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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No	Course Code	Course Name	Category	Hours Per Week			Credits
				L	T	P	
1.	25A120101	Advanced Structural Analysis	PC	3	0	0	3
2.	25A120102	Theory of Elasticity	PC	3	0	0	3
3.		**Program Elective – I**	PE	3	0	0	3
	25A120103a	Fracture Mechanics					
	25A120103b	Advanced Concrete Technology					
	25A120103c	Advanced Mathematical Methods					
4.		**Program Elective – II**	PE	3	0	0	3
	25A120104a	Advanced Reinforced Concrete Design					
	25A120104b	Experimental Stress Analysis					
	25A120104c	Precast And Prefabricated Structures					
5.	25A120105	Advanced Concrete Laboratory	PC	0	0	4	2
6.	25A120106	Computer Aided Design Laboratory	PC	0	0	4	2
7.	25A1RM101	Research Methodology and IPR	MC	2	0	0	2
8.	25A120107	**Skill Enhancement Course** Artificial Intelligence and Applications in Civil Engineering	SE	2	0	0	2
9.		**Audit Course – I**	AC	2	0	0	0
	25A1AC101a	English for Research Paper Writing					
	25A1AC101b	Disaster Management					
	25A1AC101c	Essence of Indian Traditional Knowledge					
TOTAL							**20**

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SEMESTER – II

S. No	Course Code	Course Name	Category	Hours Per Week			Credits
				L	T	P	
1.	25A120201	Structural Dynamics	PC	3	0	0	3
2.	25A120202	Stability of Structures	PC	3	0	0	3
3.		**Program Elective – III**	PE	3	0	0	3
	25A120203a	Finite Element Methods for Structural Engineering					
	25A120203b	Advanced Steel Structures Design					
	25A120203c	Theory of Plates and Shells					
4.		**Program Elective – IV**	PE	3	0	0	3
	25A120204a	Design of Prestressed Concrete					
	25A120204b	Design of Bridges					
	25A120204c	Structural Health Monitoring					
5.	25A120205	Advanced Structural Engineering Laboratory	PC	0	0	4	2
6.	25A120206	Advanced Structural Analysis and Design Laboratory	PC	0	0	4	2
7.	25A158207	Quantum Technologies and Applications	MC	2	0	0	2
8.	25A120207	Comprehensive Viva Voce	PC	0	0	0	2
9.		**Audit Course – II**	AC	2	0	0	0
	25A1AC201a	Pedagogy Studies					
	25A1AC201b	Personality Development Through Life Enlightenment Skills					
	25A1AC201c	Yoga For Stress Management					
TOTAL							**20**

****Students must undergo an Industry Internship after I Year II Semester for a duration of 6 to 8 weeks that will be evaluated in III semester.**

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI
Semester – III

S. No	Course Code	Course Name	Category	Hours Per Week			Credits
				L	T	P	
1.		**Program Elective – V**	PE	3	0	0	3
	25A120301a	Earthquake Resistant Design of Structures					
	25A120301b	Rehabilitation and Retrofitting of Structures					
	25A120301c	Design of Tall Buildings					
2.		**Open Elective – I**	OE	3	0	0	3
	25A120302	Green Buildings					
3.	25A120303	Dissertation Phase – I	PR	0	0	20	10
4.	25A120304	Industry Internship		0	0	0	2
5.	25A120305	Co-Curricular Activities		0	0	0	1
TOTAL							**19**

Open Elective- I

S. No	Course Code	Course Name	Offered by the Dept.
1	25A158101	Advanced Data Structures & Algorithms	CSE and allied branches
2	25A158305	Cloud Computing	
3	25A158306	AI Tools	
4	25A185302	IoT and its Applications	ECE
5	25A107302	Photovoltaic Systems	EEE
6	25A115302	Integrated Product Design and Development	ME
7	25A1OE59a	Advanced Numerical Methods and Computational Mathematics	Mathematics
8	25A1OE59b	Mathematics for Machine Learning and Data Science	
9	25A1OE59c	Statistical Learning Theory and Mathematical Foundations of AI	
10	25A1OE59d	Chemistry Of Nanomaterials and Applications in Engineering	Chemistry
11	25A1OE59e	Photonics For Engineers	Physics

Semester – IV

S. No	Course Code	Course Name	Category	Hours Per Week			Credits
				L	T	P	
1.	25A120401	Dissertation Phase – II	PR	0	0	32	16
TOTAL							**16**

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Course Code	ADVANCED STRUCTURAL ANALYSIS	L	T	P	C
25A120101		3	0	0	3
Semester		I			

Course Objectives: This Course objectives are:

- To introduce the fundamentals of matrix methods for structural analysis, including degrees of freedom, coordinate systems, and structure idealization.
- To develop knowledge of stiffness and flexibility matrices for different structural elements and coordinate transformations.
- To impart skills in assembling global stiffness matrices and applying the direct stiffness method.
- To provide the ability to analyze plane trusses, beams, and frames using stiffness and flexibility methods.
- To familiarize students with special analysis procedures including static condensation, sub structuring, and evaluation of initial and thermal stresses.

Course Outcomes (CO): After the completion of the course, the student will be able to

- Explain matrix methods, element stiffness/flexibility equations, and coordinate transformations for structural analysis.
- Assemble global stiffness matrices from element matrices and apply the direct stiffness method to structural systems.
- Analyze plane trusses, continuous beams, and single-storey/single-bay frames using flexibility methods.
- Analyze complex plane frames, grids, and multi-storey structures using stiffness methods.
- Apply special analysis procedures such as static condensation, sub structuring, and evaluation of initial and thermal stresses in structural systems.

UNIT – I

Introduction To Matrix Methods of Analysis - Statical Indeterminacy and Kinematical Indeterminacy - Degree of Freedom - Coordinate System - Structure Idealization Stiffness and Flexibility Matrices - Suitability Element Stiffness Equations - Elements Flexibility Equations - Mixed Force - Displacement Equations - For Truss Element, Beam Element and Torsional Element. Transformation Of Coordinates - Element Stiffness Matrix - And Load Vector - Local and Global Coordinates.

UNIT – II

Assembly Of Stiffness Matrix from Element Stiffness Matrix - Direct Stiffness Method - General Procedure - Banded Matrix - Semi Bandwidth - Assembly by Direct Stiffness Matrix Method.

UNIT – III

Analysis Of Plane Truss - Continuous Beams with And Without Settlement - Plane Frame Including Side Sway Single Storey, Single – Bay and Gable Frame by Flexibility Method Using System Approach.

UNIT – IV

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Analysis Of Plane Truss - Continuous Beams with And Without Settlement - Plane Frame Including Sides Sway, Grids and Gable Frames by Stiffness Methods, Single Bay – Two Storey, Two Bay Single – Storey.
UNIT – V
Special Analysis Procedures - Static Condensation and Sub Structuring - Initial and Thermal Stresses.
Textbooks:
1. Matrix Analysis of Frames Structures by William Weaver J. R And James M.Gere, CBS Publications. 2. Advanced Structural Analysis by Ashok. K.Jain, New Channel Brothers. 3. Matrix Method Of S.A By Pandit &Gupta
Reference Books:
1. Matrix Structural Analysis by Madhu B. Kanchi. 2. Matrix Methods Of Structural Analysis By J.Meek. 3. Structural Analysis by Ghali and Neyveli. 4. Structural Analysis by Devdas Menon, Narosa Publishing Housing Pvt Ltd.

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Course Code	THEORY of ELASTICITY	L	T	P	C
25A120102		3	0	0	3
Semester		I			

Course Objectives: This Course objectives are:

- To introduce the fundamentals of plane stress and plane strain, elasticity concepts, and governing equations.
- To develop skills in solving two-dimensional elasticity problems in rectangular coordinates using analytical methods.
- To impart knowledge of two-dimensional elasticity problems in polar coordinates, including symmetric and asymmetric cases.
- To provide understanding of three-dimensional stress and strain analysis, principal stresses, and general equilibrium and compatibility theorems.
- To familiarize students with torsion of prismatic bars, energy methods, and practical solutions for shafts, tubes, and other structural members.

Course Outcomes (CO): After the completion of the course, the student will be able to

- Explain plane stress, plane strain, elasticity theory, and related differential equations.
- Solve two-dimensional elasticity problems in rectangular coordinates and apply Fourier series for structural analysis.
- Analyze two-dimensional elasticity problems in polar coordinates for symmetric and asymmetric stress distributions.
- Determine three-dimensional stress and strain states, principal stresses, maximum shear stresses, and apply general theorems of elasticity.
- Apply methods for solving torsion problems in prismatic bars, shafts, and tubes using energy methods and analytical techniques.

UNIT - I

INTRODUCTION TO PLANE STRESS and PLANE STRAIN ANALYSIS:

Elasticity –Notation for Forces and Stresses-Components of Stresses –Components of Strain – Hooke's Law. Plane Stress-Plane Strain-Differential Equations of Equilibrium- Boundary Conditions- Compatibility Equations-Stress Function-Boundary Conditions.

UNIT - II

TWO DIMENSIONAL PROBLEMS in RECTANGULAR COORDINATES:

Solution by Polynomials-Saint Venant's Principle-Determination of Displacements-Bending of Simple Beams-Application of Fourier Series for Two Dimensional Problems - Gravity Loading.

UNIT - III

TWO DIMENSIONAL PROBLEMS in POLAR COORDINATES:

General Equation in Polar Co-Ordinates - Stress Distribution Symmetrical About an Axis – Pure Bending of Curved Bars- Strain Components in Polar Coordinates-Displacements for Symmetrical Stress Distributions-Simple Symmetric and Asymmetric Problems-General

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Solution of Two-Dimensional Problem in Polar Coordinates-Application of The General Solution of Two-Dimensional Problem in Polar Coordinates-Application of The General Solution in Polar Coordinates.

UNIT - IV

ANALYSIS OF STRESS and STRAIN in THREE DIMENSIONS: Principle Stress - Ellipsoid and Stress-Director Surface-Determination of Principle Stresses- Maximum Shear Stresses-Homogeneous Deformation-Principle Axis of Strain Rotation.

General Theorems: Balance Laws - Differential Equations of Equilibrium- Conditions of Compatibility - Determination of Displacement-Equations of Equilibrium in Terms of Displacements-Principle of Superposition-Uniqueness of Solution –The Reciprocal Theorem.

UNIT - V

TORSION OF PRISMATIC BARS:

Torsion of Prismatic Bars- Elliptical Cross Section-Other Elementary Solutions-Membrane Analogy-Torsion of Rectangular Bars-Solution of Torsional Problems by Energy Method-Use of Soap Films in Solving Torsional Problems-Hydra Dynamical Analogies-Torsion of Shafts, Tubes and Bars.

Textbooks:

1. Theory Of Elasticity and Plasticity by Timoshenko, S., MC Graw Hill Book Company.
2. Advanced Strength of Materials by Papoov, MC Graw Hill Book Company.
3. Theory Of Elasticity and Plasticity by Sadhu Singh. Khanna Publishers.

Reference Books:

1. Plasticity For Structural Engineers- Chen, W.F. And Han, D.J., Springer – Verlag, New York.
2. Plasticity Theory, Lubliner, J., Mac Millan Publishing Co., New York.
3. Foundations Of Solid Mechanics By Y.C.Fung, PHI Publications.
4. Advanced Mechanics of Solids by L.S. Srinath, Tata MC Graw Hill Book Company.

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Course Code	FRACTURE MECHANICS	L	T	P	C
25A120103a	(PE-I)	3	0	0	3
Semester		I			

Course Objectives: This Course objectives are:

- To design based on linear elastic fracture mechanics
- To find out the variation of plastic zone over thickness of various elements
- To know about the plane strain and plane stress in slip planes
- To understand the fracture process of concrete and different materials

Course Outcomes (CO): After the completion of the course, the student will be able to

- Acquire basic skills in fracture mechanism of brittle materials
- Apply fracture mechanics theory to calculate stress areas
- Calculate the "energy release rate" around crack tips
- Examine crack growth due to fatigue

UNIT - I

Summary of Basic Problems and Concepts:

Introduction - A Crack in A Structure - The Stress at A Crack Tip - The Griffith Criterion the Crack Opening Displacement Criterion - Crack Propagation - Closure

UNIT - II

The Elastic Crack – Tip Stress Field:

The Airy Stress Function - Complex Stress Functions - Solution to Crack Problems - The Effect of Finite Size - Special Cases - Elliptical Cracks - Some Useful Expressions

UNIT - III

The Crack Tip Plastic Zone:

The Irwin Plastic Zone Correction - The Dugdale Approach - The Shape of The Plastic Zone - Plane Stress Versus Plane Strain - Plastic Constraint Factor - The Thickness Effect

UNIT - IV

The Energy Principle:

The Energy Release Rate - The Criterion for Crack Growth - The Crack Resistance (R Curve) - Compliance, The J Integral (Definitions Only)

Plane Strain Fracture Toughness:

The Standard Test - Size Requirements - Non-Linearity – Applicability

Plane Stress and Transitional Behaviour:

Introduction - An Engineering Concept of Plane Stress - The R Curve Concept

UNIT - V

The Crack Opening Displacement Criterion:

Fracture Beyond General Yield - The Crack Tip Opening Displacement - The Possible Use of The CTOD Criterion

Determination of Stress Intensity Factors:

Introduction - Analytical and Numerical Methods - Finite Element Methods, Experimental

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Methods (An Ariel Views Only)
Textbooks:
1. Elementary Engineering Fracture Mechanics-David Broek, Battelle, Columbus Laboratories, Columbus, Ohieo, USA 2. Fracture and Fatigue Control in Structures- John M.Barsom, Stanley T.Rolfe, Ross H.Forney 3. Rock and other Quasi-brittle materials - Surender P Shah, Stuart E Swartz,Wiley 1995.
Reference Books:
1. Analysis of Concrete Structures by fracture mechanics, Elfgren L, Routledge,1990 2. Fracture Mechanics- Applications to concrete, Victor C.Li and Z P Bazant, ACI SP118 3. Fracture Mechanics, CT Suri and Zh jin , Elsevier Academic Press,2012

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Course Code	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
25A120103b	(PE-I)	3	0	0	3
Semester		I			

Course Objectives: This Course objectives are:

- To provide knowledge of cement types, chemical composition, hydration, properties, and use of admixtures.
- To familiarize students with aggregates, their classification, properties, grading, and influence on concrete behavior.
- To develop understanding of fresh and hardened concrete properties, workability, strength, curing, and non-destructive testing methods.
- To impart knowledge on elasticity, shrinkage, and creep behavior of concrete and factors influencing them.
- To introduce concrete mix design methods and special concretes such as lightweight, fiber-reinforced, and polymer concretes.

Course Outcomes (CO): After the completion of the course, the student will be able to

- Explain cement properties, hydration process, and the role of chemical admixtures in concrete.
- Assess aggregate properties, grading, and suitability for concrete mixes.
- Evaluate fresh and hardened concrete properties, workability, strength, and curing requirements.
- Analyze elasticity, shrinkage, and creep characteristics of concrete under various conditions.
- Design concrete mixes as per IS, ACI, and other codes, and apply knowledge of special concretes for practical applications.

UNIT - I

Cements And Admixtures: Portland Cement – Chemical Composition - Hydration, Setting and Fineness's of Cement – Structures of Hydrated Cement – Mechanical Strength of Cement Gel - Water Held in Hydrate Cement Paste – Heat of Hydration of Cement – Influence of Compound Composition on Properties of Cement – Tests on Physical Properties of Cement – I.S. Specifications – Different Types of Cements – Admixtures.

UNIT - II

Aggregates: Classification Of Aggregate – Particle Shape and Texture – Bond Strength and Other Mechanical Properties of Aggregate Specific Gravity, Bulk Density, Porosity, Absorption and Moisture in Aggregate – Soundness of Aggregate – Alkali – Aggregate Reaction, Thermal Properties – Sieve Analysis – Fineness Modulus – Grading Curves – Grading Requirements – Practical Grading – Road Note No.4 Grading of Fine and Coarse Aggregates Gap Graded Aggregate – Maximum Aggregate Size.

UNIT - III

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Fresh Concrete: Workability – Factors Affecting Workability – Measurement of Workability by Different Tests – Effect of Time and Temperature on Workability – Segregation and Bleeding – Mixing and Vibration of Concrete – Quality of Mixing Water.

Hardened Concrete: Water/Cement Ratio-Abram's Law – Gel Space Ratio – Effective Water In Mix – Nature Of Strength Of Concrete – Strength In Tension And Compression- Griffith's Hypothesis – Factors Affecting Strength – Autogeneous Healing –Relation Between Compression And Tensile Strength – Curing And Maturity Of Concrete Influence Of Temperature On Strength – Steam Curing – Testing Of Hardened Concrete – Compression Tests – Tension Tests – Factors Affecting Strength – Flexure Tests – Splitting Tests – Non Destructive Testing Methods.

UNIT - IV

Elasticity, Shrinkage and Creep: Modulus of Elasticity – Dynamic Modulus of Elasticity – Poisson's Ratio – Early Volume Changes – Swelling – Draying Shrinkage - Mechanism of Shrinkage – Factors Affecting Shrinkage – Differential Shrinkage – Moisture Movement Carbonation Shrinkage-Creep of Concrete – Factors Influencing Creep – Relation Between Creep and Time – Nature of Creep – Effect of Creep.

UNIT - V

Mix Design: Proportioning Of Concrete Mixes by Various Methods – Fineness Modulus, Trial and Error, Mix Density, Road Note. No. 4, ACI And ISI Code Methods – Factors in The Choice of Mix Proportions – Durability of Concrete – Quality Control of Concrete – Statistical Methods – High Strength Concrete Mix Design.

Special Concretes: Light Weight Concretes –Light Weight Aggregate Concrete- Cellular Concrete - No Fines Concrete – High Density Concrete – Fiber Reinforced Concrete – Different Types of Fibers - Factories Affecting Properties of FRC – Applications Polymer Concrete – Types of Polymer Concrete Properties of Polymer Concrete and Applications

Textbooks:

1. Properties Of Concrete By A.M.Neville – Pearson Publication – 4th Edition
2. Concrete Technology By M.S.Shetty. – S.Chand &Co.; 2004
3. Concrete Technology by A.R. Santha Kumar, Oxford University Press, New Delhi

Reference Books:

1. Concrete: Micro Structure, Properties and Materials – P.K.Mehta and J.M.Monteiro, Mc-Graw Hill Publishers
2. Design Of Concrete Mix by Krishna Raju, CBS Pubilishers.
3. Concrete Technology By A.M.Neville – Pearson Publication
4. Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
5. Non-Destructive Test and Evaluation of Materials By J.Prasad &C.G.K. Nair, Tata Mcgraw Hill Publishers, New Delhi

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Course Code 25A120103b	ADVANCED MATHEMATICAL METHODS (Common to SE and CM and SE (PE I)	L	T	P	C
		3	0	0	3
Semester		I			

Course Objectives: This Course objectives are:

- With calculus of variation, numerical methods of solving ordinary and partial differential equations.
- To impart knowledge in basic concepts of finite element methods and applications.

Course Outcomes (CO): After the completion of the course, the student will be able to

- Solve functionals using Hamilton's principle.
- Numerically solve ordinary and partial differential equations that are initial value or boundary value problems.
- Apply the concepts of finite element method for 1-D and 2-D problems.

UNIT - I	Calculus of Variation

Calculus of Variation – Functionals – Euler's Equation - Solution of Euler's Equation – Isoperimetric problems – several dependent variables – Functionals involving higherOrder derivatives – Hamilton's principle – Lagrange's Equations.

UNIT - II	Numerical Solution of ordinary Differential Equations & Eigen values and Eigen vectors

Numerical Methods: Eigen values and Eigen vectors – general method – power Method, spectral method.

Numerical Solution of ordinary Differential Equations - Taylor Series Method, Picard's method, Euler's method modified Euler's method & R.K. Method.

UNIT - III	Numerical solution of partial differential equations

Numerical solution of partial differential equations –elliptical equations standard five Points formula, Diagonal five-point formula –Solution of Laplace equation by Leibmann's iteration method, Poisson's equation and its applications.

UNIT - IV	Numerical Solution of Partial Differential Equations

Numerical Solution of Partial Differential Equations – Parabolic Equations Bender –Schmidt Method-Bender - Schmidt Recurrence Equation, Crank-Nicholson Difference Method.

UNIT - V	Finite Element Method

Finite Element Method – Weighted residual methods, least square method, Gelarkin's method – Finite Elements – Interpolating over the whole Domain – one dimensional case, two-dimensional case – Application to Boundary value Problems.

Textbooks:

1. Higher Engineering Mathematics by B.S. Grewal Khanna Publishers.
2. Numerical Methods for Engineers by Steven C.Chapra and Raymond P.Canale – Mc Graw Hill Book Company.

Reference Books:

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1. Applied Numerical Analysis by Curtis. F.Gerald- Addeson Wesely Publishing Company.
2. C-Language and Numerical Methods By C-Xavier. New Age International Publishers.
3. Computational Methods for Partial Differential Equations By M.K.Jain, SKR Lyengar, R.K.Jain.

Online Learning Resources:

After completion of this course the student should be able to:

- Understand the concept and steps of calculus of variation.
- Solve ordinary and partial differential equations numerically.
- Solve the initial and boundary value problems numerically.
- Solve the 1-D and 2-D problems using finite element method.
- Identify, formulate and solve structural engineering problems.

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Course Code	ADVANCED REINFORCED CONCRETE DESIGN (PE-II)	L	T	P	C
25A120104a		3	0	0	3
Semester		I			

Course Objectives: This Course objectives are:

- To develop understanding of deflection behavior in reinforced concrete beams and slabs as per various codes.
- To impart knowledge of crack width estimation and design principles for deep beams.
- To provide skills in shear analysis and design for flat slabs and flat plates.
- To familiarize students with the design of plain concrete walls and shear walls, including detailing requirements.
- To introduce fire-resistant design of reinforced concrete members and the effects of high temperatures on concrete and steel.

Course Outcomes (CO): After the completion of the course, the student will be able to

- Calculate deflections of reinforced concrete beams and slabs using IS 456, BS 8110, Eurocode, and ACI methods.
- Estimate crack widths in RC members and design deep beams according to various standards.
- Analyze and design flat slabs and plates for one-way and two-way shear, torsion effects, and openings.
- Design plain concrete walls and shear walls, considering bracing, slenderness, in-plane forces, and detailing rules.
- Apply fire-resistant design principles for RC members and evaluate the structural performance under high-temperature conditions.

UNIT - I

Deflection Of Reinforced Concrete Beams and Slabs:

Introduction -Short-Term Deflection of Beams and Slabs -Deflection Due To -Imposed Loads - Short- Term Deflection of Beams Due To Applied Loads- Calculation of Deflection by IS 456 - Calculation of Deflection by BS 8110 - Deflection Calculation by Eurocode – ACI Simplified Method - Deflection of Continuous Beams by IS 456 - Deflection of Cantilevers - Deflection of Slabs

UNIT - II

Estimation Of Crack Width in Reinforced Concrete Members and Design Of Deep Beams:

Introduction - Factors Affecting Crack Width in Beams - Mechanism of Flexural Cracking Calculation of Crack Widths - Simple Empirical Method - Estimation of Crack Width In - Beams by IS 456 Of BS 8110 - Shrinkage and Thermal Cracking.

Deep Beams: Introduction - Minimum Thickness - Steps of Designing Deep Beams - Design by IS 456 - Design According to British Practice - ACI Procedure for Design of Deep Beams - Checking for Local Failures - Detailing of Deep Beams.

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UNIT - III	

Shear In Flat Slabs and Flat Plates:

Introduction - Checking for One-Way (Wide Beam) Shear - Two-Way (Punching) Shear Permissible Punching Shear - Shear Due To Unbalanced Moment (Torsional Moments) Calculation of J Values - Strengthening of Column Areas for Moment Transfer by Torsion Which Produces Shear - Shear Reinforcement Design - Effect of Openings in Flat Slabs - Recent Revisions in ACI 318 - Shear in Two – Way Slabs with Beams.

UNIT - IV	

Design Of Plain Concrete Walls and Shear Walls:

Introduction - Braced and Unbraced Walls - Slenderness of Walls- Eccentricities of Vertical Loads at Right Angles to Wall - Empirical Design Method for Plane Concrete Walls Carrying Axial Load - Design of Walls for In-Plane Horizontal Forces - Rules for Detailing of Steel in Concrete Walls

Design Of Shear Walls: Introduction - Classification of Shear Walls - Classification According to Behavior - Loads in Shear Walls - Design of Rectangular and Flanged Shear Walls - Derivation of Formula for Moment of Resistance of Rectangular Shear Walls

UNIT - V	

Design Of Reinforced Concrete Members for Fire Resistance: Introduction - ISO 834 Standard Heating Conditions- Grading or Classification - Effect of High Temperature on Steel and Concrete - Effect of High Temperatures on Different Types of Structural Members - Fire Resistance by Structural Detailing from Tabulated Data - Analystical Determination of The Ultimate Bending Moment Capacity of Reinforced Concrete Beams Under Fire - Other Considerations

Textbooks:

1. Reinforced Concrete Structural Elements: Behaviour, Analysis and Design, P.Purushothaman, Tata Mcgraw Hill.
2. Reinforced Concrete Desigers Hand Bood, C.E. Reynolds and J.C. Steedman, A View Point Publication.
3. Advanced Reinforced Concrete Design, Varghese PC, Prentice Hall of India,2008

Reference Books:

1. Limit State Design of Reinforced Concrete Structures by P. Dayaratnam, Oxford &Ibh Publishers.
2. Advanced RCC By N. Krishna Raju, CBS Publishers &Distributors.
3. Reinforced Cement Concrete Structures – Devdas Menon &Unni Krishna Pillai Tata Mcgraw Hill

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Course Code	EXPERIMENTAL STRESS ANALYSIS	L	T	P	C
25A120104b	(PE-II)	3	0	0	3
Semester		I			

Course Objectives: This Course objectives are:

- To introduce the principles and advantages of experimental stress analysis in structural engineering.
- To familiarize students with strain measurement techniques, including mechanical, acoustic, optical, and electrical strain gauges.
- To explain the use of strain rosettes and non-destructive testing (NDT) methods for concrete evaluation.
- To provide knowledge of the theory of photoelasticity, stress optic laws, and their applications in experimental modeling.
- To develop skills in two-dimensional photoelasticity, fringe analysis, calibration techniques, and scaling models for prototype stress determination.

Course Outcomes (CO): After the completion of the course, the student will be able to

- Explain the principles, merits, and applications of experimental stress analysis.
- Select and apply appropriate strain measurement techniques for structural components using various strain gauges.
- Utilize strain rosettes and non-destructive testing methods to evaluate stresses in concrete structures.
- Apply the theory of photoelasticity to analyze stress patterns in experimental models.
- Conduct two-dimensional photo elastic experiments, interpret fringe patterns, and scale results to prototype stresses accurately.

UNIT - I

PRINCIPLES of EXPERIMENTAL APPROACH

Merits of Experimental Analysis Introduction, Uses of Experimental Stress Analysis Advantages of Experimental Stress Analysis, Different Methods –Simplification of Problems.

UNIT - II

STRAIN MEASUREMENT USING STRAIN GAUGES: -

Definition of Strain and Its Relation of Experimental Determinations Properties of Strain-Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction To Electrical Strain Gauges - Inductance Strain Gauges – LVDT – Resistance Strain Gauges – Various Types –Gauge Factor – Materials of Adhesion Base.

UNIT - III

STRAIN ROSSETTES and NON – DESTRUCTIVE TESTING of CONCRETE: - Introduction – The Three Elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity Method –Application to Concrete.

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Hammer Test – Application to Concrete.
UNIT - IV
THEORY of PHOTO ELASTICITY: - Introduction –Temporary Double Refraction – The Stress Optic Law –Effects of Stressed Model in A Polariscope for Various Arrangements – Fringe Sharpening. Brewster's Stress Optic Law.
UNIT - V
TWO-DIMENSIONAL PHOTO ELASTICITY: - Introduction – Isochromatic Fringe Patterns- Isoclinic Fringe Patterns Passage of Light Through Plane Polariscope and Circular Polariscope Isoclinic Fringe Patterns – Compensation Techniques – Calibration Methods – Separation Methods – Scaling Model to Prototype Stresses – Materials for Photoelasticity- Properties of Photo elastic Materials.
Textbooks:
1.Experimental Stress Analysis by J.W.Dally and W.F.Riley, College House Enterprises 2. Experimental Stress Analysis by Dr.Sadhu Singh.Khanna Publishers 3. Abdul Mubeen, "Experimental Stress Analysis", DhanpatRai and Sons, 2001.
Reference Books:
1. Experimental Stress Analysis by U.C.Jindal, Pearson Pubilications. 2. Experimental Stress Analysis by L.S.Srinath, MC.Graw Hill Company Publishers. 3. Moire Fringes in Strain Analysis, PS Theocaris, Pergammon Press, 2002.

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Course Code	PRECASTANDPREFABRICATEDSTRUCTURES	L	T	P	C
25A120104c	(PE-II)	3	0	0	3
Semester		I			

Course Objectives: This Course objectives are:

- To introduce the Technology of Prefabrication in Structures to the students and its need
- To make the student acquire the knowledge of various types of Precast and Prefabricated structural members
- To give the knowledge of Production of various Prefabricated structures
- To enable him to design the Prefabricated structural members

Course Outcomes (CO): After the completion of the course, the student will be able to

- Analyze the prefabricated load carrying members.
- Understand the production technology of prefabrication
- Design and detailing of precast UNIT for factories
- Acquire the knowledge of use of different types of Prefabricated structures

UNIT - I

Need for prefabrication – General Principles of Prefabrication - Comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization–Materials–Modular coordination–Systems–Production –Transportation–Erection.

UNIT - II

Prefabricated Load Carrying Members-Planning for components of prefabricated structures, disuniting of structures, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses, beams, columns, symmetric frames. Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs–Wall panels–Columns–Shear walls.

UNIT - III

Joints - Joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction.

UNIT - IV

Production Technology - Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening. Hoisting Technology - Equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

UNIT - V

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Applications - Designing and detailing of precast UNIT for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns. Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., -Importance of avoidance of progressive collapse.

TEXT BOOKS	
1	CBRI, Building materials and components, India,1990
2	Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994
3	Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.
REFERENCES	
1	Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.
2	A Text Book of Shell Analysis–Bairagi, K, Khanna Publisher, New Delhi.
3	Mokk.L, (1964), Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest.

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Course Code	ADVANCED CONCRETE LABORATORY	L	T	P	C
25A120105		0	0	4	2
Semester		I			

Course Objectives: This Course objectives are:

- To develop practical skills in the mix design and casting of conventional and high-strength concrete specimens.
- To study the fresh properties of self-compacting concrete and understand workability characteristics.
- To investigate the mechanical and durability properties of hardened concrete, including compressive, tensile, and flexural strengths.
- To introduce non-destructive testing methods and accelerated curing techniques for concrete.
- To apply concrete mix design using mineral admixtures and perform structural tests on reinforced concrete beams.

Course Outcomes (CO): At the end of the course, students will be able to:

- Prepare concrete mixes for ordinary, high-strength, and self-compacting concrete, and cast standard test specimens.
- Measure and evaluate the fresh properties of self-compacting concrete.
- Determine mechanical properties of concrete, including compressive strength, split tensile strength, flexural strength, and modulus of elasticity.
- Perform durability tests such as permeability, rapid chloride permeability, carbonation studies, and non-destructive tests on concrete.
- Conduct bending tests on reinforced concrete beams and design concrete mixes using mineral admixtures for enhanced performance.

List of Experiments:

1. **Fineness Test of Cement** – Determination of specific surface.
2. **Setting Time Test of Cement** – Initial and final setting times.
3. **Soundness Test of Cement** – Le Chatelier method.
4. **Consistency of Cement Paste** – Determination of normal consistency.
5. **Aggregate Characterization** – Specific gravity, water absorption, bulk density.
6. **Sieve Analysis of Aggregates** – Determining particle size distribution and grading.
7. **Workability Tests** – Slump test and compaction factor test.
8. **Flow Properties of Concrete** – Flow table test, V-funnel test, L-box ratio.
9. **Segregation and Bleeding Tests** – Evaluating uniformity of fresh concrete.
10. **Mix Design and Casting of Conventional Concrete Specimens** – Cubes, cylinders, beams.
11. **Mix Design and Casting of Self-Compacting / High-Strength Concrete Specimens** – Cubes, beams, cylinders.
12. **Effect of Admixtures on Fresh Concrete Properties** – Workability, flow, and

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setting behavior.
References:
1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012. 2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006. 3. Concrete Technology by A.R. Santha kumar, Oxford University Press.

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Course Code	Computer Aided Design Laboratory	L	T	P	C
25A120106		0	0	4	2
Semester		I			

Course Objectives: This Course objectives are:

- To develop practical skills in the analysis and design of determinate and indeterminate beams using modern tools like Excel.
- To provide hands-on experience in the design of slabs, frames, and multi-storeyed buildings under various loads including dead, live, wind, and earthquake loads.
- To familiarize students with the design of roof trusses, water tanks, and foundation systems using spreadsheet-based computations.
- To impart knowledge in the analysis and design of different types of staircases including open well and dog-legged types.
- To enable students to integrate theoretical concepts of structural engineering into practical design exercises using computational tools.

Course Outcomes (CO): At the end of the course, students will be able to:

- Analyze and design determinate and indeterminate beams using Excel templates.
- Perform design and analysis of one-way and two-way slabs, plane and space frames, and multi-storeyed buildings under various loading conditions.
- Design roof trusses, rectangular and circular water tanks, and foundations using spreadsheet-based calculations.
- Analyze and design different types of staircases with accurate consideration of loads and geometry.
- Apply theoretical structural engineering principles to practical design problems using computational tools efficiently.

List of Experiments:

1. Analysis and design of determinate beams with Excel template development.
2. Analysis and design of indeterminate beams with Excel template development.
3. Analysis and design of One-way slab beams with Excel template development.
4. Analysis and design of Two-way slab beams with Excel template development.
5. Analysis and design of plane frames with Excel template development.
6. Analysis and design of space frames with Excel template development.
7. Analysis and design of a multi-storeyed building subjected to dead load, live load, and wind load.
8. Analysis and design of a multi-storeyed building subjected to dead load, live load, and earthquake load.
9. Analysis and design of King roof trusses including wind load calculation using Excel spreadsheets.
10. Analysis and design of Queen roof trusses including wind load calculation using Excel spreadsheets.

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11. Analysis and design of rectangular water tanks with Excel template development.
12. Analysis and design of circular water tanks with Excel template development.
13. Analysis and design of footings and column foundations with Excel template development.
14. Analysis and design of open well type staircases with Excel template development.
15. Analysis and design of dog-legged type staircases with Excel template development.

References:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.
3. Concrete Technology by A.R. Santha kumar, Oxford University Press.

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Course Code	RESEARCH METHODOLOGY AND	L	T	P	C
25A1RM101	INTELLECTUAL PROPERTY RIGHTS	2	0	0	2
Semester		I			

Course Objectives:

1. To understand the research design process and data collection methods.
2. To develop skills in data analysis and reporting.
3. To familiarize students with intellectual property rights (IPR) and patents.
4. To apply research skills in real-world contexts.

Course Outcomes (CO):

CO1- Recall key concepts and terminology related to research design, data collection, and intellectual property rights.

CO2 - Explain the importance of research design and data analysis in research studies, and describe the concept of intellectual property rights.

CO3 - Design a research study, including data collection and analysis methods, and apply intellectual property rights principles to protect research findings.

CO4 - Analyze research studies to identify strengths and limitations, and evaluate the effectiveness of data collection and analysis methods.

CO5- Assess the impact of intellectual property rights on research and innovation, and evaluate the effectiveness of research designs and methods.

CO6 - Develop a comprehensive research plan, including a detailed research design, data collection and analysis methods, and a plan for protecting intellectual property.

UNIT - I	FUNDAMENTALS OF RESEARCH METHODOLOGY

Overview of research process and design - Types of Research - Approaches to Research (Qualitative vs Quantitative) - Observation studies, Experiments and Surveys - Use of Secondary and exploratory data to answer the research question - Importance of Reasoning in Research and Research ethics - Documentation Styles (APA/IEEE etc.) - Plagiarism and its consequences

Learning Outcomes

- Recall key concepts of the research process, including different types and approaches to research, and the importance of ethics.
- Differentiate between qualitative and quantitative research approaches and the various uses of secondary data.
- Identify the core principles of research design and ethics, including plagiarism and documentation styles.
- Explain the significance of reasoning and ethical conduct in all stages of the research process.
- Apply knowledge of different documentation styles, such as APA and IEEE, to properly cite sources and avoid plagiarism.

UNIT - II	DATA COLLECTION AND SOURCES

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Importance of Data Collection - Types of Data - Data Collection Methods - Data Sources - primary, secondary and Big Data sources - Data Quality & Ethics - Tools and Technology for Data Collection

Learning Outcomes

- Identify different types of data and the various methods for collecting both primary and secondary data.
- Explain the importance of data quality and ethical considerations in data collection.
- Differentiate between primary, secondary, and Big Data sources.
- Describe the various tools and technologies used for effective data collection.
- Analyze the ethical implications of data collection and ensure data quality in a research study.

UNIT - III	**DATA ANALYSIS AND REPORTING**

Overview of Multivariate analysis - Experimental research, cause-effect relationship, and development of hypotheses- Measurement systems analysis, error propagation, and validity of experiments - Guidelines for writing abstracts, introductions, methodologies, results, and discussions - Writing Research Papers & proposals

Learning Outcomes

- Apply knowledge of multivariate analysis and experimental research to develop hypotheses and analyze data.
- Explain the process of measurement systems analysis and error propagation in experimental design.
- Formulate clear and concise abstracts, introductions, and methodologies for research papers.
- Write effective results and discussion sections based on data analysis.
- Develop comprehensive research papers and proposals based on proper data analysis and reporting guidelines.

UNIT - IV	**UNDERSTANDING INTELLECTUAL PROPERTY RIGHTS**

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

Learning Outcomes

- Recall the fundamental concepts of Intellectual Property (IP) and its evolution.
- Describe the roles of organizations like **WIPO** and **WTO** in the establishment of IPR.
- Differentiate between various types of IPR, including trade secrets and trademarks.
- Explain the common rules and features of IPR agreements and the role of UNESCO.
- Analyze the relationship between IPR and biodiversity, and its broader impact.

UNIT - V	**PATENTS**

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Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification - Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents

Learning Outcomes

- Explain the objectives, benefits, and key features of a patent, including the concept of an inventive step.
- Differentiate between the various types of patent applications and the e-filing process.
- Describe the process of patent examination, grant, and revocation.
- Identify the roles of patent agents and the process for their registration.
- Analyze the concepts of equitable assignments, licenses, and licensing of related patents.

Text books:

1.Stuart Melville and Wayne Goddard, *Research Methodology: An introduction for Science & Engineering students*, Juta and Company Ltd, 2004

2.Catherine J. Holland, *Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets*, Entrepreneur Press, 2007.

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education 11e (2012).
2. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners.* David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
3. Deborah E. Bou choux, *Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 6th Edition,* Cengage 2024.
4. Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, *The Craft of Research*, 5th Edition, University of Chicago Press, 2024
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
6. Peter Elbow, *Writing with Power*, Oxford University Press, 1998.

Online Resources (Free & Authentic)

- **Coursera / edX** – Research Methodology and Data Analysis courses
- **Springer Link & ScienceDirect** – Latest journals on research design and statistics
- **Google Scholar** – Free access to research papers
- **NCBI Bookshelf** – Open-access research methodology resources
- **Khan Academy (Statistics & Probability)** – For fundamentals of hypothesis testing, regression, and ANOVA.

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Course Code	ARTIFICIAL INTELLIGENCE AND APPLICATIONS IN CIVIL ENGINEERING	L	T	P	C
25A120107		2	0	0	2
Semester		I			

Course Objectives: This Course Objectives are:

- To introduce the fundamentals of Artificial Intelligence, its history, evolution, and branches relevant to civil engineering.
- To provide knowledge of machine learning principles, algorithms, and their applications to engineering problems.
- To develop understanding of artificial neural networks, and their role in civil and structural engineering.
- To impart knowledge on fuzzy logic, uncertainty handling, and expert systems for decision-making in engineering.
- To create awareness of the latest tools, to train in Prompt Engineering, and to make aware of ethical issues related to AI

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

CO 1: Understand the concepts, history, and branches of Artificial Intelligence with relevance to civil engineering applications.

CO 2: Apply machine learning models and algorithms to solve civil engineering problems.

CO 3: Develop artificial neural network and deep learning models for infrastructure and structural engineering applications

CO 4: Utilize fuzzy logic and expert systems to handle uncertainty in engineering decision-making

CO 5: Give correct Prompts for different AI tools to get the required output

UNIT - I

Introduction To AI: Introduction to AI, Definition of AI, Historical Evolution of AI, AI Types, Brief Introduction to The Branches of AI, Machine Learning, Natural Language Processing, Computer Vision, Robotics, Expert Systems, Artificial Neural Networks, Evolutionary Computation, Cognitive Computing, And Swarm Intelligence.

UNIT - II

Machine Learning: Introduction to Machine Learning-Different Kinds of Machine Learning, Supervised, Unsupervised, Applications of Different ML Techniques and applications In Civil Engineering.

UNIT – III

Artificial Neural Networks (ANN): Introduction, Biological Noron, Motivation, Appropriate Problems in ANN Learning**, Perceptron's**, The Representational Power of Perceptions, Multilayer Networks, Back Propagation. Applications Of Neural Networks In Highway/ Infrastructure Construction Management and Other Civil Engineering Domains.

UNIT – IV

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Uncertainty and Ambiguity, Fuzzy Logic, Linguistic Variables, Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Expert Systems, Fuzzification, Defuzzification, Fuzzy Rules, Fuzzy Inferences. Fuzzy Inference System, Illustrative Examples of Engineering Applications of Fuzzy Logic with Specific Reference to Civil Engineering.

UNIT – V

Introduction to Prompt Engineering: What is Prompt Engineering? A simple introduction to the art of crafting effective instructions (prompts) for Large Language Models (LLMs). Understanding prompts as the way to communicate with and control AI tools. Using LLMs to enhance productivity, automate routine tasks, and aid in problem-solving. The core principles of writing good prompts. • **Clarity and Specificity**: The importance of giving clear, detailed instructions. • **Providing Context**: How to give the AI background information for better results. • **Assigning a Persona**: Telling the AI to "act as" a specific professional (e.g., a structural engineer, a project manager). • **Iterative Refinement**: The process of improving prompts based on AI responses. Practical Applications in Civil Engineering. **Ethical Considerations in AI**: Discussing bias, accountability, and societal impact.

Textbooks:

1. Afaq Ahmad, Nikos D. Langaros, Vagelis Pleveris – **Artificial Intelligence and Machine learning Techniques for Civil Engineers** IGI Global
2. Pijush Samui, Dwarakadas Pralhaddas Kothari, **Artificial Intelligence in Civil Engineering** Lambert Academic Publishing
3. **Introduction to Artificial Intelligence and Machine Learning** by Munesh Chandra Trivedi and Ankit Srivastava, Khanna Publishing House

References:

1. Phillip D Wassermann **Neural Computing Theory and Practice**
2. S. Rajasekharan, G A Vijayalakshmi Pai Neural Networks, **Fuzzy Logic and Genetic Algorithms and Its Applications,** PHI Learning
3. **Web Resource**: https://www.kaggle.com/whitepaper-prompt-engineering

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Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
25A1AC101a	(Audit Course-I)	2	0	0	0
	Semester	**I**			

Course Objectives:

1. To equip students with the fundamentals of academic English for research paper writing.
2. To develop students' advanced reading skills for analyzing and evaluating research articles.
3. To refine students' grammar and language skills for clarity and precision in research writing.
4. To master the skills of revising, editing, and proofreading research papers.
5. To familiarize students with the role of technology and AI in research writing, including digital literacy and ethical considerations.

Course Outcomes (CO): Student will be able to

CO1 - Recall the key language aspects and structural elements of academic writing in research papers.

CO2 –Explain the importance of clarity, precision, and objectivity in research writing.

CO3 - Apply critical reading strategies and advanced grammar skills to analyze and write research papers.

CO4 –Analyze research articles and identify the strengths and limitations of different methodologies.

CO4 – Evaluate research papers to check for plagiarism, structure, clarity, and language accuracy.

CO5 – Evaluate the effectiveness of different language and technology tools in research writing, including AI-assisted tools and plagiarism detection software.

6. CO6 – Develop a well-structured research paper that effectively communicates complex ideas.

UNIT - I	Fundamentals of Academic English

Academic English - MAP (Message-Audience-Purpose) - Language Proficiency for Writing - Key Language Aspects - Clarity and Precision - Objectivity - Formal Tone - Integrating References - Word order - Sentences and Paragraphs - Link Words for Cohesion - Avoiding Redundancy / Repetition - Breaking up long sentences - Structuring Paragraphs - Paraphrasing Skills – Framing Title and Sub-headings

UNIT - II	Reading Skills for Researchers

Reading Academic Texts - Critical Reading Strategies - Skimming and Scanning - Primary Research Article vs. Review Article - Reading an Abstract - Analyzing Research Articles - Identifying Arguments - Classifying Methodologies - Evaluating Findings - Making Notes

UNIT - III	Grammar Refinement for Research Writing

Advanced Punctuation Usage - Grammar for Clarity - Complex Sentence Structures - Active-Passive Voice - Subject-Verb Agreement - Proper Use of Modifiers - Avoiding Ambiguous Pronoun References - Verb Tense Consistency - Conditional Sentences

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UNIT - IV	**Mastery in Refining Written Content/Editing Skills**
Effective Revisions - Restructuring Paragraph - Editing vs Proofreading, Editing for Clarity and Coherence - Rectifying Sentence Structure Issues - Proofreading for Grammatical Precision – Spellings - Tips for Correspondence with Editors - Critical and Creative Phases of Writing	
UNIT - V	**Technology and Language for Research**
Digital Literacy and Critical Evaluation of Online Content - Technology and Role of AI in Research Writing – Assistance in Generating Citations and References - Plagiarism and Ethical Considerations – Tools and Awareness – Fair Practices	
Textbooks:	
1.Bailey. S. A*cademic Writing: A Handbook for International Students.* London and New York: Routledge,2015. 2. Adrian Wallwork, *English for Writing Research Papers*, Springer New York Dordrecht Heidelberg London, 2011.	
Reference Books: 1. Craswell, G. *Writing for Academic Success,* Sage Publications, 2004. 2. Peter Elbow, *Writing with Power, E-book*, Oxford University Press, 2007 3. Oshima, A. & Hogue, A. *Writing Academic English*, Addison-Wesley, New York, 2005 4. Swales, J. & C. Feak, Academic Writing for Graduate Students: Essential Skills and Tasks. Michigan University Press, 2012. 5.Goldbort R. *Writing for Science*, Yale University Press (available on Google Books), 2006 6. Day R. *How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006	
Online Learning Resources:	
1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge04/ 2. https://onlinecourses.swayam2.ac.in/ntr24_ed15/preview 3.. "Writing in the Sciences" – Stanford University (MOOC on Coursera) [https://www.coursera.org/learn/sciwrite] (https://www.coursera.org/learn/sciwrite) 4. Academic Phrase bank – University of Manchester [http://www.phrasebank.manchester.ac.uk] (http://www.phrasebank.manchester.ac.uk) 5. OWL (Online Writing Lab) – Purdue University, [https://owl.purdue.edu] (https://owl.purdue.edu) *(Resources on APA/MLA formats, grammar, structure, paraphrasing) * 6. Zotero or Mendeley (Reference Management Tools) – Useful for managing citations and sources.	

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Course Code	DISASTER MANAGEMENT	L	T	P	C
25A1AC101b	(Audit Course-I)	2	0	0	0
Semester		I			

Course Objectives:

1. **To enable the students to understand** the fundamental concepts of disasters, hazards, their factors, and significance with special reference to India.
2. **To prepare them to classify and analyze** different types of natural and man-made disasters, their causes, magnitude, and impacts.
3. **To foster them ddevelop understanding** of disaster preparedness, monitoring systems, and the role of government, community, and media.
4. **To equip them in learning** risk assessment techniques, disaster risk reduction strategies, and the importance of global and national cooperation.
5. **To foster their ability to think critically and respond to disasters and design** effective mitigation measures (structural and non-structural) with a focus on emerging trends and Indian disaster management programs.

Course Outcomes

On successful completion, students will be able to:

CO1 - Define and distinguish between hazards and disasters, and explain their types, nature, and impacts.

CO2 Identify and map disaster-prone areas in India and understand the epidemiological consequences of disasters.

CO3 Assess the economic, social, and ecological repercussions of major natural and man-made disasters.

CO4 Demonstrate knowledge of disaster preparedness tools such as remote sensing, meteorological data, risk evaluation, and community awareness.

CO5 Apply risk assessment methods and propose disaster risk reduction strategies at local, national, and global levels.

CO6: Formulate and evaluate structural and non-structural disaster mitigation strategies, with emphasis on Indian programs and emerging trends.

SYLLABUS

UNIT –I	Introduction

Disaster - Definition, Factors and Significance - Difference Between Hazard and Disaster - Natural and Man-made Disasters - Difference, Nature, Types and Magnitude - Disaster Prone Areas in India - Study of Seismic Zones - Areas Prone to Floods and Droughts, Landslides and Avalanches - Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami - Post-Disaster Diseases and Epidemics.

UNIT - II	Repercussions of Disasters and Hazards

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Economic Damage - Loss of Human and Animal Life - Destruction of Ecosystem - Natural Disasters - Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster - Nuclear Reactor Meltdown - Industrial Accidents - Oil Slick sand Spills - Outbreaks of Disease and Epidemics War and Conflicts

UNIT - III	**Disaster Preparedness and Management**

Preparedness - Monitoring of Phenomena - Triggering a Disaster or Hazard - Evaluation of Risk-Application of Remote Sensing - Data from Meteorological and Other Agencies - Media Reports-Governmental and Community Preparedness.

UNIT - IV	**Risk Assessment**

Disaster Risk -Concept and Elements, Disaster Risk Reduction - Global and National Disaster Risk Situation -Techniques of Risk Assessment – Global Co-Operation in Risk Assessment and Warning - People's participation in Risk Assessment – Strategies for Survival.

UNIT - V	**Disaster Mitigation**

Meaning, Concept and Strategies of Disaster Mitigation - Emerging Trends in Mitigation - Structural Mitigation and Non- Structural Mitigation - Programs of Disaster Mitigation in India

Text books

1. Gupta, H. K. *Disaster Management*. Universities Press, 2003
2. Singh, R. B. *Natural Hazards and Disaster Management*. Rawat Publications, 2006.

Reference Books

1.Coppola, D. P. (2020). *Introduction to International Disaster Management* (4th ed.). Elsevier.
2.Shaw, R., & Izumi, T. (2022). *Science and Technology in Disaster Risk Reduction in Asia*. Springer.
3.Wisner, B., Gaillard, J. C., & Kelman, I. (2021). *Handbook of Hazards and Disaster Risk Reduction and Management* (2nd ed.). Routledge.
4.Saini, V. K. (2021). *Disaster Management in India: Policy, Issues and Perspectives*. Sage India.
5.Kelman, I. *Disaster by Choice: How Our Actions Turn Natural Hazards into Catastrophes*, Oxford University Press, 2022
6.Sahni, P. & Dhameja, A. *Disaster Mitigation: Experiences and Reflections*. Prentice Hall of India, 2004.

Online Resources

- **National Disaster Management Authority (NDMA), India**: https://ndma.gov.in – official guidelines, reports, and policy frameworks.
- **United Nations Office for Disaster Risk Reduction (UNDRR)**: https://www.undrr.org – Sendai Framework, global risk reduction strategies.
- **Global Disaster Alert and Coordination System (GDACS)**: https://www.gdacs.org – real-time disaster alerts.
- **World Health Organization (WHO)** – https://www.who.int/emergencies – disaster-related health guidelines.

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Subject Code	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE (Audit Course-I)	L	T	P	C
25A1AC101c		2	0	0	0

COURSE OBJECTIVES: The objective of this course is	
1	To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of knowledge system.
2	To make them understand the need for protecting traditional knowledge and its significance in the global economy.
3	To make them understand the legal frame work and policies related to traditional knowledge protection.
4	To enable them to understand the relationship between traditional knowledge and intellectual property rights.
5	To make them explore the applications of traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology

Unit-I: Introduction to traditional knowledge - Definition, Nature and characteristics, scope and importance - Kinds of traditional knowledge - Physical and social contexts in which traditional knowledge develop - Historical impact of social change on traditional knowledge systems - Indigenous Knowledge (IK) – Characteristics - traditional knowledge vis-à-vis indigenous knowledge -Traditional knowledge Vs western knowledge, traditional knowledge vis-à-vis formal knowledge

Learning Outcomes:

At the end of the unit the student will able to:

- Understand the concept of traditional knowledge.
- Contrast and compare characteristics, importance& kinds of traditional knowledge.
- Analyze physical and social contexts of traditional knowledge.
- Evaluate social change on traditional knowledge.

Unit-II: Protection of traditional knowledge- Need for protecting traditional knowledge - Significance of TK Protection - Value of TK in global economy - Role of Government to harness TK.

Learning Outcomes:

At the end of the unit the student will able to:

- Know the need of protecting traditional knowledge.
- Apply significance of TK protection.
- Analyze the value of TK in global economy.
- Evaluate role of government

Unit-III: Legal frame work and TK - A) The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 - Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act) – B) The Biological Diversity Act 2002 and Rules 2004 - the protection of traditional knowledge bill, 2016 - Geographical Indicators Act 2003.

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Learning Outcomes:
At the end of the unit the student will able to:
• Understand legal frame work of TK.
• Contrast and compare the ST and other traditional forest dwellers
• Analyze plant variant protections
• Understand the rights of farmers forest dwellers
Unit-IV: Traditional knowledge and Intellectual property - Systems of traditional knowledge protection - Legal concepts for the protection of traditional knowledge - Certain non-IPR mechanisms of traditional knowledge protection - Patents and traditional knowledge - Strategies to increase protection of traditional knowledge -Global legal FORA for increasing protection of Indian Traditional Knowledge.
Learning Outcomes:
At the end of the unit the student will able to:
• Understand TK and IPR
• Apply systems of TK protection.
• Analyze legal concepts for the protection of TK.
• Evaluate strategies to increase the protection of TK.
Unit-V: Traditional knowledge in different sectors - Traditional knowledge and Engineering - Traditional medicine system - TK and Biotechnology - TK in Agriculture - Traditional societies depend on it for their food and healthcare needs - Importance of conservation and sustainable development of environment - Management of biodiversity, Food security of the country and protection of TK
Learning Outcomes:
At the end of the unit the student will be able to:
• Know TK in different sectors.
• Apply TK in Engineering.
• Analyze TK in various sectors.
• Evaluate food security and protection of TK in the country.
Prescribed Books: 1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. Introduction to Indian Knowledge System: Concepts and Applications, PHI Learning Pvt.Ltd. Delhi, 2022. 2.Basanta Kumar Mohanta and Vipin Kumar Singh, Traditional Knowledge System and Technology in India, Pratibha Prakashan 2012.
Prescribed Books: 1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. Introduction to Indian Knowledge System: Concepts and Applications, PHI Learning Pvt.Ltd. Delhi, 2022. 2.Basanta Kumar Mohanta and Vipin Kumar Singh, Traditional Knowledge System and Technology in India, Pratibha Prakashan 2012.
Reference Books:

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1. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Kak, S.C. "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), 1987
3. Subbarayappa, B.V. and Sarma, K.V. Indian Astronomy: A Source Book, Nehru Centre, Mumbai, 1985.
4. Bag, A.K. History of Technology in India, Vol. I, Indian National Science Academy, New Delhi, 1997.
5. Acarya, P.K. Indian Architecture, Munshiram Manoharlal Publishers, New Delhi, 1996.
6. Banerjea, P. Public Administration in Ancient India, Macmillan, London, 1961.
7. Kapoor Kapil, Singh Avadhesh,Indian Knowledge Systems Vol – I & II, Indian Institute of Advanced Study, Shimla, H.P., 2022

COURSE OUTCOMES: At the end of the course, students will be able to

CO1	Define and explain the concept of traditional knowledge, its nature, characteristics, and scope
CO2	Understand the need for protecting traditional knowledge and its significance in the global economy
CO3	Explain the legal framework and policies related to traditional knowledge protection
CO4	Apply traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology
CO5	Analyze the importance of traditional knowledge in various contexts, including its historical impact and social change
CO6	Analyze the relationship between traditional knowledge and intellectual property rights, including patents and non-IPR mechanisms

E-Resources:

1.https://www.youtube.com/watch?v=LZP1StpYEPM

2. http://nptel.ac.in/courses/121106003/

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Course Code	**STRUCTURAL DYNAMICS**	**L**	**T**	**P**	**C**
25A120201		**3**	**0**	**0**	**3**
Semester		**II**			

Course Objectives: This Course Will Enable Students:

- To introduce the fundamentals of vibrations, including elements of vibratory systems, degrees of freedom, and continuous versus lumped mass systems.
- To develop understanding of single degree of freedom (SDOF) systems, their free and forced vibration responses, and dynamic loading analysis.
- To provide knowledge on multi-degree of freedom (MDOF) systems, mode shapes, natural frequencies, and dynamic response analysis.
- To familiarize students with practical vibration analysis methods including Stodola, Holzer, and transfer matrix procedures.
- To impart knowledge of earthquake analysis, SDOF and MDOF systems under seismic excitation, and vibrations of continuous systems like beams.

Course Outcomes (CO): Student will be able to

- Explain the theory of vibrations, free and forced oscillations, and the significance of damping in structural systems.
- Formulate and solve equations of motion for SDOF systems under various types of dynamic loading.
- Analyze MDOF systems, determine natural frequencies, mode shapes, and compute dynamic responses using modal analysis. Apply practical vibration analysis methods such as Stodola and Holzer for determining structural response.
- Perform basic earthquake analysis of structures using SDOF and MDOF models, and analyze flexural vibrations of continuous beams.

UNIT - I Lecture Hrs:10

Theory of Vibrations: Introduction –Elements of A Vibratory System – Degrees of Freedom-Continuous Systems –Lumped Mass Idealization –Oscillatory Motion –Simple Harmonic Motion –Pictorial Representation of S.H.M - Free Vibrations of Single Degree of Freedom (SDOF) Systems –Undamped and Damped –Critical Damping –Logarithmic Decrement –Forced Vibrations of SDOF Systems-Harmonic Excitation –Dynamic Magnification Factor- Bandwidth. Fundamental Objective of Dynamic Analysis-Types of Prescribed Loading- Methods of Discretization- Formulation of The Equations of Motion.

UNIT - II Lecture Hrs:10

Single Degree of Freedom System: Formulation and Solutions of The Equation of Motion - Free Vibration Response –Response to Harmonic, Periodic, Impulsive and General Dynamic Loading –Duhamel Integral.

UNIT - III Lecture Hrs:10

Multi Degree of Freedom System: Selection of The Degree of Freedom –Evaluation of Structural Property Matrices-Formulation of The MDOF Equations of Motion –

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Undamped Free Vibrations-Solution of Eigen Value Problem for Natural Frequencies and Mode Shapes- Analysis of Dynamic Response –Normal Coordinates –Uncoupled Equations of Motion –Orthogonal Properties of Normal Modes-Mode Superposition Procedure	
UNIT - IV	Lecture Hrs:9
Practical Vibration Analysis: Stodola Method- Fundamental Mode Analysis –Analysis of Second and Higher Modes –Holzer's Method –Basic Procedure –Transfer Matrix Procedure	
UNIT - V	Lecture Hrs:9
Introduction To Earthquake Analysis: Introduction –Excitation by Rigid Base Translation –Lumped Mass Approach -SDOF and MDOF System- I.S Code Methods of Analysis. **Continuous System:** Introduction –Flexural Vibrations of Beams- Elementary Case-Equation of Motion –Analysis of Undamped Free Shapes of Simple Beams with Different End Conditions-Principles of Application to Continuous Beams.	
Textbooks:	
1. Structural Dynamics for Earthquake Engineering,A.K.Chopra,PearsonPubilications 2. Dynamics of Structures by Clough &Penziem 3. Structural Dynamics by Roy. R. Craig John willy & fours.	
Reference Books:	
1. Structural Dynamics by Mario Paz 2. I.S:1893(Latest)— Code of Practice for Earthquakes Resistant Design of Stuctures 3. Fundamentals of Vibration, Anderson R.A, Amerind Pulblishing Co.,1972.	

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Course Code	**STABILITY of STRUCTURES**	**L**	**T**	**P**	**C**
25A120202		**3**	**0**	**0**	**3**
Semester			**II**		

Course Objectives: This Course Will Enable Students:

- To introduce the fundamentals of beam-column behavior, stability concepts, and determination of allowable stresses.
- To develop understanding of elastic buckling of columns under various loading and boundary conditions using analytical and energy methods.
- To provide knowledge on inelastic and torsional buckling, including double modulus and tangent modulus theories.
- To familiarize students with mathematical methods for stability analysis, including Ritz, Timoshenko, and Galerkin methods.
- To impart skills in analyzing lateral buckling of beams and rectangular plates under bending and compressive loads.

Course Outcomes (CO): Student will be able to

- Formulate and solve beam-column problems for different support conditions and axial loads.
- Analyze elastic buckling of straight, eccentrically loaded, and built-up columns using energy methods.
- Evaluate inelastic and torsional buckling behavior of bars, thin-walled sections, and combined torsion-flexure cases.
- Apply mathematical methods like Ritz, Timoshenko, and Galerkin for solving structural stability problems.
- Analyze lateral buckling of simply supported beams and rectangular plates under pure bending and compressive forces.

UNIT - I	Lecture Hrs:10

Formulations Related to Beam Columns: Concept of Stability, Differential Equation for Beam Columns –Beam Column with Concentrated Loads –Continuous Lateral Load – Couples -Beam Column with Built in Ends –Continuous Beams with Axial Load – Application of Trigonometric Series –Determination of Allowable Stresses.

UNIT - II	Lecture Hrs:10

Elastic Buckling of Bars: Elastic Buckling of Straight Columns –Effect of Shear Stress on Buckling-Eccentrically and Laterally Loaded Columns –Energy Methods –Buckling of A Bar on Elastic Foundation, Buckling of A Bar with Intermediate Compressive Forces and Distributed Axial Loads –Buckling of Bars with Change in Cross Section –Effect of Shear Force on Critical Load –Built Up Columns

UNIT - III	Lecture Hrs:10

Inelastic Buckling and Torsional Buckling: Buckling of Straight Bars-Double Modulus Theory –Tangent Modulus Theory. Pure Torsion of Thin-Walled Bar of Open Cross Section-Non –Uniform Torsion of Thin-Walled Bars of Open Cross Section-Torsional

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Buckling –Buckling Under Torsion and Flexure.	
UNIT - IV	Lecture Hrs:9
Mathematical Treatment of Stability Problems: Buckling Problem Orthogonality Relation –Ritz Method-Timoshenko Method, Galerkin Method	
UNIT - V	Lecture Hrs:9
Lateral Buckling of Simply Supported Beams and Rectangular Plates: Beams of Rectangular Cross Section Subjected for Pure Bending. Derivation of Equation of Rectangular Plate Subjected to Constant Compression in Two Directions and One Direction.	
Textbooks:	
1. Stability of Metallic Structure by Bleich –Mc Graw Hill 2. Theory of Beam Columns Vol I by Chen & Atsuta Mc.Graw Hill 3. Timoshenko, S., and Gere., Theory of Elastic Stability, Mc Graw Hill Book Company, 1973.	
Reference Books:	
1. Elastic Stability of Structures, Smitses, Prentice Hall,1973. 2. Buckling of Bars Plates and Shells, Brush and Almorth., Mc Graw Hill Book Company ,1975. 3. Principles of Structural Stability Theory, Chajes, A., Prentice Hall,1974 4. Stability Theory of Structures, Ashwini Kumar, TATA Mc Graw Hill Publishing Company Ltd, New Delhi,1985.	

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Course Code	FINITE ELEMENT METHODS for STRUCTURAL ENGINEERING (PE III)	L	T	P	C
25A120203a		3	0	0	3
Semester			II		

Course Objectives: This Course Will Enable Students:

- To introduce the fundamental concepts, merits, limitations, and energy principles of the Finite Element Method.
- To develop knowledge of one-dimensional FEM analysis including stiffness matrix formulation, shape functions, and effects of initial strain and temperature.
- To provide understanding of two-dimensional FEM analysis, element types, shape functions, compatibility requirements, and generation of stiffness and load matrices.
- To familiarize students with isoperimetric formulations, 2D isoperimetric elements, and axi-symmetric modelling for bodies of revolution.
- To impart skills in three-dimensional FEM analysis, including 3D elements, strain-displacement relationships, and formulation of solid elements.

Course Outcomes (CO): Student will be able to

- Explain the concepts, advantages, and limitations of FEM along with energy principles and discretization techniques.
- Formulate and solve 1D FEM problems for beams and bars including static condensation and temperature/strain effects.
- Generate stiffness and load matrices for 2D FEM problems and apply shape functions for plane stress, plane strain, and axi-symmetric problems.
- Apply isoparametric formulations for 2D elements and perform axi-symmetric FEM analysis for bodies of revolution.
- Formulate and analyze 3D FEM models using hexahedral and isoparametric solid elements for complex structural problems.

UNIT - I	Lecture Hrs:10

Introduction-Concepts of FEM –Steps Involved –Merits &Demerits –Energy Principles – Discretization –Rayleigh –Ritz Method of Functional Approximation. **Elastic Formulations:** Stress Equations-Strain Displacement Relationships in Matrix Form-Plane Stress, Plane Strain and Axi-Symmetric Bodies of Revolution with Axi Symmetric Loading

UNIT - II	Lecture Hrs:10

One-Dimensional FEM-Stiffness Matrix for Beam and Bar Elements Shape Functions for ID Elements –Static Condensation of Global Stiffness Matrix-Solution –Initial Strain and Temperature Effects.

UNIT - III	Lecture Hrs:10

Two-Dimensional FEM-Different Types of Elements for Plane Stress and Plane Strain Analysis –Displacement Models –Generalized Coordinates-Shape Functions-Convergent

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and Compatibility Requirements –Geometric Invariance –Natural Coordinate System-Area and Volume Coordinates-Generation of Element Stiffness and Nodal Load Matrices –Static Condensation.	
UNIT - IV	Lecture Hrs:9
Isoparametric Formulation-Concept, Different Isoparametric Elements for 2D Analysis-Formulation of 4-Noded and 8-Noded Isoparametric Quadrilateral Elements – Lagrangian Elements-Serendipity Elements. **Axi Symmetric Analysis** –Bodies of Revolution-Axi Symmetric Modelling –Strain Displacement Relationship-Formulation of Axi Symmetric Elements.	
UNIT - V	Lecture Hrs:9
Three-Dimensional FEM-Different 3-D Elements, 3D Strain –Displacement Relationship- Formulation of Hexahedral and Isoparametric Solid Element.	
Textbooks:	
1. Finite Elements Methods in Engineering by Tirupati. R. Chandrnpatla and Ashok D. Belegundu – Pearson Education Publications. 2. Finite Element Analysis – Theory & Programming by C.S.Krishna Murthy- Tata Mc.Graw Hill Publishers 3. Finite Elements Methods in Engineering by Tirupati. R. Chandrnpatla, Universities Press India Ltd. Hyderabad.	
Reference Books:	
1. Finite Element Method and Its Application by Desai ,2012, Pearson Pubilications. 2. finite Element Methods by Darrel W.Pepper, Vikas Pubilishers 3. Finite Element Analysis and Procedures in Engineering by H.V.Lakshminaryana, 3rd Edition, Universities Press, Hyderabad. 4. Finite Element Analysis in Engineering Design by S.Rajasekharan, S.Chand Publications, New Delhi. 5. Finite Element Analysis by S.S. Bhavakatti-New Age International Publishers 6. Finite Element Analysis by P Seshu-PHI Learning Publications.	

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Course Code	ADVANCED STEEL STRUCTURES DESIGN (PE-III)	L	T	P	C
25A120203b		3	0	0	3
Semester		**II**			

Course Objectives: This Course Will Enable Students:

- To provide knowledge on the design of self-supporting steel stacks/chimneys considering industrial, thermal, mechanical, wind, and dead load requirements.
- To introduce approximate methods for analysis of multi-storey frames, including cantilever and portal methods.
- To develop understanding of gantry girder design, including load assessment, permissible stresses, and crane considerations.
- To familiarize students with theorems of plastic analysis and optimization principles for rectangular portal frames.
- To impart knowledge on general plastic design methods, plastic moment redistribution, and deflection estimation in steel structures.

Course Outcomes (CO): Student will be able to

- Design self-supporting steel stacks/chimneys considering wind, dead, and accidental loads.
- Apply approximate methods and substitute frame methods for analysis of multi-storey steel frames.
- Design gantry girders for electrically operated cranes, evaluating maximum moments and shears.
- Apply theorems of plastic analysis and optimization principles to simple portal frames for minimum weight design.
- Use general plastic design methods and plastic moment redistribution techniques for two-storey portal frames, including deflection assessment.

UNIT - I	Lecture Hrs:10

Design of Self-Supporting Steel Stacks/Chimneys – Considerations for Preliminary Design (Industrial Requirements – Thermal Requirement – Mechanical Force Requirement – Wind Load and Dead Load Estimation) – Detailed Estimation of Wind; Dead-And Other Accidental – Loads; Analysis; Detailed Design Including Provision of Stakes /Spoilers – Design of Super Structure Only.

UNIT - II	Lecture Hrs:10

Analysis of Multi-Storey Frames Using Approximate Methods and Substitute Frame Method: Cantilever Method &Portal Method

UNIT - III	Lecture Hrs:10

Design of Gantry Girder – Introduction – Loads Acting on The Gantry Girder – Permissible Stresses - Types of Gantry Girders and Crane Sails – Crane Data – Maximum Moments and Shears – Design Procedure (Restricted to Electrically Operated Cranes)

UNIT - IV	Lecture Hrs:9

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Theorems of Plastic Analysis, Applications to the Cases of Rectangular Portal Frames. Principles of Optimization in Structural Design – Application to Simple – Rectangular Portal Frame – Minimum Weight Design.	
UNIT - V	Lecture Hrs:9
General Methods of Plastic Design: Combining Mechanics Methods, Plastic Moment Redistribution Method; Application to Few Cases of Simple Two Storied Rectangular Portal Frames Including Estimation of Deflection.	
Textbooks:	
1. Plastic Analysis of Structures by B.G.Neal 2. Steel Skeleton V.I and II by Baker 3. Design of Steel Structures by Vazarani and Ratwani	
Reference Books:	
1. Strength of Materials (Vol-II)) by Timoshenko. 2. Analysis of Steel Structure by Manohar. 3. Analysis of Steel Structure by Pinfold 4. Analysis of Steel Structure by Arya &Azmani 5. Analysis of Steel Structure by Relevant IS Codes. 6. Analysis of Steel Structure by Punmia, B.C.	

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Course Code	**THEORY OF PLATES and SHELLS (PE-III)**	**L**	**T**	**P**	**C**
25A120203c		**3**	**0**	**0**	**3**
Semester			**II**		

Course Objectives: This Course Will Enable Students:

- To introduce the fundamental concepts of shell theory, space curves, shell coordinates, and strain-displacement relations.
- To develop skills in analyzing thin rectangular plates under various boundary conditions using Navier and Levy solutions.
- To provide knowledge on circular plate bending, differential equations, and solutions for uniformly and concentrically loaded plates.
- To impart understanding of shell behavior, classification, stress resultants, and derivation of equilibrium equations for cylindrical shells.
- To familiarize students with double-curvature shells, axi-symmetrical shells, and their analysis and design for practical structures like cooling towers.

Course Outcomes (CO): Student will be able to

- Explain shell theory, displacement field approximations, stress resultants, and boundary conditions.
- Analyze thin rectangular plates under different loadings using Navier and Levy methods.
- Solve circular plate problems with uniform, central, and concentric loading using differential equations.
- Determine stress resultants and equilibrium equations for cylindrical shells and classify shell structures.
- Apply membrane theory to double-curvature and axi-symmetrical shells, and perform basic design of structures such as cooling towers.

UNIT - I	Lecture Hrs:10

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

UNIT - II	Lecture Hrs:10

Small Deflection Theory of Thin Rectangular Plates: Assumptions – Derivation of Governing Differential Equation for Thin Plates – Boundary Conditions – Simply Supported Plate Under Sinusoidal Load – Navier Solution – Application to Different Cases – Levy's Solution for Various Boundary Conditions Subjected to Different Loadings Like Uniform and Hydrostatic Pressure.

UNIT - III	Lecture Hrs:10

Circular Plates: Differential Equation for Symmetrical Bending of Laterally Loaded Circular Plates – Uniformly Loaded Circular Plates –Circular Plate Concentrically Loaded – Circular Plate Loaded at Center

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UNIT - IV	Lecture Hrs:9
Shells – Functional Behaviour – Examples – Structural Behaviour of Shells Classification of Shells – Definitions – Various Methods of Analysis of Shells – Merits and Demerits of Each Method – 2D. Membrane Equation. Equations Of Equilibrium: Derivation Of Stress Resultants – Cylindrical Shells – Flugges Simulations Equations.	
UNIT - V	Lecture Hrs:9
Introduction To the Shells of Double Curvatures: Geometry, Analysis and Design of Elliptic Paraboloid, Conoid and Hyperbolic Parabolic Shapes, Inverted Umbrella Type. Axi- Symmetrical Shells: General Equation - Analysis and Axi-Symmetrical by Membrane Theory. Application To Spherical Shell and Hyperboloid of Revolution Cooling Towers.	
Textbooks:	
1. Theory Of Plates & Shells –Stephen, P.Timoshenko, S.Woinowsky-Krieger – Tata MC Graw Hill Edition 2. Analysis And Design of Concrete Shell Roofs By G.S.Ramaswami. CBS Publications. 3. Design Of Concrete Shell Roofs by Billington – Tata MC Graw Hill, New York	
Reference Books:	
1. Shell Analysis By N.K.Bairagi. Khanna Publishers, New Delhi. 2. Design Of Shells and Folded Plates by P.C. Varghese, PHI Learning Pvt. Ltd 3. Design Of Concrete Shell Roofs ByChaterjee. Oxford And IBH.,	

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Course Code	DESIGN OF PRESTRESSED CONCRETE (PE-IV)	L	T	P	C
25A120204a		3	0	0	3
Semester			II		

Course Objectives: This Course Will Enable Students:

- To introduce the development, principles, advantages, and materials of prestressed concrete, including pre-tensioning and post-tensioning methods.
- To provide knowledge on various losses of prestress and their estimation in PSC members.
- To develop understanding of flexural behavior, deflections, and elastic design of prestressed concrete beams as per IS codes.
- To impart knowledge on shear, bond, bearing, and anchorage stresses and their design in PSC members.
- To familiarize students with the analysis and design of statically indeterminate continuous prestressed concrete structures.

Course Outcomes (CO): Student will be able to

- Explain the principles, advantages, and materials used in prestressed concrete, including pre-tensioning and post-tensioning methods.
- Estimate prestress losses due to elastic shortening, creep, shrinkage, relaxation, friction, and anchorage slip.
- Analyze and design PSC beams for flexure and deflection using elastic theory and IS code provisions.
- Design for shear, bond, bearing, and anchorage stresses, including end block detailing in PSC members.
- Analyze and design statically indeterminate prestressed concrete beams, including continuous beam layouts and moment distribution.

UNIT - I	Lecture Hrs:10

INTRODUCTION: Development of Prestressed Concrete –Advantages and Disadvantages of PSC Over RCC –General Principles of Pre-Stressing-Pre Tensioning and Post Tensioning –Materials Used in PSC-High Strength Concrete –High Tension Steel-Different Types /Methods/Systems of Prestressing.

UNIT - II	Lecture Hrs:10

Losses of Prestress: Estimation of The Loss of Prestress Due To Various Causes Like Elastic Shortening of Concrete, Creep of Concrete, Shrinkage of Concrete, Relaxation of Steel, Slip in Anchorage and Friction.

UNIT - III	Lecture Hrs:10

Flexure & Deflections: Analysis of Sections for Flexure in Accordance with Elastic Theory-Allowable Stresses-Design Criteria as Per I.S Code of Practice –Elastic Design of Beams (Rectangular, I and T Sections) for Flexure –Introduction to Partial Prestressing. Introduction-Factors Influencing Deflections-Short Term and Long-Term Deflections of

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Un-cracked and Cracked Members.	
UNIT - IV	Lecture Hrs:10
Shear, Bond, Bearing and Anchorage: Shear in PSC Beams –Principal Stresses – Conventional Elastic Design for Shear-Transfer of Prestress in Pre-tensioned Members-Transmission Length –Bond Stresses-Bearing at Anchorage –Anchorage Zone Stresses in Post-Tensioned Members-Analysis and Design of End Blocks by Guyon, Magnel and Approximate Methods –Anchorage Zone Reinforcements.	
UNIT - V	Lecture Hrs:10
Statistically Indeterminate Structures: Introduction –Advantages and Disadvantages of Continuity –Layouts for Continuous Beams-Primary and Secondary Moments –Elastic Analysis of Continuous Beams-Linear Transformation-Concordant Cable Profile-Design of Continuous Beams.	
Textbooks:	
1. Prestressed Concrete by N. Krishna Raju, TMH Pubilishers. 2. Prestressed Concrete by K.U.Muthu, I.K. International Publishing House. 3. Prestressed Concrete Design by Praveen Nagarajan, Pearson Pubilications.	
Reference Books:	
1. Design of Prestressed Concrete Structures, T.Y.Lin, Asian Publishing House, Bombay, 1953. 2. Prestressed Concrete, Vol.I&II, Y.Guyon, Wiley and Sons, 1960. 3. Prestressed Concrete Design and Construction, F.Leohhardt, Wilhelm Ernst and Shon, Berlin, 1964. 4. Reinforced concrete designers' hand bood, A view point publication, C.E.Reynolds and J.C. Steedman, 1989. 5. Prestressed Concrete, Edward P.Nawy, Prentice Hall –. 6. Prestressed Concrete – by Raj Gopal, Narsoa Pubilications.	

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Course Code	DESIGN OF BRIDGES (PE-IV)	L	T	P	C
25A120204b		3	0	0	3
Semester			II		

Course Objectives: This Course Will Enable Students:

- To provide knowledge of bridge classification, planning, IRC specifications, and design considerations.
- To develop analytical and design skills for box culverts and slab bridges under IRC loading.
- To impart knowledge of T-beam bridge analysis using theories such as Pigeaud's and Courbon's, and their design and detailing.
- To introduce prestressed concrete bridges, bridge bearings, and their design principles.
- To enable understanding of design, stability, and detailing of piers and abutments.

Course Outcomes (CO): Student will be able to

- Explain the classification, planning, and design considerations of bridges in accordance with IRC specifications.
- Design box culverts and slab bridges considering load distribution, moments, and detailing requirements.
- Apply Pigeaud's and Courbon's theories to analyze and design reinforced concrete T-beam bridges.
- Design prestressed concrete slab bridges, and select and design suitable bridge bearings.
- Analyze and design piers and abutments, ensuring safety and stability under various loading conditions.

UNIT - I	Lecture Hrs:10

Introduction – Classification, Investigations and Planning, Choice of Type – Economic Span Length – IRC Specifications for Road Bridges, Standard Live Loads, Other Forces Acting on Bridges, General Design Considerations.

UNIT - II	Lecture Hrs:10

Design of Box Culverts – General Aspects – Design Loads – Design Moments, Shears and Thrusts – Design of Critical Section. **Design of Slab Bridges** – Effective Width of Analysis – Workings Stress Design and Detailing of Slab Bridges for IRC Loading.

UNIT - III	Lecture Hrs:10

T-Beam Bridges – Introduction – Wheel Load Analysis – B.M. in Slab – Pigaud's Theory – Analysis of Longitudinal Girders by Courbon's Theory Working Stress Design and Detailing of Reinforced Concrete T-Beam Bridges for IRC Loading.

UNIT - IV	Lecture Hrs:9

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Prestressed Concrete Bridges – General Features – Advantages of Prestressed Concrete Bridges – Pre-tensioned Prestressed Concrete Bridges – Post Tensioned Prestressed Concrete Bridge Decks. Design of Post Tensioned Prestressed Concrete Slab Bridge Deck. Bridge Bearings – General Features – Types of Bearings – Forces on Bearings Basis for Selection of Bearings – Design Principles of Steel Rocker and Roller Bearings and Its Design – Design of Elastometric Pad Bearing Detailing of Elastomeric Pot Bearings.

UNIT - V	Lecture Hrs:9

Piers and Abutments – General Features – Bed Block – Materials for Piers and Abutments – Types of Piers – Forces Acting on Piers – Design of Pier – Stability Analysis of Piers – General Features of Abutments – Forces Acting on Abutments – Stability Analysis of Abutments.

Textbooks:

1. Essentials of Bridges Engineering – D.Hohnson Victor Oxford & IBH Publishers Co-Private Ltd.
2. Design of Concrete Bridges MC Aswanin VN Vazrani, MM Ratwani, Khanna Publishers.
3. Bridge Engineering – S.Ponnuswamy.

Reference Books:

1. Concrete Bridge Design, Browe, R.E., C.R.Books Ltd., London, 1962.
2. Reinforced Concrete Bridges, Taylor F.W., Thomson, S.E., and Smulski E., John Wiley and Sons, New York, 1955.
3. An Introduction to Structural Design of Concrete Bridges, Derrick Beckett, Surrey University; Press, Henlely – Thomes, Oxford Shire, 1973
4. Bridge Analysis Simplified, Bakht.B.And Jaegar, L.G. Mc Graw Hill, 1985.
5. Design of Bridges – N.Krishna Raju – Oxford & IBH
6. Design of Bridge Structures – FR Jagadeesh, M.A. Jaya Ram – Eastern Economy Edition.

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Course Code	STRUCTURAL HEALTH MONITORING (PE-IV)	L	T	P	C
25A120204c		3	0	0	3
Semester			II		

Course Objectives: This Course Will Enable Students:

- To introduce the concept of structural health and factors affecting the durability and serviceability of structures.
- To familiarize students with structural health monitoring (SHM) concepts, procedures, and auditing techniques.
- To provide knowledge on static and dynamic field-testing methods and instrumentation for evaluating structural behavior.
- To impart understanding of remote monitoring systems, data acquisition, and modern sensor technologies.
- To expose students to rehabilitation techniques, smart materials, and advanced methods such as the electro-mechanical impedance (EMI) technique.

Course Outcomes (CO): Student will be able to

- Explain the causes of distress and the importance of maintenance in structural health.
- Apply SHM concepts, procedures, and auditing techniques to assess the safety of structures.
- Select appropriate static and dynamic field-testing methods for evaluating structural performance.
- Utilize modern sensor systems, hardware, and remote monitoring technologies for structural health assessment.
- Demonstrate knowledge of rehabilitation techniques, smart materials, and EMI-based approaches through case studies.

UNIT - I	Lecture Hrs:10
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.	
UNIT - II	Lecture Hrs:10
Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.	
UNIT - III	Lecture Hrs:10
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	
UNIT - IV	Lecture Hrs:9
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	

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UNIT - V	Lecture Hrs:9
Introduction to Repairs and Rehabilitations of Structures: Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.	
Textbooks:	
1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006 2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.	
Reference Books:	
1. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006. **2.** Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic PressInc,2007.	

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Course Code	ADVANCED STRUCTURAL ENGINEERING LAB	L	T	P	C
25A120205		0	0	4	2
Semester			II		

Course Objectives: The students will acquire knowledge about

- To perform destructive and non-destructive testing of hardened concrete and structural elements.
- To evaluate the strength, durability, and serviceability of concrete components.
- To understand the behavior of reinforced concrete members under axial, flexural, and shear loads.
- To correlate experimental results with theoretical predictions for structural assessment.
- To develop skills for structural health evaluation and quality control using practical testing methods.

Course Outcomes (CO): At the end of the course, students will be able to:

- Determine compressive, tensile, and flexural strengths of concrete and RCC members.
- Assess structural performance using destructive tests like bending, shear, and axial load tests.
- Evaluate concrete quality and reinforcement condition using NDT techniques (Rebound Hammer, UPV, Half-Cell Potential).
- Assess durability characteristics through rapid chloride penetration and carbonation tests.
- Apply test results to assess structural integrity, serviceability, and repair requirements for concrete structures.

List of Experiments:

1. **Compression Test on Concrete Cubes** – Determination of compressive strength.
2. **Compression Test on Concrete Cylinders** – Standard strength evaluation.
3. **Flexural Test on RCC Beams (Single Point Load)** – Bending and cracking behavior.
4. **Flexural Test on RCC Beams (Two-Point Load)** – Moment distribution and failure patterns.
5. **Split Tensile Test on Cylindrical Specimens** – Indirect tensile strength.
6. **Shear Test on Slabs / Beams** – Determination of one-way or two-way shear strength.
7. **Load Testing of Columns** – Axial load behavior and failure mode.
8. **Load Testing of Walls** – Axial and lateral load evaluation.
9. **Rebound Hammer Test (NDT)** – Surface hardness and strength estimation.
10. **Ultrasonic Pulse Velocity Test (NDT)** – Homogeneity and quality of concrete.
11. **Rapid Chloride Penetration Test / Carbonation Depth** – Durability assessment.
12. **Half-Cell Potential / Corrosion Assessment of Reinforced Concrete** – Estimation of reinforcement corrosion probability.

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Course Code	ADVANCED STRUCTURAL ANALYSIS AND DESIGN LABORATORY	L	T	P	C
25A120206		0	0	4	2
Semester			II		

Course Objectives: The students will acquire knowledge about

- To develop practical skills in the analysis and design of bridges, including bridge decks using grillage analogy.
- To impart knowledge in the analysis and design of Pre-Engineered Buildings (PEB) and gantry girders.
- To provide hands-on experience in analyzing and designing high-rise multi-storeyed buildings with various structural systems, including shear walls and flat slabs.
- To familiarize students with the design of raft foundations for flat slab and beam-slab systems.
- To integrate theoretical concepts of structural analysis and design into practical computational exercises.

Course Outcomes (CO): At the end of the course, students will be able to:

- Analyze and design bridge decks using grillage analogy and structural design principles.
- Perform analysis and design of PEB structures and gantry girders under applied loads.
- Design high-rise multi-storeyed buildings with different systems including shear walls and flat slabs.
- Design raft foundations for flat slab and beam-slab structural systems.
- Apply theoretical knowledge and computational tools to perform practical structural analysis and design projects efficiently.

List of Experiments:

1. Analysis of a Bridge Deck by Grillage Analogy
2. Analysis and Design of a PEB Structure
3. Analysis and design of a Gantry Girder
4. Analysis and design of a High-Rise Multi storied Building
5. Analysis and design of a Highrise Multi storey Building with shear wall
6. Analysis and design of a Highrise Multi storey Building with Flat Slab System
7. Analysis and design of Flat Slab Raft foundation
8. Analysis and design of Beam Slab Raft foundation

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25A158207	**QUANTUM TECHNOLOGIES AND APPLICATIONS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objectives

1. Present core quantum principles such as superposition and entanglement without mathematical formalism.
2. Develop conceptual clarity on qubits, quantum states, and information frameworks.
3. Examine the theoretical challenges in realizing scalable quantum systems.
4. Introduce foundational ideas in quantum communication and computing.
5. Highlight applications, industrial adoption, and future research directions in quantum technologies.

Course Outcomes Upon completion, the learner will be able to:

- Explain fundamental quantum concepts conceptually.
- Distinguish classical information systems from quantum information frameworks.
- Identify the principal theoretical limitations in building quantum computers.
- Describe the conceptual basis of quantum communication and computation.
- Discuss current applications, technological trajectories, and career opportunities in the quantum domain.

Unit 1: Foundations of Quantum Theory and Technologies Transition from classical to quantum physics. Key conceptual principles: Superposition, Entanglement, Uncertainty, Wave-particle duality. Quantum states and measurement; the role of the observer. Representative quantum systems: electrons, photons, atoms. Concept of quantization and discrete energy levels. Strategic relevance of quantum technologies. Overview of major domains: Computing, Communication, Sensing. Global quantum initiatives: India's National Quantum Mission, EU Quantum Flagship, USA, China.

Unit 2: Conceptual Structure of Quantum Information Qubits: qualitative understanding using spin and polarization. Classical bits vs quantum bits: distinctions and implications. Quantum systems (non-engineering perspective): trapped ions, superconducting qubits, photonics. Coherence and decoherence mechanisms. Abstract notions: quantum states, measurement operators, Hilbert space—interpretation without mathematics. Entanglement and non-locality as foundational resources. Quantum vs classical information principles; philosophical considerations.

Unit 3: Building a Quantum Computer – Challenges and Requirements

Conceptual prerequisites for functional quantum hardware. Fragility of quantum states: decoherence, noise, stability issues. Requirements: isolation, error resilience, scalability, control. Why maintaining entanglement is difficult; theoretical necessity of quantum error correction. Comparative overview of hardware platforms (superconducting circuits, trapped ions, photonics). Current progress vs scientific constraints; conceptual view of quantum software's role.

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Unit 4: Quantum Communication and Computing (Redundant explanations removed, retaining only unique themes.) Quantum vs classical communication paradigms. Essentials of Quantum Key Distribution (QKD) and its security rationale. Entanglement-enabled communication protocols. Concept of the Quantum Internet and secure global networking. Introduction to quantum computing and quantum parallelism. Conceptual comparison of classical and quantum gate operations. Challenges: decoherence, noise, and the necessity of error correction frameworks.

Unit 5: Applications, Industry, and Future Directions Application domains: Healthcare and drug discovery, Material science and chemistry, Optimization and logistics, Quantum sensing and precision timing. Case studies: IBM, Google, Microsoft, Psi Quantum. Ethical, societal, and policy considerations. Barriers to adoption: cost, skilled workforce, standards. Emerging research and career landscapes; India's strategic opportunity in the global quantum ecosystem.

Textbooks

1. Nielsen & Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.
2. Rieffel & Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books

David McMahon, Quantum Computing Explained, Wiley, 2008.
Kaye, Laflamme, Mosca, An Introduction to Quantum Computing, OUP, 2007. Scott Aaronson, Quantum Computing Since Democritus, CUP, 2013.
Susskind & Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books, 2014.
Rosenblum & Kuttner, Quantum Enigma, OUP, 2011.
Benenti et al., Principles of Quantum Computation and Information, World Scientific, 2004.
DST India and MeitY: Official Quantum Mission Reports, 2020 onwards.
Quantum Flagship EU: Roadmaps and Strategy Documents.

Online Learning Resources

IBM Quantum Experience & Qiskit Textbook Coursera – Quantum Mechanics and Quantum Computation (UC Berkeley) edX – Quantum Internet & Quantum Computers
YouTube – Quantum Computing for the Determined (Michael Nielsen).

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25A1AC201a	**PEDAGOGY STUDIES**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

Semester	**II**

Course Objectives:

1. To enable the students to understand the aims, rationale, policy background, and conceptual frameworks in pedagogy, curriculum, and teacher education research.
2. To develop an understanding of diverse pedagogical practices
3. To make them learn the methodologies for assessing the effectiveness of pedagogical practices and teacher education models.
4. To enable them to learn professional development strategies, including peer support, community engagement, and alignment with curriculum and assessment.

Course Outcomes (CO): Students will be able to

1. Define and explain key concepts, frameworks, and methodologies in pedagogy and teacher education research.
2. Critically analyze pedagogical practices used in diverse classroom settings, with reference to teacher education and curriculum design.
3. Evaluate the effectiveness of pedagogical approaches using quality assessment tools and theory of change models.
4. Apply evidence-based strategies to improve classroom practices, curriculum alignment, and teacher professional development.
5. Identify and address barriers to learning through innovative pedagogical strategies.
6. Design and propose research studies that contribute to filling gaps in pedagogy, curriculum, and teacher education, with focus on dissemination and impact.

UNIT -I	**Foundations of Pedagogy**

Introduction to pedagogy and its importance in education - Historical and philosophical foundations of pedagogy - Theories of learning and teaching (behaviorist, cognitive, constructivist) - Role of pedagogy in shaping educational practices - Role of technology in modern pedagogy (ICT, e-learning, blended learning)

UNIT - II	**Teaching-Learning Processes**

Understanding the teaching-learning process - Lesson planning and curriculum design - Strategies for effective teaching and learning (expository, collaborative, experiential) - Use of technology to enhance teaching-learning processes (multimedia, simulations, gamification)

UNIT - III	**Technology Integration in Education**

Educational technology and system design - Instructional design models (ADDIE, ASSURE, Dick and Carey Model) - Emerging trends in e-learning (social learning, MOOCs, mobile learning) - ICT tools for teaching and learning (Learning Management Systems, online resources)

UNIT - IV	**Pedagogy and Assessment**

Pedagogy, pedagogical analysis, and assessment - Types of assessment (placement, formative,

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diagnostic, summative) - Technology-based assessment tools (online quizzes, polls, discussions) - Rubrics for self and peer evaluation- Reflective Practices	
UNIT - V	**Contemporary Issues and Trends**
Inclusive education and technology (assistive technology, accessibility) - Change management and innovation in education - Quality assurance and evaluation in education (TQM, Six Sigma) - Future trends in pedagogy and technology (AI, AR, VR in education) - Personalized learning and adaptive teaching	

Textbooks

1. Alexander, R. J. Essays on Pedagogy. Routledge, 2008.
2. Shulman, L. S. The Wisdom of Practice: Essays on Teaching, Learning, and Learning to Teach. Jossey-Bass, 2004

Reference Books

1. Teaching for the Future: Effective Teacher Education and Pedagogical Practices. OECD Publishing., 2021
2. Fullan, M., & Edwards, M. System Change in Education: Sustainability and Impact. Routledge, 2022.
3. Coe, R., Rauch, C., Kime, S., & Singleton, D. Great Teaching Toolkit: Evidence Review. Evidence Based Education., 2020
4. Zeichner, K. M. The Struggle for the Soul of Teacher Education. Routledge, 2024
5. UNESCO. Global Education Monitoring Report: Pedagogy, Teachers and Learning. UNESCO Publishing, 2024
6. Hattie, J. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement. Routledge., 2009
7. Darling-Hammond, L. Teacher Education Around the World: What Can We Learn from International Practice? Routledge, 2007

Online Resources

- UNESCO Education Resources – https://www.unesco.org/education
- OECD Education and Skills – https://www.oecd.org/education
- ERIC (Education Resources Information Center) – https://eric.ed.gov (peer-reviewed papers, reports).
- World Bank Education – https://www.worldbank.org/en/topic/education (research reports on teacher development in developing countries).
- NPTEL/SWAYAM MOOCs – Teacher education and pedagogy-focused courses.
- Google Scholar Alerts – set alerts for "pedagogical practices", "teacher education", "curriculum research" for the latest academic papers.

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25A1AC201b	**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

Semester	**II**

Course Objectives: This course will enable students:

- To develop students' self-awareness by identifying their strengths, weaknesses, opportunities, and challenges (SWOC analysis).
- To enable students to understand and apply the principles of emotional intelligence and effective interpersonal communication.
- To cultivate positive thinking, resilience, mindfulness, and a growth-oriented mindset.
- To enhance verbal and non-verbal communication skills, including confidence in public speaking and professional presentations.
- To familiarize students with leadership styles, teamwork strategies, and collaborative problem-solving in personal and professional contexts.

Course Outcomes (CO): Student will be able to

1. Define and explain key concepts of self-awareness, personality, and personal growth.
2. Identify and apply strategies of emotional intelligence to regulate emotions and build effective interpersonal relationships
3. Demonstrate positive thinking, gratitude, and resilience to overcome personal and professional challenges
4. Analyse barriers to effective communication and apply verbal and non-verbal communication techniques in diverse contexts.
5. Prepare, deliver, and evaluate effective presentations and public speeches with confidence
6. Develop leadership and teamwork skills to collaborate, negotiate, and solve problems in group settings.

UNIT –I	**Self-Awareness and Personal Growth**

Understanding personality and its development- Identifying strengths, weaknesses, opportunities, and challenges (SWOC analysis)- Setting personal and professional goals- Practicing Self-Reflection and Journaling (Activities: Personality assessments, self-reflection exercises, group discussions, SWOC analysis worksheet, Action Plan, SMART goal activities, Reflective journaling, Self-care Planning)

UNIT – II	**Emotional Intelligence and Interpersonal Skills**

Understanding emotional intelligence and its importance - Developing self-awareness, self-regulation, and motivation - Building effective communication and interpersonal skills - Conflict resolution and negotiation strategies. (Activities: Emotional Intelligence Quiz, Self-Reflection exercises, feedback sessions, mindfulness exercises, Positive self-talk, Active Listening exercises, conflict-resolution Role-play, Case studies & Group activities)

UNIT – III	**Positive Thinking and Attitude**

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Understanding the power of positive thinking- Developing a growth mindset and resilience - Practicing gratitude and mindfulness- Overcoming negative thoughts and behaviors (Activities on positive thinking, growth mindset, mindfulness and self-care plan for overcoming negative thoughts)	
UNIT – IV	**Effective Communication and Presentation Skills**
Understanding the importance of effective communication- Developing verbal and non-verbal communication skills- Preparing and delivering effective presentations- Building confidence and public speaking skills (Activities: Group discussions, Case studies, Role-Play, Non-verbal communication exercises, Practice presentations, Peer feedback, public speaking exercises, Storytelling, Debates)	
UNIT – V	**Leadership and Teamwork**
Understanding leadership styles and qualities - Developing leadership skills and qualities- Building effective teams and teamwork strategies- Practicing collaboration and problem-solving (Activities: Case studies, Group discussions, Debates, Leadership role-playing, team building activities, Group projects, Collaborative problem-solving exercies, feedback sessions)	
Prescribed Books 1. Daniel Goleman, *Emotional Intelligence: Why It Can Matter More Than IQ*, Bantam Books, 2017. 2. Stephen R. Covey, *The 7 Habits of Highly Effective People*, Simon & Schuster, 2020.	
Reference Books 1. Dale Carnegie, *How to Win Friends and Influence People*, Simon & Schuster, 2020. 2. Brian Tracy, *Goals! How to Get Everything You Want Faster Than You Ever Thought Possible*, Berrett-Koehler Publishers, 2021. 3. Robin Sharma, *the 5 AM Club: Own Your Morning, Elevate Your Life*, HarperCollins, 2020. 4. Carol S. Dweck, *Mindset: The New Psychology of Success*, Random House, 2016. 5. Daniel H. Pink, *Drive: The Surprising Truth About What Motivates Us*, Riverhead Books, 2018. 6. John C. Maxwell, *Leadershift: 11 Essential Changes Every Leader Must Embrace*, HarperCollins, 2019.	
Online Resources 1. **Coursera** – *Personal Development Specialization* (https://www.coursera.org) 2. edX – Leadership and Emotional Intelligence Courses (https://www.edx.org) 3. **Future Learn** – *Mindfulness and Resilience Training* (https://www.futurelearn.com) 4. **MindTools** – Practical resources on leadership, communication, and emotional intelligence (https://www.mindtools.com) 5. **Positive Psychology** – Articles and tools on resilience, gratitude, and well-being (https://positivepsychology.com) 6. **TED Talks** – Inspirational talks on leadership, communication, and self-growth (https://www.ted.com)	

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25A1AC201c	YOGA FOR STRESS MANAGEMENT	L	T	P	C
		2	0	0	0

Semester	II

Course Objectives:

1. To make the students understand the foundational concepts of Yoga, including Ashtanga (eight limbs) as prescribed in classical texts.
2. To enable them analyze the principles of Yama and Niyama, and their role in ethical, personal, and social development.
3. To make them learn do's and don'ts of life through the practice of ahimsa, satya, astheya, brahmacharya, aparigraha, shaucha, santosh, tapa, swadhyaya, and ishwar-pranidhana.
4. To make them practice asanas and pranayama techniques for physical fitness, mental balance, and spiritual awareness.
5. To make them understand the holistic lifestyle through regular yoga practice, leading to personality development.

Course Outcomes (CO): Student will be able to

1. Explain the eight limbs of Yoga (Ashtanga) and their interrelationship in holistic development.
2. Demonstrate understanding of Yama and Niyama as ethical guidelines and apply them in personal and professional life.
3. Differentiate between do's and don'ts in daily life with reference to Yogic principles like ahimsa, satya, and swadhyaya.
4. Perform selected asanas and pranayama techniques with correct posture, breathing, and awareness.
5. Evaluate the physical, mental, and emotional benefits of yoga practices in stress reduction, concentration, and self-discipline.
6. Integrate yoga philosophy and practices into a personal routine for sustainable health and inner growth.

UNIT -I

Definitions of Eight parts of yoga. (Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do's and Don'ts in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii)Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

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i) Various yoga poses and their benefits for mind and body
ii) Regularization of breathing techniques and its effects-Types of pranayam

Textbooks

1. Swami Prabhavananda and Christopher Isherwood (translation & commentary), *Patanjali Yoga Sutras,*Sri Ramakrishna Math, 1953.
2. B.K.S. Iyengar, Light on Yoga, Thorsons, 2003.

Reference Books

1. T.K.V. Desikachar, The Heart of Yoga: Developing a Personal Practice, Inner Traditions 2nd Edition, 1999.
2. Acharya Yatendra, Yoga & Stress Management, Fingerprint Publishers, 2019
3. Yamini Muthanna, The Power of Yoga, Om Books International, 2015.
4. Nayaswami Devarshi, Kriya Yoga: Spiritual Awakening for the New Age, Ananda Sangha Publications, 2023.

Online Resources

- **NPTEL / SWAYAM Online Courses** – Yoga and Physical Education modules.
- **AYUSH Ministry Website:** https://yoga.ayush.gov.in – official yoga resources, protocols, and research.
- **Yoga Journal:** https://www.yogajournal.com – practical guides, research updates, asana tutorials.
- **Art of Living Foundation:** https://www.artofliving.org – pranayama, meditation, and wellness practices.
- **YouTube Channels** (scholarly & practice-based):
- Sivananda Yoga Vedanta Centre
- Yoga with Adriene (for practical asana guidance)

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25A120301a	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (PE -V)	L	T	P	C
		3	0	0	3
Semester		III			

The objectives of this course are to:

1. **Understand** the fundamental concepts of engineering seismology, including earthquake phenomena, seismic waves, and measuring instruments. (*Bloom's Level: Understand - L2*)
2. **Analyze** the principles of structural vibrations, degrees of freedom, and dynamic response of structures to earthquake ground motions. (*Bloom's Level: Analyze - L4*)
3. **Evaluate** conceptual design strategies, seismic design principles, and methods for improving earthquake resistance in structures. (*Bloom's Level: Evaluate - L5*)
4. **Apply** earthquake-resistant design principles to reinforced concrete and masonry buildings using IS codes and lateral force methods. (*Bloom's Level: Apply - L3*)
5. **Assess** the role of structural walls, non-structural elements, and ductility considerations in enhancing earthquake resistance. (*Bloom's Level: Evaluate - L5*)

Course Outcomes (COs):

After successful completion of this course, students will be able to:

1. **Explain** earthquake mechanisms, seismic waves, and seismic zones, including measuring techniques and instruments. (*Bloom's Level: Understand - L2*)
2. **Analyze** vibratory systems, single-degree-of-freedom (SDOF) models, damping effects, and earthquake-induced dynamic forces. (*Bloom's Level: Analyze - L4*)
3. **Evaluate** conceptual design strategies, ductility factors, and seismic design methods for ensuring structural resilience. (*Bloom's Level: Evaluate - L5*)
4. **Apply** IS code provisions and lateral force methods for seismic design of reinforced concrete and masonry buildings. (*Bloom's Level: Apply - L3*)
5. **Assess** the significance of structural walls, non-structural elements, and ductile detailing in enhancing earthquake resistance. (*Bloom's Level: Evaluate - L5*)

Course Outcomes	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
CO -1	3	2	1	2	1	2	3	1	-	2	-	2	2	2
CO -2	3	3	2	3	2	2	3	1	-	2	-	2	2	2
CO -3	3	3	3	3	3	2	3	2	-	2	-	2	3	3
CO -4	3	2	3	3	3	3	3	2	-	2	2	2	3	3
CO -5	3	3	3	3	3	3	3	2	-	2	2	2	3	3

UNIT - I Engineering Seismology: Earthquake Phenomenon - Cause of Earthquakes-Faults-Plate Tectonics- Seismic Waves- Terms Associated with Earthquakes-Magnitude/Intensity of An Earthquake-Scales- Energy Released-Earthquake Measuring Instruments Seismogram - Seismoscope, Seismograph, - Strong Ground Motions- Seismic Zones of India.

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Theory Of Vibrations: Elements Of a Vibratory System- Degrees of Freedom-Continuous System- Lumped Mass Idealization-Oscillatory Motion-Simple Harmonic Motion-Free Vibration of Single Degree of Freedom (SDOF) System- Undamped and Damped-Critical Damping-Logarithmic Decrement-Forced Vibrations-Harmonic Excitation-Dynamic Magnification Factor-Excitation by Rigid Based Translation for SDOF System-Earthquake Ground Motion.

UNIT - II Conceptual Design: Introduction-Functional Planning-Continuous Load Path-Overall Form-Simplicity and Symmetry-Elongated Shapes-Stiffness and Strength-Horizontal and Vertical Members-Twisting of Buildings-Ductility-Definition-Ductility Relationships-Flexible Buildings-Framing Systems-Choice of Construction Materials-Unconfined Concrete-Confined Concrete-Masonry-Reinforcing Steel. **Introduction To Earthquake Resistant Design**: Seismic Design Requirements-Regular and Irregular Configurations-Basic Assumptions-Design Earthquake Loads-Basic Load Combinations-Permissible Stresses-Seismic Methods of Analysis-Factors in Seismic Analysis-Equivalent Lateral Force Method.

UNIT - III Reinforced Concrete Buildings: Principles of Earthquake Resistant Deign of RC Members- Structural Models for Frame Buildings - Seismic Methods of Analysis- IS Code Based Methods for Seismic Design - Vertical Irregularities - Plan Configuration Problems-Lateral Load Resisting Systems- Determination of Design Lateral Forces as Per IS 1893 (Part-1):2016- Equivalent Lateral Force Procedure- Lateral Distribution of Base Shear.

UNIT - IV Masonry Buildings: Introduction- Elastic Properties of Masonry Assemblage-Categories of Masonry Buildings- Behaviour of Unreinforced and Reinforced Masonry Walls- behaviour of Walls- Box Action and Bands- behaviour of Infill Walls- Improving Seismic behaviour of Masonry Buildings- Load Combinations and Permissible Stresses-Seismic Design Requirements- Lateral Load Analysis of Masonry Buildings.

UNIT - V Structural Walls And Non-Structural Elements: Strategies In The Location of Structural Walls- Sectional Shapes- Variations In Elevation- Cantilever Walls Without Openings – Failure Mechanism of Non-Structures- Effects of Non-Structural Elements on Structural System- Analysis of Non-Structural Elements- Prevention of Non-Structural Damage Ductility Considerations In Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements For Ductility- Assessment of Ductility-Factors Affecting Ductility- Ductile Detailing Considerations As Per IS 13920-2016 - Behaviour of Beams, Columns And Joints In RC Buildings During Earthquakes

TEXT BOOKS:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.

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REFERENCE BOOKS:

1. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly,John Wiley & Sons.
2. Eartquake Resistant Design of Buidling structures by Vinod Hosur, Wiley India Pvt. Ltd.
3. Elements of Mechanical Vibration by R.N.Iyengar, I.K.International Publishing House Pvt. Ltd.
4. Masory and Timber structures including earthquake Resistant Design –Anand S.Arya, Nem chand& Bros
5. Earthquake Tips – Learning Earthquake Design and Construction, C.V.R. Murthy
6. BIS Codes: 1. IS 1893(Part-1):2016 or latest codes; 2. IS 13920:2016. 3. IS 4326. 4. IS 456:2000 or latest.

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Course Code	REHABILITATION AND RETROFITTING OF STRUCTURES (PE V)	L	T	P	C
25A120301b		3	0	0	3
Semester			III		

Course Objectives:

1. To learn various distress and damages to concrete and masonry structures
2. To understand the importance of maintenance of structures
3. To assess the damage to structures using various tests
4. To study the various types and properties of repair materials
5. To learn various repair techniques of damaged structures, corroded structures

Course Outcomes (CO):

1. Understand corrosion effects
2. Understand the deterioration in structures
3. Understand non-destructive tests
4. Understand the surface repair of structures
5. Understand the concepts of Strengthening and stabilization of structural elements

UNIT - I

Introduction, significance of corrosion, and corrosion mechanisms - Embedded metal corrosion

UNIT - II

Deterioration of cementations systems – Sulphate and Acid attack - Alkali Silica Reaction (ASR), Shrinkage, and others

UNIT - III

Concrete assessment using non-destructive tests (NDT) - Concrete assessment and load effects

UNIT - IV

Surface repair – Condition assessment – Analysis, strategy, and design – Material requirement, surface preparation, placement of repair material

UNIT - V

Strengthening and stabilization -Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage, earthquake-Transportation of Structures from one place to other -Structural Health Monitoring- demolition techniques-Engineered demolition methods-Case studies, Study of structural conditions of heritage buildings.

Textbooks:

1. Concrete Repair and Maintenance by Peter H. Emmons, R.S. Means Company, Kingston, MA, USA.
2. Maintenance Repair & Rehabilitation & Minor Works of Buildings by P.C. Varghese, PHI Learning Pvt. Ltd., New Delhi.

Reference Books:

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1. Concrete Repair to EN1504 – Diagnosis, Design, Principles and Practice by Michael Raupach and Till Buttner, CRC Press.,
2. Concrete Structures – Protection, Repair and Rehabilitation by R. Dodge Woodson, Butterworth-Heinemann – Elsevier, UK

Online Learning Resources:
https://nptel.ac.in/courses/105106202

Course Code	DESIGN OF TALL BUILDINGS (PE-V)	L	T	P	C
25A120301c		3	0	0	3
Semester			III		

Course Objectives: This Course Will Enable Students:

- To study the behaviour of tall structures.
- To enhance competence in understanding the various structural systems of high-rise buildings
- To familiarize with the methods of analysis of tall-steel and concrete buildings under various loading conditions

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Course Outcomes (CO): Student will be able to

- Understand structural systems of tall buildings.
- Implement latest construction practices and processes for structural systems.
- Analyse and design high rise structures.
- □ Design fire protection systems in tall buildings.

UNIT - I Lecture Hrs:10

EVOLUTION OF TALL BUILDINGS: Introduction, Design Criteria for Structural Design of Tall Building, Concept of Premium for Height, Development of High-Rise Architecture. **ASSEMBLY OF BUILDING:** Building Performance –Cost, Quality and Time, Environmental Requirements, Industrialization& Robotics in Construction, Introduction to Safety and Health Management System.

UNIT - II Lecture Hrs:10

SITE INVESTIGATION: Stages Of Site Investigation, Site Reconnaissance & Ground Investigation-Field Tests & Laboratory Tests. **FOUNDATION SYSTEMS:** Foundation Systems. Material Handling and Mechanization: Material Handling Considerations, Earthmoving Equipment's, Horizontal and Vertical Movements, Selection & Utility of Cranes (Tower Cranes & Climbing Cranes).

UNIT - III Lecture Hrs:10

WIND EFFECTS ON BEHAVIOUR OF TALL STRUCTURES: Outlook of Design Considerations and Characteristics of Wind, Codal Wind Loads and Cladding Pressures on Behavior of Tall Buildings.

UNIT - IV Lecture Hrs:9

SEISMIC EFFECTS ON BEHAVIOUR OF TALL STRUCTURES: Introduction to Tall Building Behavior During Earthquakes and Seismic Design Philosophy – Building Behaviour – Seismic Design Concept – Dynamic Response Concept – Dynamic Analysis Theory – Design Techniques.

UNIT - V Lecture Hrs:9

STRUCTURAL FORMS &FLOORING SYSTEMS: Introduction of Various Structural Forms and Their Importance to High Rise Architecture, Introduction to Various Flooring Systems in Concrete & Steel. **MODELING FOR ANALYSIS:** Approaches For Analysis, Assumptions Involved in Modelling, Reduction Techniques, Application Using Structural Engineering Software.

Textbooks:

1. Concrete And Composite Design of Tall Buildings. By Taranath, B, Steel, 2nd Edition, Mcgraw Hill, 1998.
2. Building Structural Design Handbook. By White And Salmon, John Wiley & Sons.
3. Tall Buildings Structures Analysis and Design by Bryan S,SmithAnd Alex Coull, Wiley India Pvt Ltd.

Reference Books:

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1. The Design of Building Structures. By Wolfgang Schueller, Prentice Hall India,
2. Reinforced Concrete Design of Tall Buildings By S.Taranath.B, CRC Press.

25A120302a	GREEN BUILDINGS (OE - I)	L	T	P	C
		3	0	0	3

Course Objectives (COs)

The objectives of this course are:

1. **To understand** the fundamental concepts of green buildings, their necessity, and sustainable features. (Understanding - Level 2)
2. **To analyze** green building concepts, rating systems, and their benefits in India. (Analyzing - Level 4)
3. **To apply** green building design principles, energy efficiency measures, and renewable energy sources. (Applying - Level 3)
4. **To evaluate** air conditioning systems, HVAC designs, and energy modeling for sustainable buildings. (Evaluating - Level 5)
5. **To assess** material conservation strategies, waste management, and indoor environmental quality in green buildings. (Evaluating - Level 5)

Course Outcomes (COs)

Upon successful completion of the course, students will be able to:

1. **Understand** the importance of green buildings, their necessity, and sustainable features. (Understanding - Level 2)
2. **Analyze** various green building practices, rating systems, and their impact on environmental sustainability. (Analyzing - Level 4)
3. **Apply** principles of green building design to enhance energy efficiency and incorporate renewable energy sources. (Applying - Level 3)
4. **Evaluate** HVAC systems, energy-efficient air conditioning techniques, and their role in sustainable building design. (Evaluating - Level 5)
5. **Assess** material conservation techniques, waste reduction strategies, and indoor air quality management in green buildings. (Evaluating - Level 5)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO -1	3	-	-	-	-	2	3	-	-	-	-	-	3	3
CO -2	-	3	-	-	2	-	3	-	-	-	-	2	3	3
CO -3	-	-	3	3	3	-	3	-	-	-	-	-	3	3
CO -4	-	-	3	3	3	-	3	-	-	-	-	-	3	3
CO -5	-	-	-	-	-	3	3	3	2	-	-	-	-	3

UNIT-I

Introduction to Green Building – Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing a Green Building, Important Sustainable Features for Green Buildings.

UNIT-II

Green Building Concepts and Practices – Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.

UNIT-III

Green Building Design – Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-friendly Captive Power Generation for Factories, Building Requirements.

UNIT-IV

Air Conditioning – Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling Towers, Selection of Air Handling Units, Pre-cooling of Fresh Air, Interior Lighting Systems, Key Features of the Building, Eco-friendly Captive Power Generation for Factories, Building Requirements.

UNIT-V

Material Conservation – Handling of Non-Process Waste, Waste Reduction During Construction, Materials with Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health – Air Conditioning, Indoor Air Quality, Sick Building Syndrome, Tobacco Smoke.

Text Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
2. Green Building Hand Book by Tomwoolley and Samkimings, 2009.

Reference: -

1. Complete Guide to Green Buildings by Trish riley
2. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009
3. Energy Conservation Building Code –ECBC-2020, published by BEE

Course Code	ROAD SAFETY ENGINEERING	L	T	P	C
25A120302b	(OE- I)	3	0	0	3

Course Objectives: This Course has the following objectives:

- Discusses the fundamentals causes of road accidents & some of the statistical methods to analyze the traffic safety.
- The accident investigation and risk management are dealt.
- Introduction of Road Safety as an integral part of Road Design is emphasized.

Course Outcomes (CO): After completion of the course the student will be able

- To understand the basic causes of road accidents
- To conduct accident investigations and identify black spots
- To design & plan road geometrics incorporating road safety
- To understand the importance of Road Signs and Markings
- To conduct Road Safety Audit

UNIT - I	Lecture Hrs:10

Accident Investigations and Risk Management, Collection of Accident Data, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of
Safety Design Features, Accident Reconstruction, Condition and Collision Diagram.

UNIT - II	Lecture Hrs:10

Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis –Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons- Traffic Management Measures and Their Influence on Accident Prevention.

UNIT - III	Lecture Hrs:10

Road Safety in ` Transport Planning and Geometric Design: Vehicle and Human Characteristics,
Road Design and Safety Elements, Redesigning Junctions, Cross Section Improvements, Traffic Control, Traffic Calming Measures, Road Safety Furniture

UNIT - IV	Lecture Hrs:9

**Role of Signs and Markings in ` Safety**: Types of Signs – Design Specifications – Guidelines for Installation – Role of Signs in `Safety; Types of Road Markings – Design Specifications – Role of Road Markings in `Safety.

UNIT - V	Lecture Hrs:9

Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Road Safety Improvement Strategies, ITS and Safety.

Textbooks:

1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
2. Fundamentals of Transportation Engineering - C.S.Papacostas, Prentice Hall India.
3. Road Safety by NCHRP

Reference Books:

1. Transportation Engineering – An Introduction, C.Jotin Khisty, B. Kent Lall
2. Fundamentals of Traffic Engineering, Richardo G Sigua
3. Handbook of Road Safety Measures, Second Edition, Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson

25A158101	ADVANCED DATA STRUCTURES AND ALGORITHMS (OE-I)	L	T	P	C
		3	0	0	3

Course Objectives:

The course aims to:

1. Introduce fundamental data structures including linked lists, stacks, queues, trees, graphs, dictionaries, and hashing techniques.
2. Develop algorithmic skills for designing and analyzing searching, sorting, and traversal methods.
3. Teach implementation of priority queues, binary search trees, and balanced trees (AVL, Red-Black, Splay, B-Trees).
4. Enable students to select and apply appropriate data structures for solving computational problems efficiently.
5. Foster understanding of the performance analysis and comparative evaluation of data structures and algorithms.

Course Outcomes:

After completing this course, students will be able to:

CO1: Implement and manipulate linear data structures like singly/doubly linked lists, circular lists, stacks, and queues using dynamic memory allocation.

CO2: Apply and analyze searching and sorting algorithms including linear, binary search, bubble, selection, insertion, quick, and merge sort.

CO3: Design and implement dictionaries and hashing techniques to efficiently store and retrieve data.

CO4: Construct and operate on trees and priority queues, performing insertion, deletion, and traversal operations.

CO5: Compare and implement balanced search trees (AVL, Red-Black, Splay, B-Trees) for optimized data access and storage.

UNIT I: Introduction

Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.

UNIT II: Searching and Sorting:

Linear and Binary Search Methods, Sorting: -Basic sorting techniques, Radix Sort, Bucket Sort, Shell Sort Trees- Binary trees, Properties, Representation and Traversals, Expression Trees (Infix, prefix, postfix). Graphs-Basic Concepts, Storage structures and Traversals.

UNIT III: Dictionaries and Hashing

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

UNIT IV: Priority queues

Definition, ADT, realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion. Search Trees-Binary Search Trees, Definition, ADT, Implementation, Operations-Searching, Insertion, Deletion.

UNIT V: Search Trees-

AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching, Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

Text Books:

1. Data Structures: A Pseudo Code Approach, 2/e, Richard F.Gilberg, Behrouz A. Forouzon and Cengage
2. Data Structures, Algorithms and Applications in java, 2/e, SartajSahni, University Press

Reference Books:

1. Data Structures and Algorithm Analysis, 2/e, Mark Allen Weiss, Pearson.
2. Data Structures and Algorithms, 3/e, Adam Drozdek, Cengage
3. C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples, N.B.Venkateswarulu, E.V.Prasad and S Chand & Co.

25A158305	CLOUD COMPUTING (Open Elective I)	L	T	P	C
		3	0	0	3

Course Objectives:

- Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure. Compare the advantages and disadvantages of various cloud computing platforms.
- Investigate how a global storage solution can be optimized so that it can be delivered successfully from the cloud
- Evaluate information storage management design in a cloud environment and how it relates to the business objectives of an organization
- Analyze how best to provide reliable access to information both locally and remotely using storage technologies
- Critically appraise the opportunities and challenges of information management in complex business environments.

Course Outcomes:

After the completion of the course, student will be able to

- Deploy applications over commercial cloud computing infrastructures such as Amazon Web Services, Windows Azure, and Google App Engine.
- Program data intensive parallel applications in the cloud.
- Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
- Identify security and privacy issues in cloud computing.
- Solve a real-world problem using cloud computing through group collaboration.

UNIT–I:

Definition, characteristics, components, Cloud service provider, the role of networks in Cloud computing, Cloud deployment models- private, public & hybrid, Cloud service models, multitenancy, Cloud economics and benefits, Cloud computing platforms - IaaS: Amazon EC2, PaaS: Google App Engine, Microsoft Azure, SaaS.

UNIT–II:

Virtualization concepts, Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, VMware hypervisors and their features

UNIT–III: Relational databases, Cloud file systems: GFS and HDFS, Bigtable, HBase and Dynamo. MapReduce and extensions: Parallel computing, the map -Reduce model, Parallel efficiency of Map Reduce.

UNIT–IV: Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Cloud computing security architecture: General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro - architectures; Identity Management and Access control, Autonomic security.

UNIT–V: Issues in cloud computing Implementing real time application over cloud platform, Issues in Inter - cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud.

Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware.

TEXT BOOKS:

1. Enterprise Cloud Computing by Gautam Shroff, Cambridge publication
2. Gautam Shroff, —Enterprise Cloud Computing Technology Architecture Applications‖, Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.

REFERENCE BOOKS:

1. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley -India
2. Dr. Kumar Saurabh, —Cloud Computing‖, Wiley Publication
3. Dimitris N. Chorafas, —Cloud Computing Strategies‖ CRC Press; 1 edition [ISBN: 1439834539],2010
4. Toby Velte, Anthony Velte, Robert Elsenpeter, —Cloud Computing, A Practical Approach‖ McGraw Hill Osborne Media; 1 edition [ISBN: 0071626948], 200
5. RajkumarBuyya, James Broberg, Andrzej M. Goscinski, —Cloud Computing: Principles and Paradigms‖, Wiley Publication, 2011
6. Tim Mather, SubraKumaraswamy, Shahed Latif, —Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance‖, O'ReillyMediaInc, 2009

25A158305	AI TOOLS (OE-I)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES (COs)

After completing the course, the student will be able to:

- CO1: Explain the fundamentals and evolution of AI tools
- CO2: Use AI tools for text, language, and communication tasks
- CO3: Apply AI tools for image, audio, and video generation
- CO4: Utilize AI tools for coding, research, and productivity enhancement
- CO5: Analyze ethical, security, and application-oriented aspects of AI tools

COURSE OBJECTIVES (COBJ)

After completing this course, students will be able to:

- Understand the fundamentals and evolution of AI tools
- Explore popular AI tools for text, image, video, and code generation
- Apply AI tools in education, research, and industry use cases
- Analyze ethical, security, and societal implications of AI tools
- Develop practical skills to effectively use AI tools for productivity and innovation

UNIT–I: Introduction to AI Tools

Definition of Artificial Intelligence, Evolution of AI and Intelligent Systems, Categories of AI Tools (Generative, Analytical, Assistive), Rule-based vs Learning-based AI Tools, Overview of Machine Learning & Deep Learning Tools, AI Tool Ecosystem (OpenAI, Google, Meta, Microsoft), Cloud-based AI Tools, Future Trends in AI Tool Development

UNIT–II: Text & Language AI Tools

Natural Language Processing (NLP) Basics, ChatGPT – Architecture and Capabilities, Prompt Engineering Concepts, AI Tools for Content Writing, AI Tools for Email, Resume & Report Generation, AI-based Translation and Summarization Tools, AI Chatbots and Virtual Assistants, Limitations and Bias in Language AI Tools.

UNIT–III: Image, Audio & Video AI Tools

Image Generation Tools (DALL·E, Midjourney, Stable Diffusion), Image Editing and Enhancement using AI, AI Tools for Graphic Design & Posters, Text-to-Speech AI Tools (ElevenLabs, Google TTS), Speech-to-Text AI Tools, AI-based Video Creation Tools, Avatar and Animation AI Tools, Applications in Media, Education & Healthcare

UNIT–IV: AI Tools for Coding, Research & Productivity

AI Tools for Programming Assistance, Code Generation and Debugging using AI, AI Tools for Data Analysis, AI Tools for Research Paper Writing, AI Tools for Literature Survey and Citations, AI in Project Management, AI Tools for Presentation Creation, AI Tools for Automation and Workflow Optimization

UNIT–V: Ethical, Security & Applied AI Tools

Ethical Issues in AI Tool Usage, Data Privacy and Security Concerns, AI Tool Regulations and Policies, AI Tools in Education, AI Tools in Healthcare, AI Tools in Finance and Business, AI Tools in Smart Cities and Governance, Responsible and Sustainable AI Practices

TEXT BOOKS

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2021.
2. Michael Miller, AI for Everyone, Pearson, 2020.
3. Liam Ottley, Artificial Intelligence for Business, Wiley, 2022.

REFERENCE BOOKS

1. **Kai-Fu Lee**, *AI Superpowers: China, Silicon Valley, and the New World Order*, Houghton Mifflin Harcourt, 2018.
2. **Bernard Marr**, *Artificial Intelligence in Practice*, Wiley, 2020.
3. **Ethical Guidelines for Trustworthy AI**, European Commission, 2019.

Course Code	IOT AND ITS APPLICATIONS	L	T	P	C
25A185302		3	0	0	3

Course Objectives:

- To apply the Knowledge in IOT Technologies and Data management.
- To determine the values chains Perspective of M2M to IOT.
- To implement the state of the Architecture of an IOT.
- To compare IOT Applications in Industrial & real world.
- To demonstrate knowledge and understand the security and ethical issues of an IOT.

Course Outcomes (CO): Student will be able to

- Apply the Knowledge in IOT Technologies and Data management.
- Determine the values chains Perspective of M2M to IOT.
- Implement the state of the Architecture of an IOT.
- Compare IOT Applications in Industrial & real world.
- Demonstrate knowledge and understand the security and ethical issues of an IOT.

UNIT - I

Fundamentals of IoT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures, oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.

UNIT - II

IoT Protocols: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo,

Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

UNIT - III

Design and Development: Design Methodology, Embedded computing logic, Microcontroller,

System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT - IV

Data Analytics and Supporting Services: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web

Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.

UNIT - V

Case Studies/Industrial Applications: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target
boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino).

Textbooks:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press,2015

Reference Books:

1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
2. —From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence‖, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.

Course Code	PHOTOVOLTAIC SYSTEMS (OE-I)	L	T	P	C
25A107302		3	0	0	3

Course Objectives:

- To introduce photovoltaic systems.
- To deal with various technologies of solar PV cells.
- To understand details about manufacture, sizing and operating techniques.
- To have knowledge of design considerations.

Course Outcomes (CO): Student will be able to

- Identify photovoltaic system components and system types. L2
- Calculate electrical energy and power. L2
- Correctly size system components, design considerations of solar equipment. L3
- Design a basic grid-tie PV system. L5

UNIT - I	SOLAR ENERGY	Lecture Hrs:10

Sun and Earth, Solar Spectrum, Solar Geometry, Solar radiation on horizontal and inclined planes, Instruments for measurement of solar radiation, Solar cell, Equivalent circuit, V-I characteristics, Performance improvement.

UNIT - II	SOLAR CELLS	Lecture Hrs:8

Manufacture of Solar Cells-Technologies, Design of Solar cells, Photovoltaic modules, Design requirements, Encapsulation systems, Manufacture, Power rating, Hotspot effect, Design qualifications.

UNIT - III	PROTECTION AND MEASUREMENTS	Lecture Hrs:12

Flat plate arrays, Support structures, Module interconnection and cabling, Lightning protection, Performance measurement using natural sun light and simulator, Determination of temperature coefficients, Internal series resistance, Curve correction factor.

UNIT - IV	PHOTOVOLTAIC SYSTEMS	Lecture Hrs:8

Photovoltaic systems, Types, General design considerations, System sizing, Battery sizing, Inverter sizing, Design examples, Balance of PV systems.

UNIT - V	MAXIMUM POWER POINT TRACKERS	Lecture Hrs:10

Maximum power point trackers, Perturb and observe, Incremental conductance method, Hill climbing method,
Hybrid and complex methods, Data based and other approximate methods, Instrument design, Other MPP techniques, Grid interactive PV system.

Textbooks:

1. F.C.Treble, —Generating electricity from Sun‖, Pergamon Press.
2. A.K.Mukherjee, Nivedita Thakur,‖ Photovoltaic systems: Analysis and design‖, PHI, 2011.

Reference Books:

1. C.S.Solanki,‖ Solar Photovoltaic's: Fundamentals, Technologies and applications‖, PHI, 2009.

Online Learning Resources:

1. https://nptel.ac.in/courses/117108141

Course Code	INTEGRATED PRODUCT DESIGN AND DEVELOMENT Open Elective-I	L	T	P	C
25A115302		3	0	0	3

Course Objectives:

- To know the design concepts, product development planning and customer requirements
- To generate the concept using creative problem-solving methods, concept generation and testing
- To understand product teardown, specifications, portfolios and Architecture, configurations and detailed design with prototyping
- To acquaint DFN process and know design aspects for risk, reliability and safety and environments
- To do industrial design, intellectual property and robust design and product development economics

Course Outcomes (CO): Student will be able to

- Understand To know the design concepts, product development planning and customer requirements
- Generate the concept using creative problem-solving methods, concept generation and testing
- Realize Product Teardown, Specifications, Portfolios and Architecture, configurations and prototyping
- Demonstrate and classify The Design aspects for Risk, Reliability and Safety and environments
- Do industrial design, understand intellectual property, robust design and product development economics

UNIT - I	PRODUCT DEVELOPMENT CONCEPTS	Lecture Hrs:09

Design Concepts: Design process – Considerations of a good design – Description of good design process – Design codes and standards. Product Development and Planning Process: Characteristics and challenges of product development – Concept development – Generic product development – Product development process flows –Tyco product development – Product development organizations – Organizational structure and design – Product and process cycles – Technological innovation – Structure of opportunity – Opportunity identification – Product planning process – Types of product development projects. **Identifying Customer Needs**: Process of identifying customer needs – Customer requirements.

UNIT - II	CONCEPT SELECTION, GENERATION AND TESTING	Lecture Hrs:09

Concept Generation: Activity – Concept generation process – Creativity and problem solving – Creative thinking methods and design – Functional decomposition and synthesis – Morphological methods – Axiomatic design.

Concept Selection and Testing: Development process – Choosing a concept – Concept screening and scoring – Decision making and evaluation – Methods for testing product concepts.

UNIT - III	EMBODIMENT AND DETAIL DESIGN	Lecture Hrs:09

Product Teardown, Specifications, Portfolios and Architecture: Teardown process, methods and applications – Post teardown report – Benchmarking approach and support tools for benchmarking process – Product portfolios architecture – Architecture type – Platform architecture – Target Specifications – Setting the final specifications – Modularity – Implications of the architecture – Establishing the architecture – Delayed differentiation – Platform planning – Related system-level design.

Configuration and Detail Design: Generating, analyzing and evaluating configuration design – Best practices for configuration design – Design for X – Design and manufacturing information – Final design review – Activities beyond detail design.

Prototyping: Principles, types and technologies – Understanding prototypes and planning.

UNIT - IV	DESIGN FOR ENVIRONMENT, MANUFACTURING AND SAFETY	Lecture Hrs:09

Design for Manufacture and Environment: Cross-functional team – Overview of DFM process – Life cycles – Environmental impacts – Design for environment process.

Design for Risk, Reliability and Safety: Classification of societal hazards – Standards – Risk assessment – Design for reliability – Causes of unreliability – Minimizing failure – FMEA – Fault tree analysis – Defects and failure modes – Potential dangers – Guidelines for design for safety – Warning labels.

UNIT - V	INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ECONOMICS	Lecture Hrs:09

Industrial Design: Need – Impact – Industrial design process – Management of the industrial design process –Assessing the quality of industrial design. **Robust Design:** Robust design process. **Intellectual Property:** Disclosure – Process of pursuing a patent.

Product Development Economics: Elements of economic analysis and process.

Managing Projects: Understanding and representing tasks – Baseline project planning – Accelerating projects – Project execution – Postmortem project evaluation - Project Portfolio Management (PPM) - Earned Value Management (EVM) - Sustainability and ESG in Project Management.

Textbooks:

1. Product Design and Development, Karl T Ulrich, Steven D Eppinger and Maria C. Yang, 7/e, 2020, McGraw-Hill Education Pvt.Ltd., Noida.
2. Engineering Design, George E.Dieter and Linda C.Schmidt, 4/e, 2013, McGraw-Hill Education Pvt.Ltd.,Noida.

Reference Books:

1. Product Design, Kevin Otto and Kristin Wood, 1/e, 2003, Pearson Education, India.
2. Product Development, Anil Mital, Anoop Desai, Anand Subramanian and Aashi Mital, 1/e, 2007, Butterworth-Heinemann, Elsevier.
3. Integrated Product and Process Design and Development: the Product Realization Process (Special Indian Edition), Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, 2/e, 2010, CRC Press, Taylor & Francis Group, LLC.
4. Product Design for Engineers, Devdas Shetty, 1/e, 2016, Cengage Learning, India.
5. Introduction to Product Design and Development for Engineers, Ali Jamnia, 2018, CRC Press,Taylor & Francis Group, LLC.

25A1OE59a	ADVANCED NUMERICAL METHODS AND COMPUTATIONAL MATHEMATICS (OPEN ELECTIVE-I)	L	T	P	C
		3	0	0	3

Program Outcomes (as per NBA for PG Engineering Programs)

- **PO1:** An ability to independently carry out research/investigation and development work to solve practical problems.
- **PO2:**An ability to write and present a substantial technical report/document.
- **PO3:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program; the mastery should be at a level higher than the requirements of the bachelor program.

Course Objectives:

- Equip students to analyze, design, and implement stable, accurate, and efficient numerical algorithms for large- scale models across engineering domains.
- Develop mastery in discretization, linear algebra, and optimization techniques, supported by modern scientific computing tools and reproducible workflows.
- Integrate high- performance computing paradigms to solve realistic, data- and compute- intensive problems.

Course Outcomes (COs):

- CO1: Analyze conditioning, stability, and error behavior of numerical linear algebra routines for dense and sparse problems (L3, L4).
- CO2: Derive and apply finite difference for BVP for linear and nonlinear models (L3, L4, L5).
- CO3: Derive and apply finite difference for PDE models; assess consistency and stability with Lax equivalence and CFL ideas(L3, L4).
- CO4: Optimize engineering models via unconstrained/constrained methods; justify algorithm selection and tuning using theory and diagnostics (L4, L5).
- CO5: Integrate GPU/MPI paradigms and the SciPy stack to build scalable, reproducible computational workflows; profile and validate results (L4, L5).

CO–PO Articulation Matrix

	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	1	3
CO4	3	2	3
CO5	3	3	3
1 = low, 2 = moderate, 3 = high			

Course Contents:

Unit I — Numerical Linear Algebra

- Floating- point arithmetic, conditioning, stability, backward/forward error.
- Direct solvers: LU/Cholesky/QR; pivoting and orthogonality.
- SVD, low- rank approximations, pseudoinverses.
- Iterative solvers: Jacobi/Gauss–Seidel/CG/GMRES; basic preconditioning.
- Sparse matrix formats and operations for large- scale systems.

- Krylov subspace and Arnoldi/Lanczos overviews.

Unit II — Discretization of linear and nonlinear ODEs

- Numerical solutions of initial value problems: (single step and multi -step methods)
- Stability of the numerical methods for initial value problems.
- Boundary value problems; shooting method.
- Finite difference for BVP (second and higher order methods), for linear and nonlinear problems
- Consistency–stability–convergence

Unit III — Discretization of linear and nonlinear PDEs

- Finite difference methods for parabolic problems explicit and implicit methods,
- Finite difference for hyperbolic explicit and implicit methods
- Elliptic PDE.
- Consistency, Stability and convergence.
- Lax equivalence and CFL (Courant–Friedrichs–Lewy) ideas.
- Iterative solvers and multigrid overview for discretized systems.

Unit IV — Numerical Optimization and Inverse Problems

- Unconstrained methods: gradient, Newton, quasi- Newton, trust- region.
- Constrained methods: KKT conditions, interior- point, SQP principles.
- Nonlinear least squares: Gauss–Newton and Levenberg–Marquardt.
- Regularization (Tikhonov/L1) and model selection concepts.
- Scientific Python stack:scipy.optimize.minimize, scipy.optimize.linprog, and scipy.optimize.curve_fit; solver choice and diagnostics.

Unit V — High- Performance Scientific Computing

- Parallel paradigms: data/task parallelism; domain decomposition fundamentals.
- GPU programming model: threads/warps/memory hierarchy; CUDA libraries.
- MPI and PETSc for scalable sparse linear algebra and time- steppers.
- Performance engineering: profiling, locality, and roofline- style thinking.
- Python at scale: NumPy/SciPy sparse andvectorization; brief Numba/CuPy ecosystem.
- End- to- end case sketches in CFD/structures/machine learning numerics.

Textbooks:

1. Trefethen, L. N., and D. Bau III, Numerical Linear Algebra, Twenty- Fifth Anniversary Edition, SIAM, 2023.
2. LeVeque, R. J., Finite Difference Methods for Ordinary and Partial Differential Equations: Steady- State and Time- Dependent Problems, SIAM, 2007.
3. Nocedal, J., and S. J. Wright, Numerical Optimization, 2nd ed., Springer, 2006.

References:

1. Hwu, W.- M. W., and D. B. Kirk, Programming Massively Parallel Processors: A Hands- on Approach, 4th ed., Elsevier, 2022.
2. B. N. dutta, —Numerical linera algebra and Application, - Springer Publications
3. SciPy Project. —Optimization (scipy.optimize) — SciPy Manual‖ and —Optimization and Root Finding — SciPy 1.16.2 (stable) Reference.‖
4. Balay, S., et al. PETSc/TAO Users Manual. Argonne National Laboratory, ANL-21/39 Rev 3.18release documentation.
5. Logg, A., K.- A. Mardal, and G. N. Wells (eds.). Automated Solution of Differential Equations by

the Finite Element Method: The FEniCS Book. Berlin: Springer, 2012.

6. David Kincaid Ward Chenery, — Numerical analysis Mathematics of scientific computing, - AMS Book publishers.
7. M. K. Jain, S. R. K. Iyengar and R. K. Jain, — Computational Methods for Partial Differential Equations, - New Age publications.

25A1OE59b	MATHEMATICS FOR MACHINE LEARNING AND DATA SCIENCE (OPEN ELECTIVE-I)	L	T	P	C
		3	0	0	3

Program Outcomes (as per NBA for PG Engineering Programs)

- **PO1:** Ability to independently carry out research/investigation and development work to solve practical problems
- **PO2:** Ability to write and present a substantial technical report/document
- **PO3:** Demonstrate mastery in the program specialization at a level higher than the bachelor's program requirements

Course Objectives

- Equip students with rigorous linear algebra, optimization, and probabilistic tools that underpin modern ML and data science across engineering domains.
- Enable cross- disciplinary modeling, inference, and decision- making using mathematically principled methods and uncertainty quantification.
- Develop capability to analyze, formulate, and validate algorithms with provable properties and computational efficiency for real- world applications.

Course Outcomes (COs)

- **CO1:** Analyze linear models and matrix factorizations for dimensionality reduction and feature representation (L3, L4)
- **CO2:** Formulate and solve convex and constrained optimization problems; compare first- and second- order methods (L4,L5)
- **CO3:** Apply probabilistic modeling, Bayesian inference, and information- theoretic measures to estimation and generalization (L3, L4, L5)
- **CO4:** Prove convergence properties or error bounds for selected learning algorithms such as SGD and regularized estimators (L4, L5)
- **CO5:** Evaluate and integrate methods into applications such as PCA, SVMs, and neural networks with appropriate regularization (L3, L4, L5)

CO–PO Articulation Matrix (1–3 scale)

	PO1	PO2	PO3
CO1	2	1	3
CO2	3	1	3
CO3	3	2	3
CO4	3	2	3
CO5	2	2	3
1 = low, 2 = moderate, 3 = high			

Course Contents

Unit I — Linear Algebra Foundations

- Vector spaces, norms, inner products, orthogonality, and projections
- Eigenvalues/eigenvectors, spectral theorem, and invariant subspaces

- Singular value decomposition, low- rank approximations, and Eckart–Young
- Matrix calculus for ML; gradients/Jacobians/Hessians in matrix form
- Numerical linear algebra: conditioning, stability, power/QR methods
- Feature whitening and centering; PCA link to covariance eigenstructure

Unit II — Optimization for Learning

- Unconstrained methods: gradient descent, line search, Newton/quasi- Newton
- Constrained optimization: Lagrange multipliers, projected and barrier methods
- Convex sets/functions, KKT conditions for nonlinear programing problems.
- Regularization: l_1/l_2penalties, bias–variance trade- offs in risk minimization
- Convergence rates and step- size strategies in deterministic models.

Unit III — Probability and Statistical Learning

- Random variables, expectations, covariance; exponential family basics
- Bayesian inference: conjugacy, MAP vs. MLE, posterior predictive analysis
- Hypothesis testing and confidence intervals for model comparison
- Information measures: entropy, KL divergence, mutual information in learning
- Generalization, overfitting, and model selection criteria (e.g., AIC/BIC/VC-style capacity).
- Concentration and uncertainty quantification for predictions

Unit IV — Models and Algorithms

- Linear and kernel methods: least squares, logistic regression, and SVMs
- Dimensionality reduction: PCA, kernel PCA, and manifold intuition
- Probabilistic models: Naive Bayes, Gaussian mixtures, EM overview
- Neural network mathematics: backpropagation, initialization, normalization
- Regularization schemes: weight decay, early stopping, dropout perspectives

Unit V — Integrative Applications and Worked Examples

- End- to- end ML pipelines: preprocessing, scaling/whitening, and feature engineering
- PCA- based exploration and anomaly detection in high- dimensional data
- SVMs and convex models for fault diagnosis and predictive maintenance
- Bayesian A/B testing and decision- making under uncertainty
- Neural network design trade- offs: capacity, optimization, and generalization
- Model evaluation: calibration, ROC/PR analysis, and uncertainty reporting

Textbooks

1. Deisenroth, M. P., Faisal, A. A., & Ong, C. S. Mathematics for Machine Learning. Cambridge University Press, 2020
2. Murphy, K. P. Probabilistic Machine Learning: An Introduction. MIT Press, 2022
3. Boyd, S., & Vandenberghe, L. Convex Optimization. Cambridge University Press, 2004

References

1. Goodfellow, I., Bengio, Y., & Courville, A. Deep Learning. MIT Press, 2016
2. Shalev- Shwartz, S., & Ben- David, S. Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press, 2014
3. Jolliffe, I. T., & Cadima, J. Principal component analysis: a review and recent developments. Phil. Trans. R. Soc. A, 2016
4. Cover, T. M., & Thomas, J. A. Elements of Information Theory, 2nd ed. Wiley, 2006
5. Murphy, K. P. Probabilistic Machine Learning: Advanced Topics. MIT Press, 2023.

25A1OE59c	STATISTICAL LEARNING THEORY AND MATHEMATICAL FOUNDATIONS OF AI (OPEN ELECTIVE-I)	L	T	P	C
		3	0	0	3

Program Outcomes (as per NBA for PG Engineering Programs)

- **PO1:** An ability to independently carry out research/investigation and development work to solve practical problems.
- **PO2:** An ability to write and present a substantial technical report/document.
- **PO3:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program; the mastery should be at a level higher than the requirements in the appropriate bachelor program.

Course Objectives:

- Build rigorous probabilistic, information-theoretic, and optimization foundations that support modern AI across engineering domains.
- Unify theory and algorithms to enable principled design and analysis of learning systems for cross- disciplinary problems.
- Connect generalization theory with practice through concise formulations and proofs suited to PG research contexts.

Course Outcomes (COs):

- **CO1:** Analyze probabilistic models, convergence theorems, and stochastic processes underlying learning algorithms (L3, L4).
- **CO2:** Formulate and prove generalization bounds using VC dimension, Rademacher complexity, and stability (L4, L5).
- **CO3:** Derive and optimize loss/regularization for linear, kernel, and deep models; justify selections by convexity and smoothness properties (L4, L5).
- **CO4:** Evaluate algorithms via bias–variance, PAC guarantees, and information- theoretic criteria such as KL and mutual information (L4, L5).
- **CO5:** Integrate theory to design robust AI solutions for multi- domain engineering applications and communicate findings effectively (L5).

CO–PO Articulation Matrix (1–3 scale):

	PO1	PO2	PO3
CO1	2	1	2
CO2	3	2	3
CO3	2	1	3
CO4	1	3	2
CO5	3	2	3
1 = low, 2 = moderate, 3 = high			

Course Contents:

Unit I — Probability and Measure Foundations

- Probability spaces, σ- algebras, random variables; expectation and conditional expectation.
- Inequalities and concentration: Markov, Chebyshev, Hoeffding; LLN and CLT.
- Modes of convergence and Borel–Cantelli; almost sure vs in- probability convergence.
- Random processes and martingale basics; optional stopping; Doob's inequality (overview).
- Markov chains: ergodicity, mixing, stationary distributions for modeling sequences.

Unit II — Statistical Learning Theory

- PAC learning model, realizable/agnostic cases; sample complexity and no- free- lunch.
- VC dimension, shattering, Sauer's lemma; uniform convergence guarantees.
- Empirical risk minimization and structural risk minimization; capacity control.
- Rademacher/Gaussian complexities and symmetrization for data- dependent bounds.
- Algorithmic stability and generalization; regularization and early stopping as capacity control.
- PAC- Bayes bounds and posterior- based generalization certificates.

Unit III — Optimization for Learning

- Convex analysis: Lipschitzness, smoothness, strong convexity; implications for rates.
- Gradient, stochastic, and variance- reduced methods; step- size and convergence trade- offs.
- Proximal methods and projected gradients; sparsity via ℓ_1 (Lasso) and shrinkage via ℓ_2 (ridge).
- Duality and KKT conditions; constrained learning formulations.
- Nonconvex landscapes in deep networks—saddle points, over-parameterization, and implicit regularization.
- Generalization–optimization interplay: implicit bias of optimizers.

Unit IV — Kernel and Probabilistic Models

- Reproducing kernel Hilbert spaces, kernel trick, representer theorem.
- Large- margin methods: SVMs, soft margins, hinge loss; primal–dual views.
- Gaussian processes: kernels as priors; posterior prediction and uncertainty quantification.
- Graphical models—Bayesian networks and Markov/conditional random fields for structured prediction; exact inference (variable elimination, junction tree) and approximate methods (loopy belief propagation, variational).
- Hidden Markov models; EM for latent- variable learning.
- Variational inference and message passing for scalable probabilistic AI.

Unit V — Deep Learning and Information Theory

- Backpropagation (chain rule), initialization, normalization, and activation design.
- Loss functions and calibration; cross- entropy, margin losses, and robust objectives.
- Generalization in deep nets: margins, flat minima, compression, and stability views.
- Information- theoretic tools: entropy, mutual information, KL divergence.
- Information bottleneck and representation learning, with links to PAC- Bayes.
- Worked examples: applying theory to vision, language, and control tasks in engineering.

Textbooks:

1. Shalev- Shwartz, S., Ben- David, S., Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, first edition, 2014.
2. Goodfellow, I., Bengio, Y., Courville, A., Deep Learning, MIT Press, 2016.
3. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 2006.

References:

1. Vapnik, V. N., The Nature of Statistical Learning Theory, Springer, 1995/1998.
2. Cover, T. M., Thomas, J. A., Elements of Information Theory, 2nd ed., Wiley, 2006.
3. Mohri, M., Rostamizadeh, A., Talwalkar, A., Foundations of Machine Learning, 2nd ed., MIT Press, 2018.
4. Schölkopf, B., Smola, A. J., Learning with Kernels: Support Vector Machines, Regularization, Optimization, and Beyond, MIT Press, 2002.
5. Rasmussen, C. E., Williams, C. K. I., Gaussian Processes for Machine Learning, MIT Press, 2006.

25A1OE59d	CHEMISTRY OF NANOMATERIALS AND APPLICATIONS IN ENGINEERING (OPEN ELECTIVE-I)	L	T	P	C
		3	0	0	3

Unit – I

Basics of Nanomaterials: Introduction**,** Scope of nanoscience and nanotechnology, nanoscience in nature, classification of nanostructured materials, importance of nanomaterials.

Unit – II

Synthesis of nanomaterials: Top-Down approach,Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapor deposition method, electrode position method, high-energy ball milling method.

Synthetic Methods**:** Bottom-Up approach**,** Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

UNIT-III

Techniques for characterization: Diffraction techniques, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

UNIT-IV

Studies of Nano-structured Materials: Synthesis, properties and applications of the following nanomaterials: fullerenes, carbon nanotubes, 2D-nanomaterial (Graphene), core-shell, magnetic nanoparticles, thermoelectric materials, non-linear optical materials.

UNIT-V

Advanced Engineering Applications of Nanomaterials: Applications of nanoparticles, nanorods, nano wires inWater treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation.

TEXT BOOKS:

1. **NANO: The Essentials:**T Pradeep, MaGraw-Hill, 2007.
2. **Textbook of Nanoscience and nanotechnology:** B S Murty, P Shankar, Baldev Rai,BB Rath and James Murday, Univ. Press, 2012.

REFERENCE BOOKS:

1. Concepts of Nano chemistry; LudovicoCademrtiri and Geoffrey A. Ozin& Geoffrey A. Ozin, Wiley-VCH, 2011.
2. **Nanostructures &Nanomaterials; Synthesis, Properties & Applications:** Guozhong Cao, Imperial College Press, 2007.
3. **Nanomaterials Chemistry**, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.

25A1OE59e	PHOTONICS FOR ENGINEERS (OPEN ELECTIVE-I)	L	T	P	C
		3	0	0	3

Course Objectives (CO)

The objectives of this course are to:

CO 1. To understand the basic nature and behaviour of light and its propagation in optical media and fibers.

CO 2. To introduce the principles of absorption and emission in optical materials, and to understand the operation of semiconductor light sources and photodetectors.

CO 3. To provide an understanding of nonlinear optical phenomena and the principles of electro-optic, magneto-optic, and acousto-optic modulation used in modern optical devices.

CO 4. To introduce optical fiber characteristics and outline the components and technologies used in modern fiber-optic communication systems.

CO 5. To familiarize students with advanced photonic technologies, including sensors, quantum photonics, plasmonics, metamaterials, and ultrafast/THz systems.

Sl. No.		No. of hours
1.	**Unit I – Fundamentals of Photonics:** Nature of light: wave-particle duality, polarization, coherence. Maxwell's equations and wave propagation in dielectric media. Reflection, refraction, (vector notation) interference, diffraction, dispersion and birefringence.	9
2.	**Unit II – Photonic Devices and Components – I: Absorption**, spontaneous and stimulated emission. Einstein coefficients, population inversion, optical gain. Semiconductor light sources: LEDs, laser diodes, quantum well lasers. Photodetectors: PIN, avalanche photodiodes, photomultiplier tubes.	9
3.	**Unit III – Photonic Devices and Components – II: Nonlinear** optical effects – second-harmonic generation, Kerr effect, four-wave mixing. Electro-optic Magneto optic and acousto-optic modulation principles. Optical modulators and switches (Mach Zehnder Interferometer).	9
4.	**Unit IV – Optical Waveguides and Applications:** Optical fibers – numerical aperture, V-number, modes, attenuation, dispersion. Fiber-optic communication systems: transmitters, receivers, multiplexing (WDM), optical couplers, ring resonators.	9
5.	**Unit V – Photonic Systems and Applications:** Photonic sensors – interferometric, fiber Bragg gratings, biosensing. Optical signal processing and computing. Introduction to quantum photonics: single-photon sources, entanglement, and photonic qubits. Plasmonics and metamaterials, Ultrafast and terahertz photonics.	9

Textbooks:

1. B.E.A. Saleh& M.C. Teich — *Fundamentals of Photonics* (Wiley)
2. J. Singh — *Semiconductor Optoelectronics: Physics and Technology*

3. A. Yariv& P. Yeh — *Photonics: Optical Electronics in Modern Communications*
4. G. Keiser — *Optical Fiber Communications*

References:

1. J. Wilson & J.F.B. Hawkes — *Optoelectronics: An Introduction*
2. R.W. Boyd — *Nonlinear Optics*
3. Electromagnetic waves and radiating systems ------ E. Jordan

Course Outcomes:

After studying this course, students will be able to

1. gain the ability to describe how light behaves and propagates in optical media.
2. explain light–matter interaction mechanisms and analyze the working, characteristics, and applications of LEDs, laser diodes, quantum well lasers and various photodetectors.
3. explain key nonlinear effects and analyze the operation of optical modulators and switches such as the Mach–Zehnder Interferometer.
4. analyzefiber parameters and explain the functioning of transmitters, receivers, WDM systems, couplers and resonator-based communication devices.
5. describe the working of photonic sensors and emerging quantum and ultrafast photonic technologies used in sensing, computation and communication.