO.	Understand (Level2)
CO2	Identify and differentiate between various types of intellectual property such as patents, copyrights, trademarks, and designs.	Understand (Level2)
CO3	Describe the processes for registration, licensing, assignment, and enforcement of IPRs along with the legal remedies for infringement	Understand (Level2)
CO4	Analyze the key provisions of the Information Technology Act, 2000, and their implications for e-commerce, e-governance, and cybercrimes.	Analyze (Level2)
CO5	Apply the knowledge of IPR laws and practices to protect innovations, creative works, and digital assets ethically and legally	Apply (Level4)
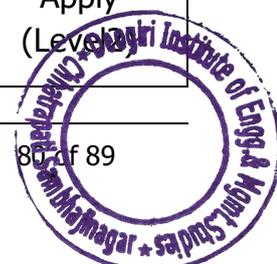
CO-PO-PSO Mapping

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	-	-	3	3	3	-	3	3	3	-	3	-	3	3
CO2	3	2	-	3	3	3	-	3	3	3	-	3	2	-	2
CO3	2	-	2	3	2	3	-	2	2	3	-	3	-	-	2
CO4	3	-	-	3	3	3	-	3	3	2	-	2	-	2	3
CO5	3	-	-	3	3	3	-	3	3	2	-	2	-	-	3

Assessment

CA-1 (a) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
CA-2 (b) (10 Marks)	Subjective Test/Course Project/Assignments/Presentation
MSE (c) (20 Marks)	Subjective Test

Course Contents

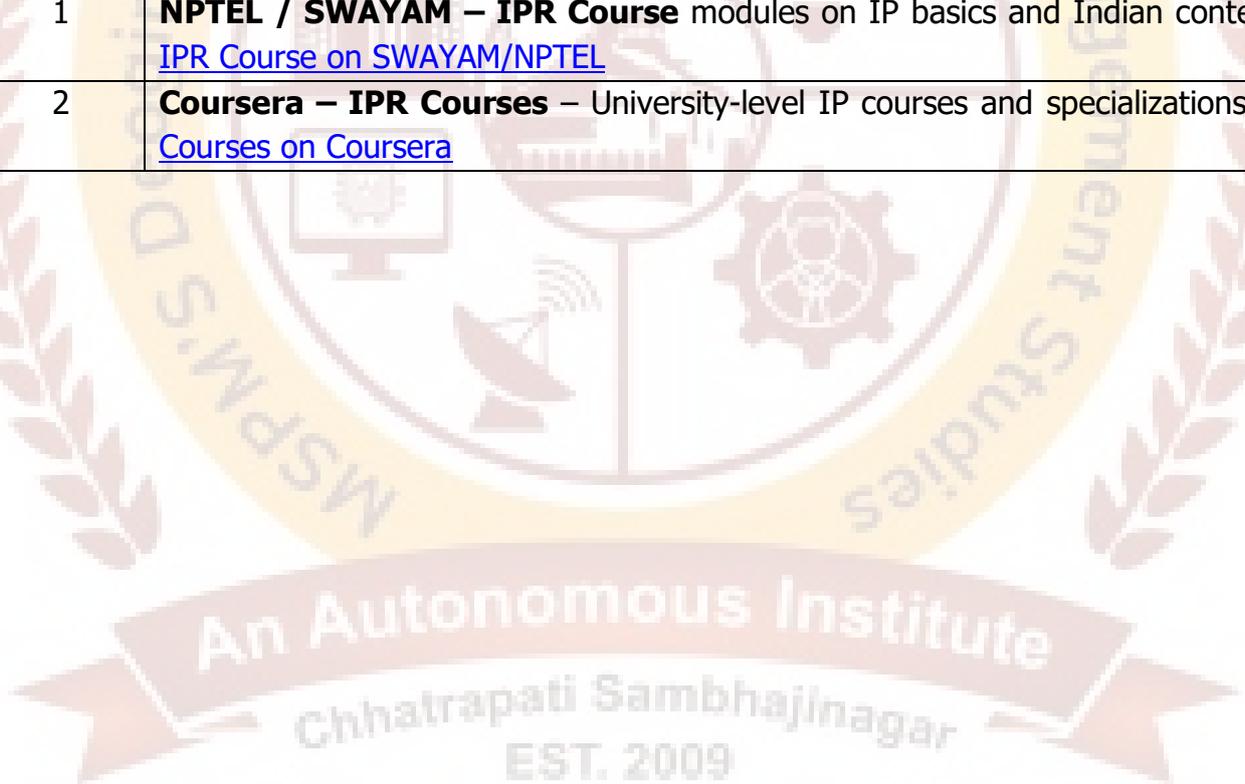|		
Unit 1	Introduction to IPR: Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights, Introduction to TRIPS and WTO, Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade; Secret and trade dress, Design, Layout Design, Geographical Indication, Plant. Varieties and Traditional Knowledge.	6 Hrs
Unit 2	Patent Rights and Copy Rights— Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.	6 Hrs
Unit 3	Copy Right—Origin, Definition &Types of Copy Right, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.	6 Hrs
Unit 4	Trade Marks: Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space.	6 Hrs
Unit 5	Design- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.	6 Hrs
Unit 6	Basic Tenants of Information Technology Act-2000, IT Act - Introduction, E-Commerce and legal provisions, E- Governance and legal provisions, Digital signature and Electronic Signature. Cybercrimes.	6 Hrs

Sr.No.	Text Books
1	Guidebook to Intellectual Property by Sir Robin Jacob
2	Intellectual Property Rights by Asha Vijay Durafe & Dhanashree K. Toradmalle –
3	Intellectual Property Rights: Protection and Management by N. K. V. Nithyananda
4	Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets by Deborah E. Bouchoux
5	Introduction to Intellectual Property Rights by Phundan Singh

| Sr.No.	Reference Books
1	V. K. Ahuja – Law Relating to Intellectual Property Rights
2	Narayanan P. – Intellectual Property Law
3	**Cornish, Llewelyn & Aplin –** Intellectual Property: Patents, Copyrights, Trade Marks and Allied Rights
4	Kompal Bansal & Parishit Bansal – Fundamentals of IPR for Engineers
5	Prabhuddha Ganguli – Intellectual Property Rights: Unleashing the Knowledge Economy

Sr.No.	Web Resources
1	**NPTEL / SWAYAM – IPR Course** modules on IP basics and Indian context. IPR Course on SWAYAM/NPTEL
2	**Coursera – IPR Courses** – University-level IP courses and specializations IP Courses on Coursera

Course Title: Project-I	
Course Code: PD253603	**Course Category: EL**

Teaching Scheme	Examination Scheme	
Practical's/Sessions: 10 Hours/Week	CA-1	25 Marks
Credits: 10	CA-2	25 Marks
Semester: S Y M.Tech. (Semester III)	ESE	50 Marks

Course Prerequisite: Basic understanding of core subjects in specialization, Ability to access, and interpret scientific literature, Exposure to technical report writing and presentation.

Course Description: Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/SRS/UML/ERD/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work; the candidate shall deliver a presentation on progress of the work on the selected dissertation topic. The student shall submit the duly certified progress report of project - I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Course Objectives:
1. To enable students to identify and define a research/industrial problem.
2. To develop skills for conducting a comprehensive literature review.
3. To formulate objectives, scope, and methodology for the proposed work.
4. To strengthen technical writing, presentation, and project planning skills.
5. To prepare a well-structured project synopsis in line with research/industry requirements.

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Identify and define a research/engineering problem relevant to the specialization.	Apply (Level-3)
CO2	Perform a critical literature review and identify research gaps.	Analyze (Level-4)
CO3	Formulate clear objectives, scope, and methodology for the project proposal.	Evaluate (Level-5)
CO4	Develop project planning with milestones, deliverables, and resources.	Apply (Level-3)
CO5	Prepare and present a structured project proposal/synopsis effectively in written and oral formats.	Create (Level-6)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	2	-	-	-	-	1	1	2	2	2	2		
CO2	2	1	2	1	-	-	-	1	1	2	3	2	2		3
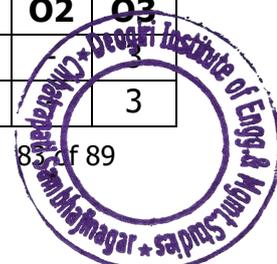
CO3	2	2	3	2	1	-	-	1	1	2	3	2	3	1	3
CO4	1	1	2	3	2	-	-	1	3	2	2	2	3	1	2
CO5	1	1	2	1	1	-	-	2	3	3	3	1	2	-	3

Course Contents
Students can take Industry Internship along with Project –I. Students must maintain regular reporting with Dissertation supervisor regarding status of Project –I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work; the candidate shall deliver a presentation on progress of the work on the selected dissertation topic. It is desired to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall submit the duly certified progress report of project -I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Assessment
Project-I will have internal marks of 50 and a Semester-end examination of marks 50. Semester end examination will be conducted by a committee consisting of three faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department, before the committee. Students individually will present their work before the committee. The committee will evaluate the students individually and marks shall be awarded as follows.

CA-I (a) (25 M)	Review-I: 25 Marks (Concept/knowledge in the topic = 10 marks, Literature-05 marks)
CA-II (b) (25 M)	Review-II: 25 Marks (Report writing & Presentation =25 Marks)
Practical/ viva voce (c) (50M)	50 Marks (Individual evaluation through viva voce / test (50marks)
Total (d) (100 M)	100 Marks

Course Title: Project-II		
Course Code: PD254604		Course Category: EL
Teaching Scheme	**Examination Scheme**	
Practical's/Sessions: 20 Hours/Week	CA-1	50 Marks
Credits: 20	CA-2	50 Marks
Semester: S Y M.Tech. (Semester IV)	ESE	100 Marks

Course Prerequisite: Basic understanding of core subjects in specialization, Ability to access, and interpret scientific literature, Exposure to technical report writing and presentation.

Course Description: M.Tech Project–II (Dissertation) is a culmination of the postgraduate program where students demonstrate their ability to independently identify, formulate, and solve research or industry-oriented engineering problems. The dissertation involves systematic literature review, problem definition, research methodology, experimentation/simulation, result analysis, and formulation of conclusions. The course aims to develop research aptitude, technical depth, and professional presentation skills aligned with the Program Outcomes (POs).

Course Objectives:
1. To enable students to undertake independent research or applied problem-solving in their domain.
2. To develop analytical and experimental skills through design, simulation, or experimental validation.
3. To strengthen technical communication through research publications and dissertation writing.
4. To encourage innovative thinking, ethical research practices, and professional responsibility.

Course Outcomes:		
Cos	**After completion of the course: Student should be able to**	**Bloom's Level**
CO1	Formulate and define research problem with appropriate objectives and scope.	Apply (Level-3)
CO2	Critically review and analyze literature to identify research gaps.	Analyze (Level-4)
CO3	Develop methodology / experimental/ simulation framework for problem- solving.	Evaluate (Level-5)
CO4	Conduct experiments/simulations and analyze results with proper validation.	Apply (Level-3)
CO5	Prepare dissertation and communicate technical findings effectively.	Create (Level-6)

CO-PO-PSO Mapping														
Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PSO 3**
CO1	2	2	3	1	-	-	1	1	1	2	3	2	3	1	3
CO2	2	2	2	1	-	-	1	1	1	2	3	2	3	1	3
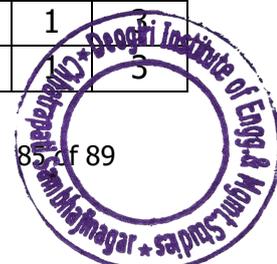
CO3	3	3	3	2	1	-	1	1	1	2	3	2	3	2	3
CO4	3	3	3	2	1	-	1	1	1	2	3	2	3	2	3
CO5	1	1	2	1	1	-	1	3	3	3	3	1	2	1	3

Course Contents

In Project - II, the student shall complete the remaining part of the project, which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions. It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Assessment

Project-II will have internal marks 100 and Semester-end examination marks 100.
Internal examination will be conducted by a committee consisting of five faculty members. The students are required to bring the report completed in all respects duly authenticated by the respective guide and head of the department, before the committee. Students individually will present their work before the committee. The committee will evaluate the students individually and internal marks shall be awarded as follows.

CA-I (a) (25M)	Review-I: 25 Marks
CA-II (b) (25M)	Review-II: 25 Marks
Guide Evaluation (c) (50M)	50 Marks
External Examination Marks:	
DPAC Evaluation (d) (30M)	30 Marks
External examiner evaluation (e) (22 M)	20 Marks
Guide Evaluation (f) (50M)	50 Marks
Total (a to f)	200 Marks

Course Title: Communication Skill and Technical Writing		
Course Code: PG254701		Course Category: CC
Teaching Scheme	**Examination Scheme**	
Lectures: 02 hrs/ week	CA-1	25 Marks
Tutorial: -----	CA-2	25 Marks
Credits: AU	MSE	-
Semester: S Y M.Tech. (Semester IV)	ESE	-

Course Prerequisite: : Basic English composition or introductory technical communication; familiarity with engineering fundamentals

Course Description: This course equips engineering students with essential communication skills for professional and academic success, focusing on technical writing and oral presentations. Students learn to craft clear, concise technical reports, research proposals, and documentation, as well as deliver effective presentations tailored to engineering. Topics include audience analysis, research document structure, visual aids, professional correspondence, and ethical communication. Through hands-on practice for drafting technical research papers, peer reviews, and research projects, students would be able to apply skills to real-world engineering contexts, such as presenting research. The course prepares students for thesis work, industry reports, and collaborative engineering environments.

Course Objectives:

To make the students aware and understand

1. Understand the principles, structure, and ethical conventions of research writing to support effective documentation in engineering applications.
2. Formulate research problems and develop structured technical documents, including abstracts, introductions, and methodologies, for engineering contexts.
3. Apply data collection and analysis techniques, such as questionnaires and observation methods, to enhance research writing for engineering projects.
4. Produce professional correspondence and technical papers formatted for submission to engineering platforms

Course Outcomes:		
Cos	**After completion of the course:** **Student should be able to**	**Bloom's Level**
CO1	Explain the principles and conventions of research writing, including its purpose, structure, and ethical considerations, to support engineering applications.	Understand (Level 2)
CO2	Formulate research problems and structure technical documents.	Creating (Leve 6)
CO3	Apply data collection and analysis techniques, including questionnaire design and observation methods, to support research writing in engineering projects.	Applying (Level 3)
CO4	Produce professional correspondence and prepare technical papers for submission to engineering platforms	Creating (Level 6)

CO-PO-PSO Mapping

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	1	-	-	-	2	2	3	-	2	-	2	3	2	-
CO2	2	3	2	2	1	1	2	2	-	2	1	2	3	-	-
CO3	2	2	2	3	2	1	2	1	1	1	1	1	3	-	-
CO4	-	1	1	1	2	2	1	1	2	3	1	2	-	-	3

Assessment

CA-1 (a)	Paper writing/ Presentations
CA-2 (b)	Paper publication /Paper submission

Course Contents

Unit 1	**Fundamentals of Research Writing** Introduction to research writing - Knowing the details of research writing - Planning the purpose and material - Practicing for the audience and content delivery. Different Methods in Research Writing Nature and meaning of research methods - Types of research - pure and applied research - Types of communication research – Quantitative, Qualitative and Rhetorical - Questionnaire and observation methods - Data collection and data analysis - Thesis/Synopsis writing - Structure and importance	6 Hrs
Unit 2	**Mechanics and Conventions of Research Writing** Research writing in broader spectrum - The tone -The language - Conventions of research – Evidence-based arguments - Thesis-driven analysis – Complexity and higher- order thinking. Components of Research Writing: Formatting a research paper – Title page – Abstract – Introduction – Methodology – Conclusion – Proof reading – Citing sources	4 Hrs
Unit 3	**Communication and Communication Processes** Introduction to Communication, Forms and functions of Communication, Barriers to Communication and overcoming them, Verbal and Non-verbal Communication **Reading Skills:** Introduction to Reading, Types of Readers and Reading, Barriers to Reading, Strategies for Reading, Comprehension. **Listening Skills**: Importance of Listening, Types of Listening, Barriers to Listening. **Speaking & Verbal & Non-verbal Communication**: Use of Language in Spoken Communication, Principles and Practice of Group Discussion, Public Speaking (Addressing Small Groups and Making Presentation), Interview Techniques, Appropriate Use of Non-verbal Communication, Presentation Skills, Extempore, Elocution.	6 Hrs
Unit 4	**Professional Correspondence:**	7 Hrs

	Writing emails, memos, and cover letters for engineering contexts	
Unit 5	**Technical Paper Submission Platforms for Engineering:** IEEE Xplore (Journals and Conferences), Elsevier Journals (ScienceDirect), Springer Journals etc	**2 Hrs**

Sr.No.	Text Books
1	Hamlin, A., Rubio, C., & DeSilva, M. (2017). Technical Writing. Open Oregon Educational Resources.
2	Intellectual Property Rights by Asha Vijay Durafe & Dhanashree K. Toradmalle –
3	Intellectual Property Rights: Protection and Management by N. K. V. Nithyananda
4	Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets by Deborah E. Bouchoux
5	Introduction to Intellectual Property Rights by Phundan Singh

Sr.No.	Reference Books
1	V. K. Ahuja – Law Relating to Intellectual Property Rights
2	Narayanan P. – Intellectual Property Law
3	Cornish, Llewelyn & Aplin – Intellectual Property: Patents, Copyrights, Trade Marks and Allied Rights
4	Kompal Bansal & Parishit Bansal – Fundamentals of IPR for Engineers
5	Prabhuddha Ganguli – Intellectual Property Rights: Unleashing the Knowledge Economy

Sr.No.	Web Resources
1	Course on SWAYAM/NPTEL
2	IP Courses on Coursera