COIMBATORE INSTITUTE OF TECHNOLOGY, COIMBATORE – 641 014
(An Autonomous Institution affiliated to ANNA UNIVERSITY, CHENNAI)
DEPARTMENT OF CIVIL ENGINEERING
REGULATIONS 2023 CHOICE BASED CREDIT SYSTEM

M. E. STRUCTURAL ENGINEERING

VISION

To provide quality education in Civil Engineering and to become a state-of-the-art source of world-class Civil Engineers and Researchers.

MISSION

- M1 - To impart quality education in diverse areas of civil engineering to achieve the industrial expectations.
- M2 - To offer state-of the art facilities towards academic and research excellence.
- M3 - To nurture intellectual knowledge in modern technologies of Civil Engineering for enhancing entrepreneurship qualities and employability skills.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

Programme Educational Objectives of the post graduate program of Environmental Engineering are

PEO 1: Become highly skilled and innovative Structural Engineers, capable of contributing effectively in academia or industry, in leading or supportive roles.

PEO 2: Commit to lifelong learning by pursuing advanced degrees, professional certifications, and continuous skill development in Structural Engineering.

PEO 3: Achieve successful employment in structural engineering firms, related industries, or research programs.

PEO 4: Demonstrate awareness of the environmental and societal impact of structural engineering practices and strive for sustainable solutions.

PROGRAM OUTCOMES (POs)

Three Graduate Attributes as given by NBA as per Washington Accord agreement should be considered for all the PG programmes without any change for POs.

PO1: An ability to independently carry out Research / Investigation and Development work to solve practical Problems in Structural Engineering

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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of the program M.E. Structural Engineering will be able to

PSO1: Acquire advanced knowledge and design capabilities in structural engineering, applying current codes, tools, and techniques to develop sustainable solutions for societal needs

PSO2: Analyze and solve complex structural engineering problems through integrated experimental, analytical, and numerical approaches, considering safety, serviceability, economy, durability, and environmental impact.

PSO3: Effectively collaborate in scientific research, drawing upon acquired knowledge to contribute to decision-making and advance innovative solutions for structural engineering challenges.

MAPPING OF PROGRAMME EDUCATIONAL OUTCOMES WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC COUTCOMES

PEOs	PROGRAMME OUTCOMES			PSOs		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
1	x	x	x	x	x	x
2	x	x	x		x	
3				x	x	x

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M. E. STRUCTURAL ENGINEERING

CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	23MSE111	Applied Mathematical methods	FC	3	1	0	4	4
2.	23MSE112	Applied Elasticity and Plasticity	PCC	3	0	0	3	3
3.	23MSE113	Matrix Methods of Structural Analysis	PCC	3	0	0	3	3
4.	23MSE114	Advanced Reinforced Concrete Structures	PCC	3	0	0	3	3
5.		Elective I	PEC	3	0	0	3	3
6.		Department Specific One Credit Course	EEC	2	0	0	2	1
PRACTICALS								
7.	23MSE121	Structural Design studio	PCC	0	0	4	4	2
8.	23MSE122	Research Proposal Writing and IPR	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**8**	**26**	**21**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	23MSE211	Structural Dynamics	PCC	3	0	0	3	3
2.	23MSE212	Finite Element Method	PCC	3	0	0	3	3
3.	23MSE213	Advanced Steel Structures	PCC	3	0	0	3	3
4.		Elective II	PEC	3	0	0	3	3
5.		Elective III	PEC	3	0	0	3	3
6.		Value Added Course	EEC	2	0	0	2	1
PRACTICALS								
7.	23MSE221	Advanced Structural Engineering Laboratory	PCC	0	0	4	4	2
8.	23MSE222	Finite Element Analysis Laboratory	EEC	0	0	4	4	2
			TOTAL	**17**	**0**	**8**	**25**	**20**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Elective IV	PEC	3	0	0	3	3
2.		Elective V	PEC	3	0	0	3	3
3.		Elective VI/Open Elective	PEC/ OEC	3	0	0	3	3
PRACTICALS								
4.	23MSE331	Practical Training (4 Weeks)	EEC	0	0	0	0	2
5.	23MSE332	Project Work Phase I	EEC	0	0	6	6	3
			TOTAL	**9**	**0**	**6**	**15**	**14**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	23MSE441	Project Work Phase II	EEC	0	0	30	30	15
			TOTAL	**0**	**0**	**30**	**30**	**15**

LIST OF PROFESSIONAL CORE COURSES:

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.	23MSE112	Applied Elasticity and Plasticity	PCC	3	0	0	3	3
2.	23MSE113	Matrix Methods of Structural Analysis	PCC	3	0	0	3	3
3.	23MSE114	Advanced Reinforced Concrete Structures	PCC	3	0	0	3	3
4.	23MSE121	Structural Design studio	PCC	3	0	0	3	3
5.	23MSE211	Structural Dynamics	PCC	3	0	0	3	3
6.	23MSE212	Finite Element Method	PCC	3	0	0	3	3
7.	23MSE213	Advanced Steel Structures	PCC	3	0	0	3	3
8.	23MSE221	Advanced Structural Engineering Laboratory	PCC	3	0	0	3	3
9.	23MSE222	Finite Element Analysis laboratory	PCC	3	0	0	3	3

LIST OF PROFESSIONAL ELECTIVE COURSES:

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.	23MSEE01	Stability of Structures	PEC	3	0	0	3	3
2.	23MSEE02	Advanced Concrete Technology	PEC	3	0	0	3	3
3.	23MSEE03	Experimental Techniques and Instrumentation	PEC	3	0	0	3	3
4.	23MSEE04	Earthquake Resistant Design of Structures	PEC	3	0	0	3	3
5.	23MSEE05	Structural Optimization	PEC	3	0	0	3	3
6.	23MSEE06	Health Monitoring of Structures	PEC	3	0	0	3	3
7.	23MSEE07	Prestressed Concrete Structures	PEC	3	0	0	3	3
8.	23MSEE08	Corrosion of Steel in Concrete Structures	PEC	3	0	0	3	3
9.	23MSEE09	Theory of Plates	PEC	3	0	0	3	3
10.	23MSEE10	Design of Concrete Bridges	PEC	3	0	0	3	3
11.	23MSEE11	Design of Steel Concrete Composite Structures	PEC	3	0	0	3	3
12.	23MSEE12	Offshore Structures	PEC	3	0	0	3	3
13.	23MSEE13	Shell Structures	PEC	3	0	0	3	3
14.	23MSEE14	Design of Tall Buildings	PEC	3	0	0	3	3
15.	23MSEE15	Wind and Cyclone Effects on Structures	PEC	3	0	0	3	3
16.	23MSEE16	Soil Structure Interaction	PEC	3	0	0	3	3
17.	23MSEE17	Mechanics of Composite Materials	PEC	3	0	0	3	3
18.	23MSEE18	Prefabricated Structures	PEC	3	0	0	3	3
19.	23MSEE19	Design of Foundation Structures	PEC	3	0	0	3	3
20.	23MSEE20	Design of Formwork	PEC	3	0	0	3	3
21.	23MSEE21	Design of Masonry Structures	PEC	3	0	0	3	3
22.	23MSEE22	Reliability Analysis of Structures	PEC	3	0	0	3	3
23.	23MSEE23	Cold Formed Steel Structures	PEC	3	0	0	3	3

LIST OF OPEN ELECTIVE COURSES OFFERED FOR THE STUDENTS OF OTHER PG PROGRAMMES:

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C	PG PROGRAMME
1.	23MSEOE01	Disaster Management	OEC	3	0	0	3	3	EE, CM, ES
2.	23MSEOE02	Energy Efficient Buildings	OEC	3	0	0	3	3	EE, CM, ES
3.	23MCMOE01	Landscape And Architecture	OEC	3	0	0	3	3	EE, CM, ES
4.	23MENOE01	Climate Change And Adaptation	OEC	3	0	0	3	3	EE, CM, ES

Programme - M.E. - Environmental Engineering, Construction Management, Embedded and Real Time Systems

SUMMARY

Category; FC – Foundational course, PCC –Professional Core, PE- Professional Elective Course, OE-Open Elective Course, EEC –Employability Enhancement Course

M.E. STRUCTURAL ENGINEERING						
Sl. No.	Subject Area	Credits per Semester				Total Credits
		I	II	III	IV	
1.	FC	4				**4**
2.	PCC	11	11			**22**
3.	PEC	3	6	6		**15**
4.	OEC			3		**3**
5.	EEC	3	3	5	15	**26**
					TOTAL CREDITS	**70**

SEMESTER I

23MSE111	APPLIED MATHEMATICAL METHODS	L	T	P	C
		3	1	0	4

MODULE I LAPLACE TRANSFORMS AND WAVE EQUATIONS **12**

Laplace transforms - Definitions - Properties- Transform of error function - Dirac delta function- Unit step function – Convolution theorem- Inverse Laplace transforms - Solution to one-dimensional wave equations.

MODULE II FOURIER TRANSFORMS AND HEAT EQUATIONS **12**

Fourier transforms - Definitions - Properties- Transform of elementary functions - Dirac delta function - Convolution theorem – Parseval's identity- Solution to one dimensional heat equations -Laplace and Poisson equations.

MODULE III CALCULUS OF VARIATIONS **12**

Concept of variation and its properties- Euler's equation- Functional dependent on first and higher order derivatives- Functionals dependent on functions of several independent variables- Variational problems with moving boundaries- Isoperimetric problems- Direct methods Ritz and Kantorovich methods.

MODULE IV CONFORMAL MAPPING AND APPLICATIONS **12**

Introduction to conformal mappings and bilinear transformations- Schwarz Christoffel transformation -Transformation of boundaries in parametric form - Physical applications - Fluid flow and heat flow problems.

MODULE V PROBABILITY AND DISTRIBUTIONS **12**

Probability- Conditional probability- Baye's theorem – One dimensional discrete random variable- Probability mass function- Probability Distribution function- One dimensional continuous random variable- Probability density function - Moment generating function- Distributions: Binomial, Poisson, Normal and Exponential

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Solve the one-dimensional wave equations by applying Laplace transforms

CO2: Compute solutions to one- and two-dimensional heat equations using Fourier transforms

CO3: Apply conformal mapping techniques, including bilinear and Schwarz-Christoffel transformations, to solv

CO4: Construct conformal mappings between various domains and apply in fluid and heat flow problems.

CO5: Apply the concepts of probability theory, various discrete and continuous standard distributions for solvi

TOTAL: 60 PERIODS

REFERENCES:

1. "Introduction to Partial Differential Equations", Sankara Rao. K., 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
2. "An Introduction to Continuum Mechanics", Reddy, J.N, 2nd Edition, Cambridge University Press, 2018.
3. "Calculus of Variations with Applications", Gupta.A.S. S, Prentice Hall of India Pvt. Ltd.,

New Delhi, 2004.

4. "Integral Transforms for Engineers", Andrews.L.C and Shivamoggi.B.K. K, Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
5. "A First Course in Probability", Sheldon Ross, 9th Edition, Pearson Education, 2019.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	2	1			2	1
2	2	1			2	1
3	2	1			2	1
4	2	1			2	1
5	2	1			2	1
Avg.	**2**	**1**			2	1

1-low, 2-medium, 3-high

23MSE12	**APPLIED ELASTICITY AND PLASTICITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

MODULE I ANALYSIS OF STRESS AND STRAIN **9**

Elasticity approach - Definition and notation of stress - components of stress and strain - generalized Hooke's Law - Principal stresses and strains for three-dimensional element Equations of equilibrium and compatibility conditions for 3-D problems in Cartesian and cylindrical coordinates - Transformation of stresses and strains - Boundary conditions.

MODULE II TWO DIMENSIONAL PROBLEMS IN CARTESIAN COORDINATES **9**

Plane stress and plane strain problems with practical examples. Equations of equilibrium and compatibility conditions in Cartesian coordinates - Airy's stress function, bending of a cantilever of narrow rectangular cross-section under the action of couples, knife edge and varying distributed loads, bending of simply supported beams by uniform and uniformly varying loads.

MODULE III TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES **9**

Equations of equilibrium and compatibility conditions in polar coordinates - asymmetrical problems; thick cylinder under uniform pressure, shrink and force fits, circular arc beams subjected to pure bending - bending of curved bar - Stress concentrations due to circular hole in plate - effect of concentrated and uniformly distributed load on straight boundary of semi-infinite plates, stresses in circular disc subjected to diametrically opposite concentrated loads

MODULE IV TORSION **9**

Torsion of various shaped bars, pure torsion of prismatic bars, prandtle's membrane analogy, strain energy and finite difference method, torsion of rolled profiles, stress concentrations at re-entrant corners, torsion of thin-walled tubes and hollow shafts. Plastic torsion - Elastic - plastic torsion analysis - circular section - sand heap analogy.

MODULE V PLASTICITY & FRACTURE MECHANICS **9**

Stress - strain diagram - Ideal plastic body - Illustration of plastic Analysis - Yield criteria - Rankine's theory - St. Venant’s theory - Tresca Criterion - Beltramis theory - Von Mises criterion - Mohr's theory of yielding - Yield surface - Flow rule (stress - strain relation for perfectly plastic flow)- Prandtl Reuss equality - plastic work - stress - strain relation based on Tresca - plastic potential - Uniqueness of a stress distribution - strain hardening - sand heap analogy. Failure criteria and fracture toughness – stress intensity factor.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Apply the elasticity approach to interpret the concepts of stress and strain analysis in a comprehensive manner.

CO2 : Examine stress and strain problems in Cartesian and cylindrical coordinates, focusing on their three-dimensional nature

CO3 : Formulate and solve equations of equilibrium and compatibility for axisymmetric problems to determine stresses and analyze their behavior under various loading conditions.

CO4 : Examine the torsional behavior exhibited by variously shaped bars, including prismatic bars, as well as the phenomenon of elastic-plastic torsion.

CO5 : Apply the concepts and principles underlying plasticity and fracture mechanics for real

time applications.

TOTAL: 45 PERIODS

REFERENCES:

1. "Theory of Elasticity", Timoshenko. S. and Goodier J.N., Third Edition, McGraw Hill Book Co., New York, 2017.
2. "Plasticity for Structural Engineers", Chen.W.F. and Henry. D. J., Cengage Learning India Pvt. Ltd., New Delhi, 2008
3. "Theory of Plasticity", Sadhu Singh, Khanna Publications, New Delhi, 2000.
4. "Advanced Strength and Applied Elasticity", A.C. Ugural and S.K. Fenster, Edward Arnold Publishers Ltd., UK, 2003.
5. "Elasticity Engineering", Ernest E. Sechler, Dover Publications, New York, 1968.
6. "Elementary engineering fracture mechanics", David Broek, Springer; 4th Edition, 2005

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	3	2
2	3	1	3	3	3	2
3	3	1	3	3	3	2
4	3	1	3	3	3	2
5	3	1	3	3	3	2
Avg.	**3**	**1**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSE13	MATRIX METHODS OF STRUCTURAL ANALYSIS	L	T	P	C

		3	0	0	3

MODULE I BASIC CONCEPTS **9**

Indeterminacy - Static, Kinematic - Generalized measurements - Degrees of Freedom – Constrained measurements - Behavior of Structures - Principle of Superposition - Equilibrium, Compatibility and Force displacement relations.

MODULE II STIFFNESS AND FLEXIBILITY **9**

Stiffness and Flexibility matrices in Single, two and n-coordinates; Structures with Constrained measurements; Stiffness and flexibility coefficients - Basic Stiffness and basic Flexibility method applied to spring models.

MODULE III ENERGY CONCEPTS AND TRANSFORMATION OF INFORMATION **9**

Strain energy; Stiffness and flexibility matrices for strain energy - Betti's law and its applications - Properties of stiffness and flexibility matrices - Contra gradient law- Co-ordinate transformations - Transformation of element matrices to structure matrices - orthogonal transformations.

MODULE IV STIFFNESS METHOD **9**

Development of the method - Structure stiffness matrix for beams, frames and trusses using displacement transformation matrix and coordinate transformation matrix - Internal forces due to thermal expansion and lack of fit - Direct stiffness methods- Static condensation - transfer matrix method - symmetry and anti-symmetry of structures - reanalysis technique -Analysis by substructures using the stiffness method.

MODULE V FLEXIBILITY METHOD **9**

Flexibility Method applied to statically determinate and indeterminate structures; Choice of redundant; Primary structure- General formulation- Structure flexibility matrix using force transformation matrix - Internal forces due to thermal expansion and lack of fit.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Formulate the stiffness matrix for beams, frames, and trusses using displacement transformation matrices

CO2 : Apply the concept of strain energy and its correlation with stiffness and flexibility matrices.

CO3 : Apply energy concepts, Betti's law, and coordinate transformations to calculate strain energy and transform element matrices into structure matrices.

CO4 : Develop the stiffness method, including direct stiffness methods, static condensation, transfer matrix method, and substructure analysis.

CO5 : Apply the Flexibility Method to analyze both statically determinate and indeterminate structures

TOTAL: 45 PERIODS

REFERENCES:

1. "Advanced Structural Analysis", Devdas Menon, Narosa Publishing House, Daryagang, New Delhi,2009.
2. “Matrix Analysis of Framed Structures” Weaver, W., Jr., Gere, J.M., and Post, S.M., 4th Edition, Chapman & Hall/CRC, 2011.
3. "Structural Analysis - a Matrix Approach", Pandit.G.S and Gupta.S.P, Tata Mc Graw Hill Publishing Company, 2008.
4. "Computational Structural Mechanics", Rajasekaran.S and Sankarasubramanian.G, Prentice Hall of India, New Delhi, 2006.
5. "Matrix Analysis of Framed Structures", Weaver.J.R and Gere.J.M, CBS Publishers, New Delhi, 2004.
6. "Computer analysis of Structural Systems", Fleming.J.F, Mcgraw Hill Book Co., 1989.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	2	2
2	3	1	3	3	2	2
3	3	1	3	3	3	2
4	3	1	3	3	3	2
5	3	1	3	3	3	2
Avg.	**3**	**1**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSE14	ADVANCED REINFORCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I DESIGN OF RC ELEMENTS AND SERVICEABILITY CRITERIA 9

Review of limit state design of slabs, beams and columns according to IS codes. Calculation of Deflection and crack width for beams and slabs as per IS codes.

MODULE II DESIGN OF SPECIAL RC ELEMENTS 9

Design of RC walls - Ordinary shear walls - Design of corbels - Design of deep beams - Detailing.

MODULE III FLAT SLABS AND GRID FLOOR 9

Design of flat slabs and flat plates - Limitations - Design of voided slabs - Analysis and design of Grid floors - Detailing.

MODULE IV INELASTIC BEHAVIOUR OF CONCRETE BEAMS 9

Moment - Curvature relation of Reinforced Concrete Sections - Moment redistribution - Advantages and Disadvantages of Moment Redistribution

MODULE V DESIGN LOADS OTHER THAN EARTHQUAKE LOADS 9

Dead Loads - Imposed Loads (IS 875 Part 2) - Loads due to Imposed Deformations - General Theory of Wind Effects on Structures.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Apply limit state design principles to analyze and optimize reinforced concrete elements according to IS codes, ensuring structural integrity and serviceability.

CO2 : Design and detail a complex RC element such as wall, corbel, or deep beam requiring application of advanced techniques

CO3 : Design and detail flat slabs, flat plates, voided slabs, and grid floors, navigating their inherent limitations for efficient and structurally sound building solutions.

CO4 : Interpret the correlation between moment and curvature, conduct a critical examination of moment redistribution, and deliberate on the benefits and drawbacks associated with it.

CO5 : Examine the static loads, dynamic loads resulting from imposed deformations, and the overarching principles pertaining to the impact of wind on structures.

TOTAL: 45 PERIODS

REFERENCES:

1. "Advanced Reinforced Concrete Design", P.C.Vargheese, 2nd Edition, Prentice hall of India,New Delhi, 2009.
2. "Reinforced Concrete Structures", Park.R and Paulay.T, John Wiley and Sons, New Delhi, 1988.
3. "Reinforced Concrete design", Unnikrishnan Pillai and Devdos Menon, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2009.
4. "Fundamentals of Reinforced Concrete", Sinha.N.C and Roy.S.K, S.Chand and

Company, New Delhi, 2003.
5. "Design of Reinforced Concrete Structures", Dayaratnam.P, Oxford & OBH Publishing Co. Pvt. Ltd., Calcutta, 2005.
6. "Reinforced Concrete Structural Elements - Behaviour Analysis and Design", P.Purushothaman, Tata McGraw Hill Publishing Company Limited, New Delhi, 1986.
7. "Design of Reinforced Concrete Structures", Gambhir, PHI Learning Ltd., New Delhi, 2008.
8. IS 456-2000: Plain and Reinforced Concrete - Code of Practice.
9. IS 875: Part 1 : Part 1 Dead loads - Unit weights of building material and stored materials (Incorporating IS:1911-1967).

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	2	2
2	3	1	3	3	3	2
3	3	1	3	3	3	2
4	3	1	3	3	3	2
5	3	1	3	3	3	2
Avg.	**3**	**1**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSE15	STRUCTURAL DESIGN STUDIO	L	T	P	C
		3	0	0	3

LIST OF EXPERIMENTS

1. Analysis of beams and plane frames
2. Analysis and design of a multi storey RCC building for vertical loads.
3. Analysis and design of a multi storey RCC building for lateral loads.
4. Analysis and design of a multi storey steel building for vertical loads.
5. Analysis and design of a multi storey steel building for lateral loads.
6. Analysis and design of shear wall.
7. Analysis and design of circular elevated reinforced concrete water tank.
8. Analysis and design of rectangular reinforced concrete water tank resting on ground.
9. Analysis and design of mat foundation
10. Design of RCC and Steel elements by developing the design spreadsheet
11. Plastic analysis of portal frames by developing the design spreadsheet
12. Analysis and design of plane and space truss
13. Analysis and design of steel chimneys

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Apply engineering principles to analyze and design various structural elements for gravity and lateral loads and draft the detailing using AutoCAD.

CO2 : Evaluate and interpret structural behavior under different loading conditions, considering buckling, vibration, and stress/strain distribution

CO3 : Select and justify appropriate design approaches for concrete and steel elements based on code requirements and performance objectives

CO4 : Prepare excel spreadsheet to design structural elements

CO5: Analyze real-world structural challenges, independently proposing and evaluating potential solutions

TOTAL: 30 PERIODS

REFERENCES:

1. “Design of Reinforced Concrete Structures”, Subramanian N., 1st Edition, Oxford University Press, 2014.
2. “Reinforced concrete Design”, Unnikrishna Pillai and Devdas Menon, 3rd Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2016.
3. STAAD.Pro - manual volume 1 and 2, Bentley Systems India, Private Limited, New Delhi.
4. ETABS - Integrated Building Design Software, CSI, Berkeley, California.
5. SAFE - Analysis and Design of beams and slabs

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	2	3
2	3	1	3	3	3	3
3	3	1	3	3	3	3
4	3	1	3	3	2	3
5	3	1	3	3	3	3
Avg.	**3**	**1**	**3**	**3**	**2.6**	**3**

1-low, 2-medium, 3-high

23MEN16	RESEARCH PROPOSAL WRITING AND IPR	L	T	P	C
		3	0	0	3

Introduction to Research Proposal Writing

- Understanding the significance of research proposals
- Differentiating between reactive and proactive proposals
- Overview of the proposal development process

Components of a Research Proposal

Problem Identification and Needs Assessment

- Techniques for conducting needs assessment (e.g., PRA, participatory tools)
- Rationale and Literature Review
- Incorporating previous research into project rationale
- Goals, Objectives, and Sustainability
- Formulating clear and SMART objectives
- Strategies for project sustainability beyond initial funding

Project Implementation and Management

- Developing project activities and using tools like log frames
- Creating project work plans and GANTT charts

Budgeting and Intellectual Property Rights

- Devising project budgets considering expenses and funding sources
- Introduction to Intellectual Property Rights (IPR) and its relevance in research

Monitoring, Evaluation, and Institutional Capability

- Designing effective monitoring and evaluation plans
- Addressing management and institutional capacity in proposals

Proposal Writing Practice and Review

- Hands-on proposal writing exercises
- Peer review and feedback sessions

IPR Considerations in Proposal Writing

- Understanding copyright, patents, and other IPR concepts
- Incorporating IPR considerations in research proposals

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Apply the Skill at generating well-suited proposals to meet distinct demands.

CO2 : Apply the Skill in the creation of proactive proposals.

CO3 : Illustrate the components of a proactive proposal and the process

CO4 : Evaluate a financial plan for the project, taking into consideration all required costs and potential avenues for funding.

CO5 : Evaluate a comprehensive monitoring and evaluation scheme to assess the project's progress and outcomes.

TOTAL: 30 PERIODS

REFERENCES:

1. “Proposal Writing”, Cheryl Nunnally. Thousand Oaks, CA: SAGE Publications, 10th Edition, 2017.
2. “The Craft of Research Proposals”, Ronald N. Boisvert. San Francisco, CA: Jossey-Bass, 3rd Edition, 2016.
3. “Intellectual Property Law for Engineers and Scientists”, (Howard B. Burstein. New York, NY: Oxford University Press, 4th Edition, 2010.
4. “Writing for Social Science Research”, Robert K. Merton, Marjorie Orian Merritt, and Jeanne S. Rogerson. New York, NY: Oxford University Press, 8th Edition, 2016.
5. “Successful Science Proposals”, Lucille Lopiano. New York, NY: Columbia University Press, 2nd Edition, 2011.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	2	3	3	1	1	2
2	2	3	3	1	1	2
3	2	3	3	1	1	2
4	2	3	3	1	1	2
5	2	3	3	1	1	2
Avg.	**2**	**3**	**3**	**1**	**1**	**2**

1-low, 2-medium, 3-high

23MSE211	STRUCTURAL DYNAMICS	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF VIBRATION ANALYSIS **9**

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Transmissibility.

MODULE II DYNAMIC RESPONSE OF TWO DEGREE OF FREEDOM SYSTEMS **9**

Mathematical models of two degree of freedom systems, Free and forced vibrations of two degree of freedom systems, Normal modes of vibration, Applications.

MODULE III DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS **9**

Mathematical models of multi-degree of freedom systems, Orthogonality of normal modes, Free and forced vibrations of multi degree of freedom systems, Mode superposition technique, Applications.

MODULE IV DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS **9**

Mathematical models of continuous systems, Free and forced vibration of continuous systems, Rayleigh - Ritz method - Formulation using Conservation of Energy - Formulation using Virtual Work, Applications.

MODULE V DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE **9**

Damping in MDOF systems, Nonlinear MDOF systems, Step-by-step numerical integration algorithms, Substructure technique. Variable - Probability density function - Moment generating function- Distributions: Binomial, Poisson, Normal and Exponential

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Develop and implement new analytical or computational techniques for SDOF vibration analysis.

CO2 : Evaluate the limitations of the 2DOF model and its applicability to real-world engineering problems

CO3 : Evaluate the accuracy and limitations of the MDOF model and mode superposition results compared to analytical solutions

CO4 : Formulate the governing differential equation for free vibration of a specific beam or plate using Euler-Bernoulli theory or Kirchhoff plate theory.

CO5 : Evaluate the accuracy and limitations of using PDFs and MGFs to characterize complex dynamic systems

TOTAL: 45 PERIODS

REFERENCES:

1. "Dynamics of Structures", Ray Clough and Joe Penzien, McGraw Hill Book Company, 2015.
2. "Dynamics of Structures - Theory and Applications to Earth Quake Engineering", Anil K Chopra, Prentice Hall, New Delhi, 2019.

3. "Structural Dynamics - Theory of Computation", Mario Paz, Kluwer Acadamic Publication, 2012.
4. "Vibration of Structures", Smith.J.W, Chapman and Hall, 2004.
5. "Mechanical Vibrations", Singiresu S. Rao, Pearson Education Inc., New Delhi, 2004.
6. "Fundamentals of Structural Dynamics", Textbook by Roy R. Craig, Jr., Andrew J. Kurdila, John Wiley & Sons, 2011
7. "Basic Structural Dynamics", Book by FarzadNaeim and James C.Anderson, John Wiley & Sons, 2012

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	3	2
2	3	1	3	3	3	2
3	3	1	3	3	3	2
4	3	1	3	3	3	2
5	3	1	3	3	3	2
Avg.	**3**	**1**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSE212	FINITE ELEMENT METHOD	L	T	P	C
		3	0	0	3

MODULE I BASICS OF FEM **9**

General description - Basic element shapes - Discretization process - Node numbering - Mesh generation - Energy principles - Variational methods - Raleigh Ritz method - Galerkin Method - Least squares approach.

MODULE II ANALYSIS OF FRAME STRUCTURES **9**

Stiffness matrix for an axial element -axial stiffness - transformation of vectors - plane truss analysis - solution for axially loaded problems - Stiffness matrix for beam element - transformation of vectors - plane frame analysis - beam stiffness - solution for beam problems - rigid plane frames - inclined or skewed supports.

MODULE III PLANE STRESS AND PLANE STRAIN PROBLEMS **9**

Basic concepts of plane stress and plane strain - derivation of stiffness matrix for constant strain and linear strain triangular elements - rectangular elements - iso parametric elements - Lagrange and Serendipity elements - Numerical Integration - static condensation - axisymmetric elements.

MODULE IV PLATE BENDING PROBLEMS **9**

Basic concepts - derivation of element stiffness matrix - four noded, eight noded rectangular elements - isoparametric elements - shear deformation in plates.

MODULE V OTHER APPLICATIONS **9**

Three-dimensional stress analysis - Torsion problems - Free vibration analysis - Buckling problems - Fluid flow problems - Thermal analysis - Finite element packages.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Explain the fundamental principles of finite element analysis and discretization processes.

CO2 : Analyze frame structures by constructing stiffness matrices for axial and beam elements, solving for displacements, and handling rigid frames.

CO3 : Apply finite element methods to solve two-dimensional plane stress and plane strain problems using different element shapes and numerical integration techniques.

CO4 : Investigate plate bending behavior, considering shear deformations, and utilizing specialized element formulations.

CO5 : Apply the finite element method to analyze various engineering problems

TOTAL: 45 PERIODS

REFERENCES:

1. "Finite Element Method", Daryl L.Logan, Thomson Canada Ltd., India Edition, 2016.
2. “Fundamentals of Finite Element Analysis”, David Hutton, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.

3. "Concepts and Applications of Finite Element Analysis", Robert.D.Cook, David.S.Malkus, John Wiley and Sons, India Edition, 2007.
4. “The Finite Element Method”, Zienkiewicz, O.C. and Taylor, R.L., Seventh Edition, McGraw – Hill, 2013
5. "The Finite Element Method in Engineering", Singiresu.S.Rao, Butterworth-Heinemann, India Edition, 2001.
6. "Finite Element Analysis", Krishnamoorthy.C.S, Tata Mc Graw Hill Publishing Co., New Delhi, 2008.
7. “Introduction to Finite Elements in Engineering”, Chandrupatla, R.T. and Belegundu, A.D., Fourth Edition, Prentice Hall of India, 2015.
8. "Applied Finite Element Analysis", Larry.J.Segerlind, John Wiley and Sons, New York, 2010.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	3	2
2	3	1	3	3	3	2
3	3	1	3	3	3	2
4	3	1	3	3	3	2
5	3	1	3	3	3	2
Avg.	**3**	**1**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSE213	ADVANCED STEEL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I LIMIT STATE DESIGN **9**

Introduction to Limit state design -Ultimate and serviceability limit states – Unstiffened and stiffened seated connections - Framed connection - Moment resistant connection - Bracket connections

MODULE II INDUSTRIAL BUILDINGS **9**

Structural Configurations-Functional and serviceability requirements-Industrial floors- Analysis and design of trusses - forces in members - Analysis and design of braced and unbraced frames-Crane gantry girders.

MODULE III STEEL TOWERS **9**

Trestles- Micro Wave Towers - Transmission line towers - Loads on towers - Shape, Sag and Tension in Uniformly loaded conductors - Analysis of towers - Design of member in towers - Design of tower foundations.

MODULE IV SPECIAL STRUCTURES **9**

Design of self-supporting chimney and guyed steel chimney- Stress due to wind and earthquake forces - Gust factor method - Design of foundation.

MODULE V LIGHT GAUGE STEEL STRUCTURES **9**

Introduction to Direct Strength Method - Types of cross sections - Local Buckling and lateral buckling - Design of Compression and Tension members - Beams - Deflection of Beams - Combined stresses and connections- Introduction to CUFSM.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze and design unstiffened and stiffened seated connections in steel structures, applying limit state design principles.

CO2 : Design industrial floors, trusses, and braced/unbraced frames in buildings, considering both structural and functional requirements.

CO3 : Evaluate wind loads on steel towers, perform structural analysis, and design tower members and foundations.

CO4 : Develop design for self-supporting and guyed steel chimneys, considering wind forces using gust factor methods, and design appropriate foundations.

CO5 : Apply the Direct Strength Method to analyze and design steel structural elements connections as per Indian standards practices for cold formed steel structures

REFERENCES:

1. "Design of Steel Structures", Subramanian.N, Oxford University press, 2018
2. "Limit state design of Steel structures", Duggal, Tata McGraw Hill, New Delhi, 2014.

3. "Design of Steel Structures" Ramachandra V.Gehlot, Vol.2, Scientific Publishers, Jodhpur. 2016.
4. 'Design of steel structure', Dayaratnam, S.Chand & Co., Newdelhi, 2010.
5. IS 800 -2007, Indian Standard Code of practice for General Construction in Steel.
6. IS: 6533- 1989 Code of Practice for Design and Construction of steel chimney.
7. SP 6: Part 1: 1964 Handbook for structural engineers - Structural steel sections.
8. IS 802: Part 1: Sec 1: 2015 Code of practice for use of structural steel in overhead transmission line towers, Part 1 Materials and Loads and permissible stresses Section 1 Materials and Loads.
9. IS 6533: Part 2: 1989 Code of practice for design and construction of steel chimneys Part 2 Structural aspects.
10. IS 801:1965 Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	3	2
2	3	1	3	3	3	2
3	3	1	3	3	3	2
4	3	1	3	3	3	2
5	3	1	3	3	3	2
Avg.	**3**	**1**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSE221	ADVANCED STRUCTURAL ENGINEERING LABORATORY	L	T	P	C
		3	0	0	3

LIST OF EXPERIMENTS

I Study of Equipment & Mix Design

1. Study of Instruments used for measuring Forces, Deflections, strains and vibrations
2. Design of concrete mix as per IS 10262 and ACI 211

II Tests on Fresh Concrete

3.Slump Test, Compaction Factor Test

III Tests on RC Beams

4. Casting and testing of simply supported reinforced concrete beam for flexure and shear

IV Tests on RC Column

5. Casting and Testing of Reinforced Concrete column

V Tests on Steel Beam

6. Testing of Simply Supported Steel beam for flexure

VI Test on Steel Frame

7. Static cyclic testing of single bay two storied steel frames

VII Tests on Hardened Concrete and Durability Tests

8. Compressive Strength, Split Tensile Strength and flexural Strength of concrete
9. Rapid Chloride Penetration Test, Half-cell Potential Test and Rebar Locator

VIII Non - Destructive Testing

10. Ultrasonic Pulse Velocity Test
11. Rebound Hammer Test
12. Windsor Probe Test
13. Core Cutting Test

IX Testing of cantilever steel beam under dynamic loading

14. To determine the damping coefficients from free and forced vibrations

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Design a concrete mix and evaluate the Strength of the Concrete
CO2 : Cast and test the RC beam for flexure, shear and the RC column for axial load.
CO3 : Perform static cyclic load testing of Steel frame and analyze the results.
CO4 : Determine the strength and quality of concrete using Schmidt Rebound Hammer and Ultrasonic Pulse Velocity Tester.
CO5 : Perform dynamic testing of cantilever steel beam and determine the damping coefficients.

TOTAL: 30 PERIODS

REFERENCES:

1. IS 10262:2019 Recommended guidelines for concrete mix design, Fourth Revision, Bureau

of Indian Standards, 2019
2. “Concrete Technology”, Santhakumar, A. R., Oxford University Press, 2023.
3. Properties of concrete, Neville, A. M. Pearson Education, 2020
4. “Concrete Technology : Theory and practice”, Shetty, M. S. S. Chand and Company Ltd., 2018
5. “Concrete Technology”, Krishnasamy, K. T. Dhanpat Rai Publications, 2017
6. “Concrete Technology”, Gambhir, M. L. Tata McGraw-Hill Publishing Company Limited, 2015
7. Guidebook on non-destructive testing of concrete structures, International Atomic Energy Agency, IAEA Publications, 2016

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	2	3
2	3	1	3	3	3	3
3	3	1	3	3	3	3
4	3	1	3	3	2	3
5	3	1	3	3	3	3
Avg.	**3**	**1**	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

23MSE222	FINITE ELEMENT ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

I Analysis of Beam under Flexure:

1.Analysis of RC simply supported beam subjected to various loading conditions
2.Analysis of steel cantilever beam subjected to various loading conditions

II Analysis of Beam under Shear:

3.Analysis of RC simply supported beam subjected to various loading conditions
4.Analysis of steel cantilever beam subjected to various loading conditions

III Analysis of Truss

5.Analyze a statically determinate truss under various loading conditions
6.Analyze a statically indeterminate truss with joint displacement constraints

IV Finite Element Analysis of Thin and Thick Plates:

7.Analyze a simply supported thin plate under transverse and in-plane loading
8.Analyze a simply supported thick plate under transverse and in-plane loading

V Buckling behavior of Columns

9.Analyze the buckling behavior of a Reinforced column under axial load
10.Analyze the buckling behavior of a Steel column under axial load

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Apply appropriate software to build a finite element model of a given beam under various loading conditions.
CO2 : Analyze the statically determinate and indeterminate trusses by applying finite element analysis principles
CO3 : Develop a model to analyzing reinforced concrete beams using Finite Element Analysis.
CO4 : Identify and differentiate between the appropriate element types for thin and thick plates in FEA software.
CO5 : Interpret and visualize the buckling modes to understand the deformation patterns associated with potential instabilities.

TOTAL: 30 PERIODS

REFERENCES:

1. IS 10262:2019 Recommended guidelines for concrete mix design, Fourth Revision, Bureau of Indian Standards, 2019

2. “Concrete Technology”, Santhakumar, A. R., Oxford University Press, 2023.
3. Properties of concrete, Neville, A. M. Pearson Education, 2020
4. “Concrete Technology: Theory and practice”, Shetty, M. S. S. Chand and Company Ltd., 2018
5. “Concrete Technology”, Krishnasamy, K. T. Dhanpat Rai Publications, 2017
6. “Concrete Technology”, Gambhir, M. L. Tata McGraw-Hill Publishing Company Limited, 2015
7. Guidebook on non-destructive testing of concrete structures, International Atomic Energy Agency, IAEA Publications, 2016
8. “Concepts and applications of finite element analysis”, Cook, R. D., Malkus, D. S., & Plescia 4th edition. John Wiley & Sons, 2018.
9. “The finite element method: Its basis and fundamentals”, Zienkiewicz, O. C., Taylor, R. L., & Zhu, J. Z., 6th edition, Butterworth-Heinemann, 2013.
10. "Finite Element Analysis: Theory and Application with ANSYS" by Saeed Moaveni: 3rd Edition, India Pearson Education 2011.
11. “Finite Element Analysis Using ANSYS”, Paleti Srinivas, Sambana Krishna Chaitanya, Datti Rajesh Kumar, 1st Edition, Srinivas, 2010.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	3	3	2	3
2	3	1	3	3	3	3
3	3	1	3	3	3	3
4	3	1	3	3	2	3
5	3	1	3	3	3	3
Avg.	**3**	**1**	**3**	**3**	**3**	**3**

1-low, 2-medium, 3-high

SEMESTER III

23MSE31	PRACTICAL TRAINING	L	T	P	C
		3	0	0	3

PRACTICAL TRAINING

The students individually undertake training in reputed engineering companies doing Structural Engineering related works during the vacation period for a specified duration of four weeks. At the end of the training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: Identify key engineering principles and practices applied in the specific industry sector they trained in.

CO2: Explain the concepts, methodologies, and techniques used in their assigned projects during the practical training.

CO3: Apply theoretical knowledge learned in coursework to solve practical engineering problems encountered during the internship.

CO4: Critically evaluate the strengths and weaknesses of the engineering solutions implemented in their training projects.

CO5: Prepare clear, concise, and well-organized reports that effectively communicate complex engineering information

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	2	1	3	2	1	2
2	2	1	3	2	1	2
3	2	1	3	2	1	2
4	2	1	3	2	1	2
5	2	3	3	1	1	2
Avg.	**2**	**1**	**3**	**2**	**1**	**2**

1-low, 2-medium, 3-high

23MSE31	PROJECT WORK PHASE I	L	T	P	C
		0	0	6	3

PROJECT WORK PHASE I

The student individually works on a specific topic approved by faculty member who is familiar in his/her area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES

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

CO1: Identify a precise research problem for the current need of society in the chosen area of Structural Engineering Specialization.

CO2: Analyze different existing research approaches and identify the potential research gap and list parameters to work with.

CO3: Develop a Comprehensive and Feasible Methodology to address the research problem.

CO4: Apply appropriate analytical or experimental methods to investigate the chosen problem.

CO5: Prepare clear, concise, and well-organized reports that effectively communicate complex engineering information

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	3	3	3	2	3
2	3	3	3	3	2	3
3	3	3	3	3	2	3
4	3	3	3	3	2	3
5	3	3	3	3	2	3
Avg.	**3**	**3**	**3**	**3**	**2**	**3**

1-low, 2-medium, 3-high

SEMESTER IV

23MSE31	PROJECT WORK PHASE II	L	T	P	C
		0	0	30	15

PROJECT WORK PHASE II

The student individually works on a specific topic approved by a faculty member who is familiar in his/her area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES

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

CO1: Identify a precise research problem for the current need of society in the chosen area of Structural Engineering Specialization.

CO2: Analyze different existing research approaches and identify the potential research gap and list parameters to work with.

CO3: Develop a Comprehensive and Feasible Methodology to address the research problem.

CO4: Apply appropriate analytical or experimental methods to investigate the chosen problem.

CO5: Prepare clear, concise, and well-organized reports that effectively communicate complex engineering information

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	3	3	3	2	3
2	3	3	3	3	2	3
3	3	3	3	3	2	3
4	3	3	3	3	2	3
5	3	3	3	3	2	3
Avg.	**3**	**3**	**3**	**3**	**2**	**3**

1-low, 2-medium, 3-high

PROFESSIONAL ELECTIVES

23MSEE01	STABILITY OF STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I BUCKLING OF COLUMNS **9**

States of equilibrium - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis. Governing equation for column buckling - critical load using Equilibrium, Energy methods - Approximate methods - Rayleigh Ritz, Galerkin's approach - Numerical Techniques – Finite difference method.

MODULE II BUCKLING OF BEAM-COLUMNS AND FRAMES **9**

Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples - Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.

MODULE III TORSIONAL AND LATERAL BUCKLING **9**

Torsional buckling – Combined Torsional and flexural buckling - Local buckling - Buckling of Open Sections - Lateral buckling of beams - simply supported and cantilever beams

MODULE IV BUCKLING OF PLATES **9**

Governing differential equation - Buckling of thin plates with various edge conditions - Analysis by equilibrium and energy approach – Finite difference method.

MODULE V INELASTIC BUCKLING **9**

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behaviour of plates

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze the stability of columns under various loading conditions using equilibrium, energy, and other theoretical approaches.
CO2 : Calculate the critical buckling loads of beam-columns and frames with different support conditions and loading scenarios.
CO3 : Identify and characterize torsional and lateral buckling phenomena in different structural elements like beams and columns.
CO4 : Evaluate the buckling behavior of thin plates with varied edge conditions using analytical and numerical techniques.
CO5 : Apply inelastic buckling theories to evaluate the strength and post-buckling behavior of columns and plates

TOTAL: 45 PERIODS

REFERENCES:

1. "Principles of Structural Stability Theory", Chajes, A. Prentice Hall, Inc., New Jersey, 2014.
2. "Background to Buckling", Allen, H.G. & Bulson, P.S. McGraw-Hill Co., 2010.
3. "Theory of Elastic Stability", Timoshenko, S.P. and Gere, J.M. McGraw-Hill Company, 2022.
4. "Fundamentals of Structural Stability", Simitses, G.J. and Hodges, D.H. Elsevier Ltd., 2016.
5. "Stability of Structures", Bažant, Z.P. and Cedolin, L. World Scientific Co., Singapore, 2020.
6. "Structural Stability of Columns and Plates", Iyengar, N.G.R. Affiliated East-West Press Pvt. Ltd., New Delhi, 2017.
7. "Stability Analysis and Design of Structures", Gambhir, M. Springer, New York, 2018.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	2	2
2	3	2	3	3	2	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE02	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3

MODULE I CONCRETE AND TESTING **9**

Cement hydration - Concrete - Quassi-brittle nature of concrete- Micro-cracking, crack propagation - stress concentration at openings -Destructive, semi-destructive & Non-destructive testing methodology - Rebound hammer test - Ultrasonic Pulse Velocity UPV Test - Penetration resistance test - Pull-out Test - Pull-off Method - Break-off test - Cover Measurement - Half-cell electrical potential method - Introduction to Microscopic Analysis.

MODULE II CONCRETE ADMIXTURES **9**

Chemical Admixtures- Hydration of chemical admixture, Plasticizers and super Plasticizers and their effect on concrete property in fresh and hardened state, Marsh Cone test for optimum dosage of super plasticizer, retarder, accelerator, Air-entraining admixtures, and new generation super plasticizer. Mineral Admixture-Fly ash, Silica fume, GGBS and their effect on concrete property in fresh state and hardened state.

MODULE III SPECIAL CONCRETES **9**

Fibre Reinforced Concrete - High performance concrete - Ultra high strength concrete - Self Compacting Concrete - Polymer Concrete - Sulphur concrete - Geo polymer concrete - Recycled aggregate concrete - Bacterial concrete – Nano concrete.

MODULE IV CONCRETING UNDER SPECIAL CIRCUMSTANCES **9**

Underground construction - Concreting in marine environment - Underwater construction - Extreme weather concreting.

MODULE V DURABILITY OF CONCRETE **9**

Factors affecting durability - Tests on permeability - water absorption - chemical Attack- Sulphate attack - carbonation - chloride penetration - fire - frost action

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze the behavior of concrete under various loading conditions and evaluate the suitability of different test methods for characterizing its key properties.

CO2 : Evaluate admixture interactions with other concrete components and propose innovative mix designs optimized for performance and cost in diverse applications

CO3 : Categorize various types of concrete based on their inherent properties and make informed choices for different structural and environmental requirements.

CO4 : Develop and implement effective strategies for successful concrete placement and curing under a range of exposure conditions, utilizing appropriate techniques and best

practices.

CO5 : Evaluate the limitations and uncertainties associated with performance and durability predictions for concrete structures, proposing strategies for mitigation and ensuring long-term integrity.

TOTAL: 45 PERIODS

REFERENCES:

1. "Concrete Technology", Santhakumar, A.R., 5th Edition, Oxford University Press, New Delhi, 2022.
2. "Properties of Concrete", Neville, A.M., 6th Edition, Pearson Education Ltd., New Delhi, 2018.
3. "Concrete Microstructure, Properties and Materials", Mehta, P.K. and Monteiro, P.J.M., 4th Edition, McGraw-Hill Education, 2016.
4. "Concrete Technology", Gupta, B.L. and Gupta, Amit, 14th Edition, Standard Publishers and Distributors, New Delhi, 2019.
5. "Concrete Technology", Shetty, M.S., 9th Edition, S. Chand and Company, New Delhi, 2023.
6. "Concrete Technology", Gambhir, M.L., 2nd Edition, Tata McGraw Hill Book Co. Ltd., Delhi, 2020.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	2	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	2	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE03	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

MODULE I FORCE AND STRAIN MEASUREMENTS **9**

Strain gauges, principles, types, performance and uses. Photo elasticity - principle and applications- Moire Fringe - Hydraulics jacks and pressure gauges - Electronic load cells - Proving Rings - Calibration of Testing Machines - Long term Monitoring - Vibrating wire sensors - fibre optic sensors.

MODULE II VIBRATION MEASUREMENTS **9**

Characteristics of structural vibrations - Linear Variable Differential Transformer LVDT - Transducers for velocity and acceleration measurements. Vibration meter - Seismographs - Vibration Analyzer - Display and recording of signals - Cathode Ray Oscilloscope- XY Plotter - Chart plotters- Digital Data Acquisition Systems.

MODULE III ACOUSTICS AND WIND MEASUREMENTS **9**

Principles of Pressure and Flow measurements - Pressure Transducer - sound level meter - venturi meter and flow meters - wind tunnel and its use in structural analysis- structural modelling - direct and indirect model analysis.

MODULE IV DISTRESS MEASUREMENTS **9**

Diagnosis of distress in structures - crack observation and measurement - Corrosion of reinforcement in concrete - Half cell, construction, and use - Damage assessment - controlled blasting for demolition.

MODULE V NON-DESTRUCTIVE TESTING METHODS **9**

Load testing on structures, buildings, bridges and towers - Rebound Hammer - acoustic emission - holography - use of laser for structural testing - Brittle coatings, Ultrasonic testing principles and applications. Advanced NDT methods - Ultrasonic pulse echo, impact echo, impulse radar techniques, GECOR, Ground Penetrating Radar GPR.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Measure and analyze strain in structures using experimental techniques

CO2 : Interpret vibration data to assess structural health and performance.

CO3 : Conduct and analyze experiments to evaluate acoustic and wind effects on structures.

CO4 : Diagnose structural damage caused by corrosion and cracks.

CO5 : Evaluate structural integrity using non-destructive testing methods.

TOTAL: 45 PERIODS

REFERENCES:

1. "Experimental Stress Analysis", Sadhu Singh, 11th Edition, Kataria Publications, 2018.
2. "Experimental Stress Analysis", L.S. Srinath, Tata McGraw Hill Co, 1984.
3. "Non-Destructive Evaluation", D.E. Bray and R.K. Stanley, 4th Edition, CRC Press, 2018.
4. "Model Analysis of Structures", Ganesan.T.P, 8th Edition, University Press India, 2022.
5. "Structural Assessment", F.K. Garas, J.L. Clarke and G.S.T Armer, 2nd Edition, Butterworth-Heinemann, 2002.
6. "Instrumentation for Engineering and Scientists", John Turner and Martyn Hill, 6th Edition, Oxford University Press, 2022.
7. "Mechanical Measurements", R.S. Sironi and H.C. Radha Krishna, 10th Edition, New Age International P Ltd, 2019.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE04	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO EARTHQUAKE AND STRUCTURAL DYNAMICS **9**

Basic Seismology - General features of Tectonics of Seismic Regions- Earthquake Terminology - Definitions -Earthquake History - Behaviour of Buildings, Dams and Bridges in Past Earthquakes - Seismographs - Accelerographs - Theory of Vibrations - Damped and undamped system - free and forced vibrations - SDOF and MDOF systems

MODULE II EARTHQUAKE GROUND MOTION AND RESPONSE **9**

Earthquake Response to Elastic and Inelastic Buildings - Application to Response Spectrum Theory - Base exited motion - ground motion parameters - Modal response contribution - modal participation factor - approximate methods for lateral load analysis – Portal frame Method and Pushover Analysis

MODULE III DESIGN CRITERIA AND CONSTRUCTION **9**

Design Criteria - Strength, Deflection, Ductility and Energy Absorption - Cyclic Behaviour of Structures- Criteria for earthquake resistant design of structures as per IS 1893 Part I and II, Construction of Buildings as per IS 4326 - Ductile Detailing of Structures as per IS 13920.

MODULE IV EARTHQUAKE RESISTANT DESIGN **9**

Analysis and Design of Frames for Lateral Loads - Capacity Design - Shear Wall - Design of Rectangular and Flanged Shear Walls - Ductile Detailing of Frames for Earthquake Forces - Strengthening of Existing Buildings - Retrofitting and Rehabilitation - Analysis and Design of Buildings for Earthquake Load.

MODULE V MASONRY STRUCTURES AND VIBRATION CONTROL TECHNIQUES **9**

Behaviour of Masonry and Earthen Structures as per IS 13827 and IS 13828. Guideline for earthquake resistant design of masonry structures. Retrofitting and Rehabilitation of earthquake resistant masonry buildings. Basic concept, principle and applications of seismic base isolation, Passive control and active control systems.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Apply concepts of Structural dynamics to find response of free and forced vibration for a given SDOF and MDOF Systems.
CO2 : Evaluate seismic forces for reinforced concrete structures as per Indian standards.
CO3 : Design of reinforced concrete structures for seismic resistance as per Indian Standards.
CO4 : Apply concepts of repair and rehabilitation to earthquake affected reinforced concrete, masonry, and earthen structures to improve the seismic resistance.
CO5 : Analyze and assess the behavior of masonry and earthen structures under static and

dynamic loads and understanding various vibration control techniques to improve the seismic performance of structures.

TOTAL: 45 PERIODS

REFERENCES:

1. "Earthquake Resistant Design of Structures", Pankaj Agarwal and Manish Shrikhande, Springer Nature, 2022.
2. "Earthquake Resistant Design of Structures", S. K. Duggal, 4th Edition, Oxford University Press, 2020.
3. "Dynamics of Structures - Theory and applications to Earthquake Engineering", Anil K. Chopra, 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2021.
4. "Earthquake Resistant Design of Masonry Buildings", Miha Tomazevic, 2nd Edition, Imperial College Press, 2020.
5. IS 1893:2016 Part I Criteria for earthquake resistant design of structures: Part 1: General Provisions and Buildings.
6. IS 1893: 2014 Part II Criteria for earthquake resistant design of structures: Part 2: Liquid Retaining Tanks.
7. IS 4326: 2013 Code of practice for earthquake resistant design and construction of buildings.
8. IS 13920: 2016 Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice.
9. IS 13827: 1993 Improving earthquake resistance of earthen buildings - Guidelines.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

19MSEE05	STRUCTURAL OPTIMIZATION	L	T	P	C
		3	0	0	3

MODULE I BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES **9**

Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear, Side, Non-negativity, Behaviour and other constraints - Design space - Feasible and infeasible - Convex and Concave - Active constraint - Local and global optima. Differential calculus - Optimality criteria - Single variable optimization - Multivariable optimization with no constraints - Lagrange Multiplier method - with inequality constraints Khun - Tucker Criteria.

MODULE II LINEAR AND NON-LINEAR PROGRAMMING **9**

Formulation of problems - Graphical solution - Analytical methods - Standard form - Slack, surplus and artificial variables - Canonical form - Basic feasible solution - simplex method - Two phase method - Penalty method - Duality theory - Primal - Dual algorithm.

One Dimensional minimization methods: Unidimensional - Unimodal function - Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques.

MODULE III GEOMETRIC PROGRAMMING **9**

Posynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty.

MODULE IV DYNAMIC PROGRAMMING **9**

Bellman's principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods.

MODULE V STRUCTURAL APPLICATIONS **9**

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. structures such as multistorey buildings, water tanks and bridges.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze and apply fundamental optimization principles to structural element design

CO2 : Evaluate and choose appropriate optimization techniques for optimal structural element design.

CO3 : Formulate and solve linear programming problems for plastic design of frames.

CO4 : Apply optimization theorems to analyze and improve truss and frame designs.

CO5 : Evaluate and assess the potential of non-traditional optimization methods for innovative structural design solutions.

TOTAL: 45 PERIODS

REFERENCES:

1. "Structural Optimization: Fundamentals and Applications", Uri Kirsch, Springer-Verlag, 2012.
2. "Introduction to Optimum Design", J.S. Arora, 2nd Ed., Elsevier, 2014.
3. "Engineering Optimization: Theory and Practice", S.S. Rao, 4th Ed., John Wiley and Sons, 2010.
4. "Foundations of Structural Optimization - A Unified Approach", A.J. Morris, 3rd Ed., John Wiley and Sons, 2003.
5. "Elements of Structural Optimization", R.T. Haftka and P.M. Pardalopoulos, 3rd Ed., Springer, 1992. (Note: I corrected the co-author's name here).
6. "Optimization for Engineering Design: Algorithms and Examples", K. Deb, Prentice Hall, 1995.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	2	2
2	3	2	3	3	2	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE06	HEATH MONITORING OF STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I DIAGNOSTICS **9**

Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance, various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

MODULE II SERVICEABILITY AND DURABILITY OF CONCRETE **9**

Quality assurance for concrete construction, concrete properties - Strength, permeability, thermal properties and cracking - Effects due to climate, temperature, chemicals, corrosion - Design and construction errors - Effects of cover thickness and cracking.

MODULE III MATERIALS FOR REPAIR **9**

Special concretes-Sulphur infiltrated concrete, Fibre reinforced concrete, polymer concrete, foamed concrete, vacuum concrete - special mortar-concrete chemicals - special elements for accelerated strength gain, Expansive cement, Ferro cement -Rust eliminators and polymer coating for rebars during repair-mortar and dry pack, Gunite and Shotcrete, Epoxy injection.

MODULE IV TECHNIQUES FOR REPAIR OF STRUCTURES **9**

Mortar repair for cracks, shoring and underpinning-Methods of corrosion protection -corrosion inhibitors, corrosion resistant steels and cathodic protection- Repair of structures distressed due to earthquake - Strengthening using FRP- Strengthening and stabilization techniques for repair.

MODULE V DEMOLITION OF STRUCTURES **9**

Planning - Precautionary measures- principles of structural demolition- Methods of demolition - dismantling of structures - Engineered demolition techniques for structures-demolition of special structures - Waste Handling.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Apply the assessment procedure for evaluating damaged structures.

CO2 : Evaluate the causes of cracks and design and construction errors.

CO3 : Identify and evaluate appropriate materials and techniques for repairing specific types of distressed structures, based on given damage assessments.

CO4 : Develop and justify a plan for strengthening specific structural elements of deteriorated structures, considering feasibility, cost, and effectiveness.

CO5 : Select engineered demolition technique for a dilapidated structure, adhering to safety regulations and achieving desired outcomes.

TOTAL: 45 PERIODS

REFERENCES:

1. "Maintenance and Repairs of Buildings", P.K. Guha, New Central Book Agency P Ltd, Kolkata, 2017.
2. "Maintenance and Repair of Civil Structures", B.L. Gupta and Amit Gupta, Standard Publications, 2023.
3. "Maintenance and Repairs of Buildings", P.K. Guha, New Central Book Agency P Ltd, Kolkata, 2017.
4. "Learning from failures - Deficiencies in Design, Construction and Service", R.N. Raikar, R&D Centre SDCPL, Raikar Bhavan, Bombay, 2011.
5. "Concrete Technology", A.R. Santhakumar, Oxford University Press, Printed in India by Radha Press, New Delhi, 2022.
6. "Concrete Repair and Maintenance Illustrated", Peter H. Emmons, Galgotia Publications Pvt. Ltd., 2007.
7. "Handbook on Causes and Prevention of Cracks in Buildings", SP 25:2016, Bureau of Indian Standards, New Delhi, 2016.
8. "Concrete Technology - Theory and Practice", M.S. Shetty, S.Chand and Company, New Delhi, 2023.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE07	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I PRINCIPLES OF PRE-STRESSING **9**

Difference between reinforced and prestressed concrete. Principles of prestressing - Methods and systems of prestressing -Principles of Electrothermal prestressing & chemical prestressing - Classification of prestressed concrete structures - Materials- High strength concrete and High tensile steel - stress - strain diagrams. Losses in Prestress: Loss due to elastic shortening in pretensioned and post tensioned beams. Loss due to creep, shrinkage, relaxation, friction - Approximate percentage of various losses in pretensioned and post tensioned beams.

MODULE II DESIGN OF FLEXURAL MEMBERS **9**

Design of prismatic prestressed concrete members for bending - Magnel's graphical method - check for ultimate load stage Limit State Design - Non prismatic members Design principles only - Simple cable profiles - calculation of deflections.

MODULE III DESIGN FOR SHEAR TORSION AND END BLOCK **9**

Design of beams for shear and Torsion at working and ultimate loads. Design of Anchorage Zone by Guyon's method – Concept of Mangel's method - IS 1343 recommendations. Design of end blocks.

MODULE IV DESIGN OF TENSION, COMPRESSION AND COMPOSITE MEMBER **9**

Design of tension members - Design of columns subjected to bending moment and axial compression. Composite prestressed concrete beams - Design procedure - calculation of stresses at important stages both for propped and unpropped constructions- Design of shear connectors - Shrinkage Stresses.

MODULE V DESIGN OF CONTINUOUS BEAMS **9**

Statically indeterminate structures - concept of concordant cable and linear transformations - sketching of pressure lines for continuous beams and single span single storey rigid frame. Design principles of Partially prestressed concrete structures - circular prestressing - Design of a circular tank for circular and vertical prestressing. Determination of Concordant Cable profile.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Calculate the pre-stress losses in concrete members and explain different types of prestressing methods

CO2 : Design prestressed concrete beams for flexure and shear using limit state design.

CO3 : Design end blocks, tension, and compression members in prestressed concrete structures.

C**O4 :** Design composite prestressed concrete beams and optimize shear connector configuration.

CO5 : Analyze continuous prestressed concrete beams for bending and shear forces.

TOTAL: 45 PERIODS

REFERENCES:

1. "Prestressed Concrete", N. Krishna Raju, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2018.
2. "Prestressed Concrete", N. Rajagopalan, Alpha Science International Ltd., UK, 2017.
3. "Prestressed Concrete Structures", P. Dayaratnam, Oxford and India Book House Ltd., Chennai, 2017.
4. "Fundamentals of Prestressed Concrete", N.C. Sinha and S.K. Roy, S. Chand and Company, New Delhi, 2023.
5. "Code of Practice for Prestressed Concrete", IS 1343:2012, Bureau of Indian Standards, New Delhi, 2012.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE08	CORROSION OF STEEL IN CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I CORROSION AND PROCESS **9**

Corrosion of steel reinforcement in concrete, definition of corrosion, forms of corrosion, phenomenon of corrosion, corrosion initiation-environment-cover thickness-quality of cover concrete -type of steel and critical chloride-presence of cracks, corrosion propagation - electrochemical process - physical process, theory of reinforcement corrosion-basic corrosion cell-anode and cathode-electrolyte- corrosion potential and rate of corrosion.

MODULE II IDENTIFICATION AND APPRAISAL OF CORROSION **9**

Corrosion process and mechanism - approach to investigation-visual observation and documentation, insitu testing of concrete rebound hammer test, cover meter survey-ultrasonic pulse velocity UPV test - core sampling and testing, insitu testing of steel rebar -carbonation test and pH value, chloride content- half cell potential survey-resistivity mapping -measurement of corrosion rate.

MODULE III MONITORING OF CORROSION **9**

Methods used for monitoring corrosion - open circuit potential measurement, resistivity measurement, corrosion cell ratio, electrical resistance probe method, polarization resistance technique, impedance technique, guard ring technique, electrochemical noise analysis.

MODULE IV PROTECTIVE MEASURES **9**

Coating to reinforcement-metallic coatings-epoxy coatings-cement based coatings -coating to prestressing steel, galvanized reinforcement, stainless steel, non-ferrous reinforcement and coating to concrete surface, improving the concrete, corrosion resistant steel.

MODULE V INHIBITORS FOR CONCRETE **9**

Definition of inhibitor-anodic and cathodic inhibitors-rice husk ash, fly ash, electrochemical removal of chloride from concrete, non-metallic materials, carbon FRP, Glass FRP, parafil tendons.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze and explain the key mechanisms and environmental factors that trigger and accelerate corrosion processes in different materials.

CO2 : Evaluate and implement various techniques for effective corrosion monitoring and assessment.

CO3 : Design and apply suitable protective measures against different types of corrosion in diverse environments.

CO4 : Apply corrosion resistance principles and selection criteria to choose appropriate

materials and coatings for specific environments and applications.

CO5 : Develop strategies for corrosion control and prevention in engineering applications, optimizing cost and effectiveness.

TOTAL: 45 PERIODS

REFERENCES:

1. "Durability of Reinforced Concrete Structures", M.A. Ghods and W.H. Zhang, Springer, 2022.
2. "Corrosion of Steel in Concrete: Theory and Practice", Luca Bertolini, Pietro Pedeferri, and Emilio Pastorelli, Wiley-VCH, 2013.
3. "ACI Committee 222 - Corrosion of Metals in Concrete", American Concrete Institute, 2023.
4. "Corrosion and Degradation of Metals in the Architectural Environment", Michael Stratford and Paul B. Wilde, Taylor & Francis, 2019.
5. "Handbook of Research on Biocorrosion", Hans-Curt Flemming and William G.C. Whyte, John Wiley & Sons, 2010.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE09	THEORY OF PLATES	L	T	P	C
		3	0	0	3

MODULE I PLATE BEHAVIOUR AND SMALL DEFLECTION THEORY **9**

Introduction - Thin and thick plates - Plate behaviour - Material behaviour - Isotropic and orthotropic Materials, Differential equation of plates in Cartesian co-ordinate system - boundary conditions - Rigorous solution - Navier's Method - Levy's Method.

MODULE II SYMMETRICAL BENDING OF CIRCULAR PLATES **9**

Differential equation for symmetrical bending of laterally loaded circular plates - Simply supported edges-Clamped edges - Circular plate with a circular hole at the centre - Circular plate concentrically loaded.

MODULE III APPROXIMATE METHODS **9**

Energy methods - Galerkin's Method - Ritz Method, Method of Images - Plate strip - Influence surfaces - Membrane and Various Analogies - Simultaneous Bending and Stretching.

MODULE IV NUMERICAL METHODS **9**

Finite difference method - Improvements for solution, matrix displacement analysis of Grids - introduction to Finite Element Method**.**

MODULE V PLATES OF OTHER SHAPES AND ADVANCED TOPICS **9**

Triangular plates - Elliptic plates - Sector plates - Skew plates - Plates on elastic foundation - Continuous plates - Large Deflection theory - Thermal stresses - Multilayered plates. - Mindlin's theory of plates.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Explain the fundamental concepts of plate behavior and analyze the behavior of thin and thick plates under various loading conditions using plate theory to solve for deformations and stresses.

CO2 : Analyze symmetrical bending of circular plates under various boundary conditions using classical plate theory to determine deflections, moments, and stresses.

CO3 : Analyze plates by various approximate methods and solve bending and stretching problems.

CO4 : Apply numerical techniques, including finite difference method and finite element method and analyze the behavior of grids and structures.

CO5 : Analyze the response of plates with various shapes under different loading conditions using established plate theories and interpret the results to predict bending, deflection, and stress.

TOTAL: 45 PERIODS

REFERENCES:

1. "Theory and Analysis of Plates - Classical and Numerical Methods", Rudolph Szilard, Prentice Hall, 1995.
2. "Theory of Plates and Shells", S. Timoshenko and S.W. Krieger, McGraw-Hill Book Company, New York, 1990.
3. "Theory of plates", K. Chandrashekhara, University Press India Limited, Hyderabad, 2001.
4. "A Text Book of Plate Analysis", N.K. Bairagi, Khanna Publishers, New Delhi, 1996.
5. "Beams, Plates and Shells", L.H. Donnell, McGraw-Hill Inc., 1976.
6. "Plates Theories and Applications", K. Bhaskar and T.K. Varadan, Springer Cham, 2022.
7. "Plates and Shells, Theory and Analysis", Ansel C. Ugural, 4th Edition, CRC Press, 2018.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE10	DESIGN OF CONCRETE BRIDGES	L	T	P	C
		3	0	0	3

MODULE I CONCRETE BRIDGES **9**

Introduction -Classification - Investigations and planning - choice of type - IRC Specifications for road bridges - standard live loads - other forces acting on the bridges - load distribution theories for short and long span bridges - general design considerations.

MODULE II DESIGN OF RCC BRIDGES **9**

Design of RCC Solid Deck Slab Bridges - Structural Analysis of Solid Deck Slabs - Reinforcement Details and Code Requirements - Design of RCC Tee Beam Deck Slab Bridges - Structural Behavior of Tee Beams - Load Distribution and Analysis - Shear and Moment Design Considerations.

MODULE III DESIGN OF PRESTRESSED CONCRETE BRIDGES **9**

Introduction to Prestressed Concrete - Analysis and Design of Prestressed Deck Slabs - Considerations for Post-Tensioning and Pre-Tensioning - Design of PSC Girder Bridges - Prestressed Concrete Girder Behavior - Design Principles for Prestressed Girders**.**

MODULE IV OTHER TYPES OF CONCRETE BRIDGES **9**

Precast PSC Bridges -Design principles for precast segments -Erection and connection methods -Advantages and limitations compared to cast-in-situ construction - Box Girder Bridges - Design of closed box sections for flexure, torsion, and shear - Advantages and applications of box girder bridges - Design considerations for long spans bridge.

MODULE V BEARINGS AND SUBSTRUCTURES **9**

Types and Functions of Bridge Bearings - Behavior and Analysis of Different Bearing Types - Design of RC, Steel, and Elastomeric Pad Bearings - - Abutment Types and Design Principles - Pier Configurations and Load Transfer Mechanisms - Well Foundation - Construction and Types of Well foundation.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Design and optimize concrete bridges for efficiency, deflection and cost, justifying selection based on structural analysis and performance indicators.

CO2 : Design and document reinforced concrete bridge elements adhering to codes and standards with verified calculations

CO3 : Evaluate and select the optimal pre-stressed concrete technique for a given bridge design, considering cost, constructability, and long-term performance.

CO4 : Identify and use optimal design approach for Precast PSC, box girder & long-span bridges based on geometry, loading & materials.

CO5 : Design and detail bridge substructures & bearings adhering to codes and standards,

presenting for peer review.

TOTAL: 45 PERIODS

REFERENCES:

1. "Concrete Bridge Practice", V.K. Raina, Tata McGraw Hill Publishing Co, New Delhi, 2018.
2. "Design of Bridges", N. Krishnaraju, Oxford Publishing Co, 2023.
3. "Concrete Bridge Design - Principles and Practice", Mukul Kumar and Surendra Singh, CRC Press, 2023.
4. "Standard Specifications and Code of Practice for Road Bridges. Section I-General Features and Design", IRC 5:2016, Indian Road Congress.
5. "Standard Specifications and Code of Practice for Road Bridges. Section VII-Foundation and Substructures", IRC 78:2014, Indian Road Congress.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE11	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I COMPOSITE STRUCTURE **9**

Introduction to steel-concrete composite construction - Benefits and applications of composite structures - Types of composite structures (beams, columns, slabs) - Theory of composite structures - Shear connection between steel and concrete - Composite action and effective section properties - Behavior under flexure, shear, and torsion - Introduction to steel-concrete-steel sandwich construction - Benefits and applications of sandwich panels - Design considerations for sandwich panels

MODULE II DESIGN OF COMPOSITE BEAMS **9**

Behavior of composite beams - Deflections, stresses, and strains in composite beams - Ultimate strength considerations (flexure, shear, web buckling) - Design of composite beams - Design codes and standards - Serviceability limit states (deflection, crack control) - Strength limit states (flexure, shear, connection design) - Software tools for composite beam design

MODULE III DESIGN OF COMPOSITE COLUMNS AND TRUSSES **9**

Steel-concrete composite columns - Behavior and design of composite columns (axial, flexure, biaxial loading) - Confinement requirements for concrete - Design of composite trusses: - Design of chord and web members in composite trusses - Connection design in composite trusses - Stability considerations (buckling)

MODULE IV DESIGN OF CONNECTIONS **9**

Types of connections - Welded connections - Bolted connections - Shear studs - Other connection types - Design of connections in composite structures - Design for shear transfer - Design for moment transfer - Fatigue considerations - Design of connections in composite trusses: - Connection details for chord and web members - Gusset plate design - Fatigue considerations

MODULE V COMPOSITE BOX GIRDER BRIDGES **9**

Types of box girder bridges - Advantages and applications - Behavior of box girder bridges: - Torsional behavior - Shear lag - Local buckling considerations - Design concepts - Design codes and standards for bridges - Serviceability and strength limit states - Fatigue design - Construction considerations - General case studies on steel - concrete composite construction in buildings - seismic behavior of Composite structures.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Explain the behaviour of steel-concrete composite and sandwich structures under various loading conditions.

CO2 : Design efficient composite beams for specified loads and spans using relevant design codes and software.
CO3 : Utilize design principles and code provisions to create stable and load-resistant composite columns and trusses.
CO4 : Choose and design appropriate connections for composite structures, ensuring adequate strength and stiffness against shear and other forces.
CO5 : Analyze the behaviour of composite box girder bridges and predict their response to different loading scenarios.

TOTAL: 45 PERIODS

REFERENCES:

1. "Design of Steel and Composite Structures", T.Y. Lin and Ned H. Burns, John Wiley & Sons, 2020.
2. "Composite Structures of Steel and Concrete", R.P. Johnson, 3rd Edition, Wiley, 2013.
3. "Case Studies in Composite Bridges", P.C. Wasti and N.K. Jain, Springer, 2020.
4. "Standard Specifications and Code of Practice for Road Bridges. Section V- Steel Road Bridges", IRC 24:2010, Indian Road Congress.
5. "Finite Element Analysis and Design of Steel and Concrete Composite Bridges", Niels G. Ottosen, Taylor & Francis, 2005.
6. "Behavior and Design of High-Strength Concrete Composite Bridges", Lihua Fang and Li Yu, CRC Press, 2023.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE12	OFFSHORE STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I WIND EFFECTS **9**

Wind on Structures - Wind Load Estimation - Wind Tunnel Testing - Wind Loading Codes and Standards - Rigid Structures - Behavior of Rigid Structures under Wind Load - Structural Response and Deformation - Flexible Structures - Dynamic Response of Flexible Structures - Aeroelasticity Considerations - Static and Dynamic Effects - Static Analysis of Structures under Wind Load - Dynamic Effects - Vortex Shedding, Flutter, Buffeting

MODULE II WAVE HYDRODYNAMICS **9**

Wave Generation - Mechanisms of Wave Generation - Mathematical Models for Wave Generation - Propagation of Small and Finite Amplitude Wave Theories - Linear Wave Theories - Nonlinear Wave Theories - Wave Energy and Pressure Distribution - Wave Energy Spectrum - Pressure Distribution on Structures

MODULE III WAVE LOADING **9**

Wave Forces on Structures - Hydrodynamic Forces on Offshore Structures - Wave-Induced Loads on Different Types of Structures - Environmental Loadings - Combined Loading from Wind and Waves - Storm Conditions and Extreme Loading - Use of Morrison Equation - Introduction to Morrison Equation - Applications in Estimating Wave Forces.

MODULE IV OFFSHORE STRUCTURE MODELLING **9**

Different Types of Structures - Fixed Platforms - Floating Platforms - Subsea Structures - Foundation Modeling - Soil-Structure Interaction - Pile Foundation Design - Static Methods of Analysis - Static Equilibrium Analysis - Load Distribution in Offshore Structures - Dynamics of Offshore Structures - Dynamic Analysis Methods.

MODULE V DESIGN OF OFFSHORE STRUCTURES **9**

Loads - Combination of Wind, Wave, and Environmental Loads - Load Factors and Safety Considerations - Design of Platforms - Structural Design Principles - Material Selection and Fatigue Analysis - Derricks and Helipads - Structural Design and Analysis - Safety and Operational Considerations - Jacket Towers and Mooring Cables - Design Principles for Jacket Structures - Mooring System Design and Analysis - Design Examples.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Differentiate and analyze the nature of static and dynamic wind loads on various building types and geometries.

CO2 : Explain the wave generation process and apply relevant wave theories to assess offshore structure performance.

CO3 : Calculate and interpret forces acting on offshore structures under various environmental conditions.
CO4 : Develop accurate structural models of offshore structures considering different loading regimes.
CO5 : Design individual components of offshore structures to meet strength, stability, and functionality requirements.

TOTAL: 45 PERIODS

REFERENCES:

1. “Offshore Structures: Designing for Environmental Load", T.K. Sarpkaya, John Wiley & Sons, 2014.
2. “Ocean Engineering for the Polar Regions", Johan V. Ringheim, Springer, 2014.
3. "Hydrodynamics of Ship and Offshore Structures", John Newman, Cambridge University Press, 2010.
4. “Recommended Practice for Design and Construction of Fixed Offshore Platforms", API RP 2A.
5. “Environmental Conditions for Offshore and Coastal Structures", DNV-RP-C205.
6. “Case Studies in Offshore Engineering", Torgeir Moan, Elsevier, 2010.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE13	SHELL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I SHELLS AND PLATES **9**

Structural behavior of shells and folded plates - Theory of surfaces - Generation of surfaces - Classification - IS code provisions.

MODULE II ANALYSIS AND DESIGN OF CYLINDRICAL SHELLS **9**

Membrane theory; Bending theory; Beam - Arch approximation; Continuous Cylindrical shells - Long and Short shells. Shells with and without edge members - Multibarrel shells. Design by ASCE Manual - Shells of various boundary conditions - North light shells - proportioning shells - Reinforcement in shell and edge members - Prestressing of edge members - Review of recommendations of codes - Constructional aspects - Design of Traverses.

MODULE III SHELLS OF DOUBLE CURVATURE **9**

Membrane theory for shells of revolution - Membrane theory for general shells of double curvature - Synclastic and anticlastic shells - Approximate bending theory of shallow shells - Design of H.P cooling tower shells.

MODULE IV DESIGN OF DOUBLY CURVED SHELLS **9**

Hyperbolic paraboloid roofs - Determination of forces in shells and edge members - Design of umbrella and inverted umbrella roof - Design of conidial shells - Skew Hypars - H.P shells on parabolic directrix boundary - New Shell forms - Funicular shells.

MODULE V FOLDED PLATES **9**

Various steps in the analysis - Analysis by ASCE Task committee method - Analysis by Finite Strip approach-Design of reinforcement - Transverses.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Explain the structural behavior of various shell and folded plate geometries.

CO2 : Analyze cylindrical shells under membrane and bending actions for internal forces and displacements.

CO3 : Design doubly curved shells for specified loads and deflections using membrane theory principles.

CO4 : Evaluate the suitability of doubly curved shells for specific applications considering structural performance and constructability.

CO5 : Analyze the structural design of folded plates, including internal force distribution and deflection control.

TOTAL: 45 PERIODS

REFERENCES:

1. "Design and Construction of Concrete Shell Roofs", G.S. Ramaswamy, CBS Publishers and Distributors, New Delhi, 2005.
2. "Shell Structures: Theory and Practice", W.H. Wittrick and N.J. O'Donnell, Elsevier, 2013.
3. "Concrete Shell Structures: Analysis and Design", I.N. Sneddon, CRC Press, 2014.
4. "Concrete Shell Design Using Eurocode 2", P.L. Smith and D.S. El-Mohr, Thomas Telford, 2013.
5. "Thin-Shell Concrete Structures", P.N. Agrawal and V.K. Murthy, CRC Press, 2017.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE14	DESIGN OF TALL BUILDINGS	L	T	P	C
		3	0	0	3

MODULE I DESIGN CRITERIA AND LOADING **9**

History - structural systems and concepts - Design Philosophy - materials and construction - National and International Codal Provisions for Loading - Storey Stiffness and Strength – Deformations - Floor Systems – Materials - Progressive Collapse – Wind effects, Effects of Creep - Shrinkage, Temperature, Fire -Structural Analysis- Human Comfort Criteria- Human perception of building motion, perception thresholds, Use of comfort criteria in design - Gravity Load, Live Load, Construction Load, Wind Load and Earthquake Load- Static and Dynamic Methods – Load Combinations

MODULE II HIGHRISE STRUCTURAL COMPONENTS **9**

Mega structures and architecture - case studies – Classifications - Interior and Exterior structures - Rigid Frame, Braced Frame, Infilled Frame, Flat Plate-Slab, Shear Wall, Coupled Shear Wall, Flat Slab with Shear Wall, Shear Wall Frame Interaction, Framed Tube Structural System, Core Supported Structures, Outrigger, Belt Truss, Buttress Core System for Tall Building - Cladding and Facades – Foundations- Non-structural elements of tall buildings.

MODULE III DYNAMIC RESPONSE OF TALL STRUCTURES **9**

Sensitivity of structures to wind forces, Characteristics of Wind, Codal Provisions, Dynamic structural response due to wind forces - Introduction to Wind Tunnel Engineering – Site Specific Wind Tunnel Studies - Behaviour of Tall Buildings under Earthquakes, Design Philosophy, Structural Damping, Static and Dynamic Approach of Earthquake Analysis of Buildings, Empirical relations for fundamental natural frequency, Modal Analysis and its interpretation.

MODULE IV BEHAVIOR OF STRUCTURAL SYSTEMS **9**

Floor systems in concrete and steel - flat slabs with drop - shell systems- Static and dynamic approach - Moment resisting frame - braced - shear trusses -shear wall- frame system - framed tube - outrigger - bundled tube system - diagonal trussed tube - mega tube system - dynamics of outrigger systems - approximate methods of analysis - design of frames for lateral load - P-delta effects - design and detailing of shear walls for ductility.

MODULE V FOUNDATION **9**

Assembly of buildings, Safety Policy, Stages of Site investigation, on site tests, Foundation, Basement construction and Waterproofing, Materials, Selection & handling, Wall & Floor construction, Roof Construction- Construction Materials, - Specifications of using concrete in tall buildings - Building Movements - Modelling and acceptance criteria for seismic design and analysis of tall buildings - Software analysis and design.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Explain and apply the fundamental principles and regulations codes that governing the

design of tall structures against various loading conditions.

CO2 : Illustrate the structural components employed in tall buildings, analyze their functions and influence on overall structural performance

CO3 : Evaluate the dynamic response of tall structures to wind and earthquake loads, applying fundamental principles and design philosophies

CO4 : Interpret various structural systems used in the construction of tall structures

CO5 : Evaluate tall building materials, building mechanics, and apply software tools to solve complex challenges in the design, construction, and safety management

TOTAL: 45 PERIODS

REFERENCES:

1. "Structural Analysis and Design of Tall Buildings", 1st ed., Taranath B.S., CRC Press, 2012.
2. "Tall Building Structures: Analysis and Design", 3rd ed., B.S. Smith and A. Coull, John Wiley & Sons, 2023.
3. "Handbook of Concrete Engineering", 4th ed., M. Fintel, CRC Press, 2022.
4. "High Rise Buildings", 4th ed., J.B. Mehta, Skyline, 2022.
5. "Seismic Design of Tall Buildings", D.A. Billington and C.M. Wang, John Wiley & Sons, 2023.
6. "Advances in Tall Buildings", L.S. Beedle, Taylor & Francis, 2022.
7. "IS 16700:2023 - Criteria for Structural Safety of Tall Concrete Buildings", Bureau of Indian Standards, New Delhi, 2023.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE15	WIND AND CYCLONE EFFECTS ON STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I BASIC CHARACTERISTICS OF WIND **9**

Terminology - Spectral studies: Wind Characteristics- Interpretation of the Wind Response spectrum, Gust wind speed, Gust factor: Methods for wind load as per IS Codal Provision. Wind velocity: wind velocity ratio, characteristics of wind velocity, wind velocity measurement methods- Return Period: Weibull Parameter- Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects.

MODULE II WIND TUNNEL STUDIES **9**

Wind Tunnel: Types-Terrain Types based on Wind Speed - Modeling requirements, Interpretation of results, Aero - elastic models and their applications.

MODULE III EFFECT OF WIND ON STRUCTURES **9**

Wind on structures: rigid and flexible structures- static and dynamic effects- model analysis eigen frequencies-wind flow around tall buildings - cladding pressures -pressure distribution on buildings of rectangular cross section, full scale pressure measurement studies.

MODULE IV DESIGN OF SPECIAL STRUCTURES **9**

Design of structures for wind loading- as per IS, ASCE and NBC code provision. Design of Chimneys- Tall buildings- Transmission towers -Industrial sheds.

MODULE V CYCLONE EFFECT ON STRUCTURES **9**

Cyclone effect on low rise, sloped roof structures and tall buildings- effect of cyclones on claddings- design of cladding - Use of codal provisions.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze wind force measurement techniques and wind data for real-world applications.

CO2 : Evaluate the principles and applications of wind tunnel studies in designing structures for wind resilience.

CO3 : Predict and assess the impact of wind loads on different types of structures, including special configurations.

CO4 : Design and optimize buildings, chimneys, roofs, and shelters to withstand wind forces effectively.

CO5 : Develop components and systems for cyclone-resistant structures, ensuring structural integrity and occupant safety.

TOTAL: 45 PERIODS

REFERENCES:

1. "The Designer's Guide to Wind Loading of Building Structures", N.J. Cook, Butterworths, 2023.
2. "Wind Effects on Civil Engineering Structures", Kolousek et al., Elsevier Publications,

2023.
3. "Wind Forces in Engineering", Peter Sachs, Pergamon Press, New York, 2018.
4. "Wind Effects on Buildings", Volumes I and II, T.V. Lawson, Applied Science Publishers, London, 2016.
5. "IS 875: Part 3-2015 - Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures - Part 3: Wind Loads", Bureau of Indian Standards, New Delhi, 2015.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE16	SOIL STRUCTURE INTERACTION	L	T	P	C
		3	0	0	3

MODULE I SOIL - FOUNDATION INTERACTION **9**

Introduction to soil - Foundation interaction problems, Soil behaviour, Foundation behaviour, Interface, behaviour, Scope of soil foundation interaction analysis, soil response models. Winkler, Elastic continuum, Two parameter elastic models, Elastic – plastic behaviour, Time dependent behaviour.

MODULE II BEAMS ON ELASTIC FOUNDATION - SOIL MODELS **9**

Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness - Analysis through application packages.

MODULE III PLATE ON ELASTIC MEDIUM **9**

Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions, Analysis of braced cuts - Application packages.

MODULE IV ELASTIC ANALYSIS OF PILE **9**

Elastic analysis of single pile, Theoretical solutions for settlement and load distribution, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap - Pile raft - application packages.

MODULE V LATERALLY LOADED PILE **9**

Load deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Interaction analysis, pile-raft system, solutions through influence charts - Application packages.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze the complex interaction between soil and foundation structures, predicting settlements, deformations, and bearing capacity.

CO2 : Model and solve beam problems on elastic foundations using various soil models and Winkler Spring approaches.

CO3 : Illustrate and apply analytical methods for analyzing plate structures resting on elastic media, determining stresses and deflections.

CO4 : Describe elastic analysis of single piles, calculating settlements and load distributions under axial and lateral loading.

CO5 : Explain the behavior of laterally loaded piles in different soil conditions, employing analytical and numerical techniques.

TOTAL: 45 PERIODS

REFERENCES:

1. "Numerical Methods in Geotechnical Engineering", N.C. Desai and J.F. Abel, 4th Edition,

2017.
2. "Geotechnical Earthquake Engineering", Ikuo Okawa, 2nd Edition, 2019.
3. "Soil-Structure Interaction: Theory and Analysis", Edited by P.P. Zur, 2010.
4. "Analysis and Design of Substructures", 2nd Edition, S. Saran, Taylor & Francis Publishers, 2019.
5. "Elastic Analysis of Raft Foundations", 2nd Edition, J.A. Hemsley, Thomas Telford, 2021.
6. "Pile Foundation Analysis and Design", H.G. Poulos and E.H. Davis, 6th Edition, John Wiley, 2018.
7. "Essentials of Soil Mechanics and Foundations: Basic Geotechnics", 7th Edition, D.F. McCarthy, Prentice Hall, 2015.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE17	MECHANICS OF COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

MODULE I MATERIALS AND ITS PROPERTIES **9**

Introduction to Composites, Classifying composite materials, commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites, Short Fiber Composites.

MODULE II STRESS STRAIN RELATIONS **9**

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses.

MODULE III ANALYSIS OF LAMINATED COMPOSITES **9**

Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates. Static, dynamic and stability analysis for simpler cases of composite plates. Inter laminar stresses.

MODULE IV FAILURE AND FRACTURE OF COMPOSITES **9**

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction.

MODULE V APPLICATIONS AND DESIGN **9**

Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze and categorize composite materials based on their constituents and manufacturing methods.

CO2 : Predict and interpret the stress-strain behavior of orthotropic and anisotropic materials under varied loading conditions.

CO3 : Calculate and optimize the mechanical properties of laminated composites considering fiber orientation and geometric configuration.

CO4 : Evaluate the applicability of different failure criteria for composite materials and assess their fracture behavior.

CO5 : Design composite material components for specific engineering applications with optimal performance and cost considerations.

TOTAL: 45 PERIODS

REFERENCES:

1. "Mechanics of Composite Materials", R.M. Jones, McGraw-Hill, Kogakusha, International Students Edition, Tokyo, 2015.
2. "Introduction to Composite Materials Design", E.J. Barbero, CRC Press, Inc., 2017.

3. "Engineering Mechanics of Composite Materials", Daniel and Ishai, Oxford University Press, 2013.
4. "Analysis and Performance of Fiber Composites", 2nd Edition, B.D. Agarwal and L.J. Broutman, John Wiley and Sons, 2018.
5. "Stress Analysis of Fiber-Reinforced Composite Materials", Michael W. Hyer, McGraw-Hill, 2009.
6. "Mechanics of Composite Materials and Structures", M. Mukhopadhyay, University Press, India, 2005.
7. "Mechanics of Composite Materials", 2nd Edition, A.K. Kaw, CRC Press, Inc., 2012.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE18	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I MATERIALS AND METHODS OF PREFABRICATION **9**

Prefabrication- Need of prefabrication - Comparison with monolithic construction - Advantages and Disadvantages - Methods of prefabrication - site and plant prefabrication -Types of precast systems, Precast concrete - Materials- Cement, SCM, Aggregate, Water, chemical Admixtures, Pigments, reinforcement, Prestressing Tendons, Concrete and properties, Grout and mortars.

MODULE II DESIGN PRINCIPLES **9**

General Civil Engineering requirements, specific requirements for planning and layout of prefabrication plant. IS Code specifications. Modular co-ordination, standardization, Tolerance. safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

MODULE III PREFABRICATED COMPONENTS **9**

Beams-Columns- Roof units -types of roof slabs and insulation requirements, - Floor units- Types of floor slabs, one way and two-way prefabricated slabs - Staircase slab - Wall panels- Types of wall panels, Curtain, Partition and load bearing walls, Eccentricity and stability of wall panels, sandwich wall panels. Prefabricated structures - long wall and cross wall large panel buildings, framed buildings with partial and curtain walls- footings.

MODULE IV ANALYSIS, DESIGN AND JOINTS IN STRUCTURAL MEMBERS **9**

Loads-Load combination, - load transfer between different components, vertical loads - Analysis of precast frames - Ultimate strength calculations in shear and flexure. Connection in precast building - Description of joints, their behaviour and reinforcement requirements, Leak prevention, joint sealants - Floor to Beam Connections, Beam to Column Connections, Column to column Connections, Column to foundation connections.

MODULE V PRODUCTION TECHNOLOGY, HANDLING AND ERECTION **9**

Choice and planning of production setup - Manufacturing methods - Production process-Moulds - Acceleration of concrete hardening, Curing, Storage of precast elements, Handling Equipment's and Handling Devices, transportation, erection, Equipment's for hoisting and erection - Vacuum lifting pads - Installation of precast elements - Column, Wall, Beam and Slab.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Evaluate the advantages and applications of prefabricated systems and materials in construction.

CO2 : Explain the design principles and core technologies employed in prefabrication.

CO3 : Classify and analyze the different prefabricated components and their functional roles.

CO4 : Design and optimize members and connections for efficient and reliable prefabricated structures.

CO5 : Analyze the production process, handling, and installation techniques for successful

prefabrication projects.

TOTAL: 45 PERIODS

REFERENCES:

1. "Prefabricated Concrete for Industrial and Public Structures", L. Mokk, Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
2. "Precast Concrete Structures", K.M. Elliott, Butterworth-Heinemann, 2014.
3. "Building with Large Prefabricates", B. Lewicki, Elsevier Publishing Company, Amsterdam, London, New York, 1998.
4. "Manual of Precast Concrete Construction", Volumes I, II, III & IV, T. Koncz, Berlin, 1971.
5. "Industrialization and Robotics in Building: A Managerial Approach", A. Warszawski, Harper and Row, 1990.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE19	DESIGN OF FOUNDATION STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I SHALLOW FOUNDATIONS **9**

Bearing capacity and settlement - Spread footings - contact pressure - Structural design of individual footings, pedestals, combined footings Rectangular and trapezoidal, Strap footings - Eccentrically loaded footings - Mat foundations.

MODULE II PILE FOUNDATIONS **9**

Types of piles - Static and dynamic pile formula - Pile load tests - Negative skin friction - Pile groups - Efficiency of pile group - Settlement of piles - Batter piles - Analysis of pile groups - Structural design of piles and pile caps.

MODULE III RETAINING STRUCTURES **9**

Stability of walls - Design of cantilever and counter fort walls - design of gravity walls - Cantilever sheet pile walls – Anchored bulkhead - Cofferdams - Braced cofferdams - Stability of bottom excavation - Anchorages - Walls and Tie rods.

MODULE IV WELL FOUNDATIONS **9**

Types of wells or caissons - components - Shapes of wells - Forces acting - Construction and sinking - Design of drilled caissons.

MODULE V MACHINE FOUNDATIONS AND FOUNDATIONS ON EXPANSIVE SOILS **9**

Introduction to vibrations - Design criteria for satisfactory action of a machine foundation - Soil spring constants – Determination - Types of foundations - Design of Block foundation. Identification of swelling - Field conditions - consequences of swelling -Design.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze and design stable shallow foundations for various structures and soil conditions.

CO2 : Apply engineering principles to select and design appropriate pile foundations for complex loading and subsurface conditions.

CO3 : Develop strategies for designing and analyzing retaining walls to hold back soil effectively.

CO4 : Evaluate the suitability and design well foundations for deep water and challenging geotechnical environments.

CO5 : Choose and design foundations for heavy machinery and structures on expansive soils, ensuring stability and vibration control.

TOTAL: 45 PERIODS

REFERENCES:

1. "Foundations Analysis and Design", Joseph E. Bowles, 9th ed., McGraw-Hill Co., 2018.

2. "Foundation Design", Wayne C. Teng, 5th ed., Prentice Hall of India, New Delhi, 2014.
3. "Basic and Applied Soil Mechanics", Gopal Ranjan and Rao ASR, 5th ed., New Age International Publishers, 2014.
4. "Geotechnical Engineering", Gulhati & Datta, 2nd ed., Tata McGraw Hill, New Delhi, 2017.
5. "Theory and Practice of Foundation Design", Sam & Das, 4th ed., Prentice Hall of India, New Delhi, 2022.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE20	DESIGN OF FORMWORK	L	T	P	C
		3	0	0	3

MODULE I FORMWORK AND SELECTION **9**

General objectives of formwork building - Development of a Basic System - Key Areas of cost reduction - Requirements and Selection of Formwork.

MODULE II FORMWORK MATERIALS AND TYPES **9**

Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork supports. Flying Formwork, Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete.

MODULE III FORMWORK DESIGN **9**

Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

MODULE IV FORMWORK DESIGN FOR SPECIAL STRUCTURES **9**

Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

MODULE V FORMWORK FAILURES **9**

Formwork Management Issues – Pre- and Post-Award. Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi story Building Construction.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Optimize formwork selection for cost savings based on project type and material analysis, demonstrating effective decision-making skills.

CO2 : Evaluate and compare formwork materials (timber, plywood, steel, etc.) for horizontal and vertical support applications, achieving high accuracy in cost vs. efficiency analysis.

CO3 : Design safe and efficient formwork systems for foundations, walls, columns, and slabs, maximizing material utilization while ensuring compliance with safety regulations.

CO4 : Develop and justify the selection of appropriate formwork systems for complex structures like shells, domes, and bridges, incorporating specialized techniques for enhanced structural stability.

CO5 : Explain pre- and post-award formwork management strategies to mitigate potential issues and prevent future failures, drawing insights from case studies to improve risk management strategies

TOTAL: 45 PERIODS

REFERENCES:

1. "Formwork for Concrete Structures", R.L. Peurifoy and G.D. Oberlender, McGraw-Hill Education, 2016.
2. "Structural and Stress Analysis: Theories, Tutorials, and Examples", M.Y.H. Bangash,

CRC Press, 2015.
3. "Design of Reinforced Concrete Structures", M. Nadim Hassoun and Akthem Al-Manaseer, Taylor and Francis, 2018.
4. "Concrete Construction Engineering Handbook", Edward G. Nawy, CRC Press, 2017.
5. "Reinforced Concrete Design", W.H. Mosley, Palgrave Macmillan, 2018.
6. "Design of Concrete Structures", B.K. Roy, CRC Press, 2019.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE21	DESIGN OF MASONRY STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I MASONRY UNITS, MATERIALS, AND TYPES **9**

History of masonry Characteristics of Brick, stone, clay block, concrete block, stabilized mud block masonry units – strength, modulus of elasticity and water absorption. Masonry materials – Classification and properties of mortars, selection of mortars.

MODULE II STRENGTH OF MASONRY IN COMPRESSION **9**

Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, Failure theories of masonry under compression. Effects of slenderness and eccentricity, effect of rate of absorption, effect of curing, effect of ageing, workmanship on compressive strength.

MODULE III FLEXURAL, SHEAR - BOND AND STRENGTH **9**

Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating strength flexural and shear strength.

MODULE IV DESIGN OF LOAD BEARING MASONRY BUILDINGS **9**

Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings using codal provisions.

MODULE V SEISMIC RESISTANT MASONRY BUILDINGS **9**

Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions. Masonry arches, domes and vaults: Components and classification of masonry arches, domes and vaults, historical buildings, construction procedure

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Analyze historical trends, material properties, and performance of masonry units and mortars for strength, elasticity, and water absorption.

CO2 : Predict compressive strength of masonry walls, accounting for unit/mortar properties, patterns, slenderness, eccentricities, and Indian code provisions.

CO3 : Evaluate bond strength and its impact on overall strength, determining flexural and

shear strength of masonry walls through testing and considering orthotropic properties

CO4 : Design load-bearing masonry walls and columns, implementing code-compliant calculations for stress reduction, eccentricities, and openings.

CO5 : Analyze seismic behavior of masonry structures and apply earthquake-resistant design procedures according to BIS codes, including considerations for arches, domes, and vaults.

TOTAL: 45 PERIODS

REFERENCES:

1. "Design of Masonry Structures", A.W. Hendry, B.P. Sinha, S.R. Davies, and Pankaj, CRC Press.
2. "Seismic Design of Reinforced Concrete and Masonry Buildings", 2nd Edition, T. Paulay and M.J.N. Priestley, John Wiley and Sons, 2019.
3. "Earthquake Resistant Design of Structures", 4th Edition, S.K. Duggal, Oxford University Press, 2020.
4. "Earthquake Resistant Design of Masonry Buildings", 2nd Edition, Miha Tomazevic, Imperial College Press, 2020.
5. "IS 1893 (Part 1):2016 - Criteria for Earthquake Resistant Design of Structures: Part 1: General Provisions and Buildings", Bureau of Indian Standards, New Delhi, 2016.
6. "IS 13827:1993 - Improving Earthquake Resistance of Earthen Buildings - Guidelines", Bureau of Indian Standards, New Delhi, 1993.
7. "IS 13828:1993 - Improving Earthquake Resistance of Low Strength Masonry Buildings - Guidelines", Bureau of Indian Standards, New Delhi, 1993.
8. "IS 905:1987 - Code of Practice for Structural Use of Unreinforced Masonry", Bureau of Indian Standards, New Delhi, 1987.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE22	RELIABILITY ANALYSIS OF STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I DATA ANALYSIS **9**

Graphical representation Histogram, frequency polygon, Measures of central tendency-grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form y = abx, and parabola, Coefficient of Correlation.

MODULE II PROBABILITY CONCEPTS **9**

Random events-Sample space and events, Venn diagram and event space, Measures of probability- interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem.

MODULE III RANDOM VARIABLES **9**

Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions- Binomial and poison distributions, Continuous distributions, Normal, Log normal distributions.

MODULE IV RELIABILITY ANALYSIS **9**

Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method FOSM, Point Estimate Method PEM, and Advanced First Order Second Moment Method - Hasofer-Lind's method**.**

MODULE V SYSTEM RELIABILITY **9**

Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers, random numbers with standard uniform distribution, continuous random variables, discrete random variables.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Construct and interpret data visualizations, calculate central tendency and correlation for data analysis.

CO2 : Apply probability axioms, use tree diagrams and Bayes' theorem to solve probability problems.

CO3 : Explain probability distributions, calculate probabilities, and expected values for both discrete and continuous distributions.

CO4 : Analyze the impact of redundancy and correlation on system reliability using quantitative metrics

CO5 : Develop and analyze probabilistic models of system reliability using Monte Carlo simulation, including the calculation of confidence intervals and failure probability distributions.

TOTAL: 45 PERIODS

REFERENCES:

1. "Reliability Analysis of Structures", Pankaj Agarwal and Manish Shrikhande, Springer Nature, 2022.
2. "Structural Reliability Analysis and Prediction", 3rd Edition, Robert E. Melchers, CRC Press, 2018.
3. "Probabilistic Structural Dynamics: Advanced Theory and Applications", Sanjay K. Shukla, CRC Press, 2019.
4. "Reliability Engineering", B.O. Eniwumide, McGraw-Hill, 2017.
5. "Fracture Mechanics: Fundamentals and Applications", A. Carpinteri and N. Pugno, CRC Press, 2018.
6. "Structural Reliability", C.A. Cornell and M.H. Irrgang, ASCE Publications, 1986.
7. "General Principles on Reliability for Structures", ISO 2394:2015.
8. "Reliability-Based Decision-Making on Structural Design", ISO 13824:2018.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEE23	COLD FORMED STEEL STRUCTURES	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO COLD FORMED STEEL STRUCTURES **9**

Introduction to Cold Formed Steel and its advantages over other materials - Applications of Cold Formed Steel in buildings and other structures - Manufacturing processes and common cross-sectional shapes - Material properties of Cold Formed Steel, including strength, stiffness, and durability - Applications of cold-formed steel in construction.

MODULE II STRUCTURAL ANALYSIS OF COLD-FORMED STEEL MEMBERS **9**

Behavior of thin-walled sections under compression, tension, bending, shear, and combined loading - Load distribution and influence of boundary conditions - Direct strength method (DSM) for design of beams, columns, and other members - Introduction to finite element analysis (FEA) for complex CFS structures - Use of structural analysis software for CFS analysis.

MODULE III DESIGN OF COLD FORMED STEEL ELEMENTS **9**

Design of beams for flexure, shear, and deflection - Design of columns for axial compression, combined loading, and slenderness - Design of cold-formed steel trusses and purlins.

MODULE IV COLD-FORMED STEEL CONNECTIONS AND JOINTS **9**

Introduction to connections in CFS structures - Bolted and welded connections - Design of moment-resisting and bracing connections - Shear connections and fasteners in CFS structures - Design of web stiffeners and other connection elements – Joint behavior and detailing considerations.

MODULE V DETAILING, CONSTRUCTION OF COLD FORMED STEEL STRUCTURES **9**

Importance of proper detailing - Light gauge steel framing systems and their detailing - Erection, fabrication, and quality control of Cold Formed Steel structures - Sustainability considerations in Cold Formed Steel construction.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1 : Explain the fundamental principles and advantages of Cold Formed Steel (CFS) structures over other materials, including its applications in buildings and various structures.

CO2 : Analyze the structural behavior of thin-walled sections in CFS members under different loading conditions

CO3 : Design CFS beams, column and trusses, considering their specific requirements and functions.

CO4 : Design connections and joints in CFS structures, encompassing bolted and welded connections, bracing connections, shear connections, and fasteners.

CO5 : Apply knowledge in the erection, fabrication, detailing and quality control of Cold Formed Steel structures

TOTAL: 45 PERIODS

REFERENCES:

1. "Cold-Formed Steel Structures to the AISI Specification", Wei-Wen Yu, Roger A. LaBoube, and Helen Chen, John Wiley & Sons, 2007.
2. "Design of Cold-Formed Steel Structures", J. Rhodes, M.G. Hancock, and K.R. Chaplin, John Wiley & Sons, 2018.
3. "Analysis and Design of Cold-Formed Steel Structures", P.K. Rastogi and N.G. Traikovich, CRC Press, 2018.
4. "Cold-Formed Steel Structures to Eurocode 3", John Roger Hancock, John Wiley & Sons, 2010.
5. "Manual of Cold-Formed Steel Construction", American Iron and Steel Institute (AISI), 2018.
6. "Cold-Formed Steel Design Manual", AISI, 2012.

CO- PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	2	3	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**2**	**3**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MSEOE01	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OPEN ELECTIVE COURSES

MODULE I NATURAL DISASTERS **9**

Cyclones, Floods, Drought and Desertification - Earthquake, Tsunami, Landslides and Avalanche.

MODULE II MAN MADE DISASTERS **9**

Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, nuclear disaster- Forest Fire- Oil fire -accident in Mines.

MODULE III GEOSPATIAL TECHNOLOGY **9**

Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation- disaster mapping.

MODULE IV RISK ASSESSMENT AND MITIGATION **9**

Hazards, Risks and Vulnerabilities - Disasters in India, Assessment of Disaster Vulnerability of a location and vulnerable groups- Preparedness and Mitigation measures for various Disasters- Mitigation through capacity building -Preparation of Disaster Management Plans.

MODULE V DISASTER MANAGEMENT **9**

Legislative responsibilities of disaster management- Disaster management act 2005- post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development- Post Disaster, Emergency Support Functions and their coordination mechanism - Role of Engineers in Disaster Management.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Analyze and evaluate the causes, impacts, and mitigation strategies for major natural disasters to assess risks

CO2: Explain in detail about causes and effects of natural and manmade disasters.

CO3: Apply remote sensing, GIS, and GPS technologies to analyze real-time disaster data, generate disaster maps, and develop data-driven solutions for disaster monitoring, prevention, and rehabilitation.

CO4: Identify the factors that give rise to differential vulnerabilities and levels of community resilience and suggest necessary mitigation plans

CO5: Evaluate the coordination mechanisms between Emergency Support Functions (ESFs) in disaster response, proposing improvements to enhance collaboration and efficiency.

TOTAL: 45 PERIODS

REFERENCES:

1. "Disaster Management", R.Subramanian, Vikas Publishing House Pvt. Ltd, New Delhi, 110055, 2018.
2. "Disaster Science and Management", Tushar Bhattacharya, McGraw Hill India Education Pvt. Ltd., 2017.
3. "Disaster Management - A Systematic Approach", Singh & Singh, 3rd Edition, 2022.
4. "Geospatial Technologies for Disaster Risk Reduction", Mondal & Das, 2019.
5. "The Routledge Handbook of Disaster Risk Reduction", Wisner et al., 2nd Edition, 2020.
6. "Disaster Risk Reduction Approaches in India: A Critical Analysis", Ghosh & Patel, 2017.
7. "Sendai Framework for Disaster Risk Reduction" 2015-2030.

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	2	2	2	2	2	1
3	3	2	3	3	3	2
4	3	2	3	2	2	1
5	3	2	3	2	2	1
Avg.	**2.8**	**2**	**2.8**	**2.4**	**2.4**	**1.4**

1-low, 2-medium, 3-high

23MSEOE02	ENERGY EFFICIENT BUILDINGS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION **9**

Conventional versus Energy Efficient buildings - Historical perspective - Water - Energy - IAQ-requirement analysis - Future building design aspects - Criticality of resources and needs of modern living.

MODULE II LANDSCAPE AND BUILDING ENVELOPES **9**

Energy efficient Landscape design - Micro-climates - various methods - Shading, water bodies- Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, Insulation, Design methods and tools.

MODULE III HEATING, VENTILATION AND AIR-CONDITIONING **9**

Natural Ventilation, Passive cooling and heating - Application of wind, water and earth for cooling, evaporative cooling, radiant cooling - Hybrid Methods - Energy Conservation measures, Thermal Storage integration in buildings.

MODULE IV HEAT TRANSMISSION IN BUILDINGS **9**

Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Sol-air temperature; Decrement factor; Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations; Computer packages for carrying out thermal design of buildings and predicting performance.

MODULE V PASSIVE COOLING & RENEWABLE ENERGY IN BUILDINGS **9**

Passive cooling concepts: Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air tunnel. Introduction of renewable sources in buildings, solar water heating, small wind turbines, stand-alone PV systems, Hybrid system - Economics.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Compare and contrast conventional and energy-efficient buildings, analyzing the importance of resource conservation and modern living needs in future building design.

CO2: Design energy-efficient landscaping and building envelopes considering microclimates, shading, materials, insulation, and heat transfer characteristics, utilizing design tools and methods.

CO3: Apply natural ventilation and passive cooling strategies such as wind, water, and earth cooling, integrating hybrid methods and energy conservation measures.

CO4: Calculate thermal performance of buildings using heat transfer coefficients, infiltration, and solar factors, employing design tools and considering day lighting strategies.

CO5: Propose and evaluate passive cooling methods and renewable energy integration including

solar, wind, and hybrid systems, considering economic feasibility.

TOTAL: 45 PERIODS

REFERENCES:

1. “A Guide to Green Building Practices”, Lohrke, 3rd Edition, 2023.
2. “Building Energy Modeling with EQUEST”, Crawley et al., 2nd Edition, 2017.
3. “Principles and Practice in Residential Construction”, Cole & Cole, 5th Edition, 2019.
4. “A Reference Guide for Building Design, Construction, Operation, and Retrofit’, 2nd Edition, ASHRAE, 2016.
5. “Green Building Design and Delivery”, Cole, 5th Edition, 2017.

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	2
2	3	2	3	3	3	2
3	3	1	2	3	3	2
4	3	2	3	3	3	2
5	3	2	3	3	3	2
Avg.	**3**	**1.8**	**2.8**	**3**	**3**	**2**

1-low, 2-medium, 3-high

23MCMOE01	LANDSCAPE AND ARCHITECTURE	L	T	P	C
		3	0	0	3

MODULE I OVERVIEW OF ARCHITECTURE **9**

Definition of architecture - Introduction to architecture - Elements of architecture - - Need and fulfillment - Architecture design - An analysis - Integration of aesthetic and function - Mass and space, visual and emotional effects of geometric forms and their derivatives - Space - Form - Composition - Dimension - Proportion, scale, Balance, Rhythm, Symmetry, Hierarchy, Pattern and axis with building examples - Concept development.

MODULE II ELEMENTS IN LANDSCAPE DESIGN **9**

Ecology, ecological balance - Hard and soft landscape elements; Plant materials - Classification, Characteristics, use and application in landscape design; Water and landform.

MODULE III GARDEN DESIGN **9**

Landscape and garden design in history - Japanese, Italian Renaissance and Moghul gardens in India, Study of notable examples and spatial development in landscape design.

MODULE IV SITE PLANNING **9**

Organization of spaces - Circulation, built form and open spaces, site planning and micro climate, site planning of neighborhood parks, children's play area and campus development.

MODULE V LANDSCAPING OF FUNCTIONAL AREAS **9**

Urban open spaces and principles of urban landscape; Street landscaping; Landscape design for waterfront areas and functional areas in urban centers; Green roofs and walls.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Analyze the fundamental principles of architecture, including spatial concepts, form, composition, and their emotional impact, applying them to design concepts

CO2: Describe various hard and soft landscape elements, plant materials, and their roles in ecological balance and design applications.

CO3: Compare and contrast historical garden styles and analyze spatial development strategies in landscape design.

CO4: Apply site planning principles to organize spaces, considering circulation, built forms, microclimates, and functional needs for areas like parks, playgrounds, and campuses.

CO5: Propose landscaping solutions for urban spaces, functional areas, and green infrastructure concepts like green roofs and walls.

TOTAL: 45 PERIODS

REFERENCES:

1. “Landscape Architecture: An Introduction”, Simonds, 5th Edition, 2023.
2. “An Introduction to Landscape Architecture”, Marsh, 8th Edition, 2020.
3. “Site Planning and Design Handbook”, Kimm & McLain, 3rd Edition, 2018.
4. “Landscape Graphics: From Drawing to Design”, Loken, 4th Edition, 2019.
5. “The Handbook of Urban Landscape Planning”, Hough, 2nd Edition, 2018.
6. “Planting Design Handbook”, Dunnett & Hitchmough, 5th Edition, 2019.

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	2	2	2	2	2	1
2	2	1	2	2	2	1
3	2	2	2	2	2	1
4	3	2	3	3	2	1
5	3	2	3	3	2	1
Avg.	**2.4**	**1.8**	**2.4**	**2.4**	**2**	**1**

1-low, 2-medium, 3-high

23MENOE01	CLIMATE CHANGE AND ADAPTATION	L	T	P	C
		3	0	0	3

MODULE I EARTH'S CLIMATE SYSTEM **9**

Introduction - weather and climate - Climate in the spotlight-The Earth's Climate Machine - Climate Classification - Global wind systems - Trade Wind Systems - Trade Winds and the Hadley Cell - Cloud formation and Monsoon Rains - Storms, Hurricanes and Tornado - The Hydrological Cycle - Global Ocean Circulation - EI Nino - LA Nino effect - Solar Radiation - The Earth's Natural Green House Effect - Green House Gases and Global Warming

MODULE II OBSERVED CHANGES AND ITS CAUSES **9**

Observation of Climate Change - Changes in pattern of temperature, precipitation and sea level rise - Observed effects of Climate Changes - Drivers of Climate Change - Climate Sensitivity and Feedbacks - The Montreal Protocol - UNFCCC - IPCC - Evidences of Changes in Climate and Environment - on a Global Scale and in India - Climate Change modeling.

MODULE III IMPACTS OF CLIMATE CHANGE **9**

Impacts of Climate Change on various sectors - Agriculture, Forestry and Ecosystem - Water resources - Human Health - Industry, Settlement and Society - Methods and Scenarios - Projected Impacts for different regions - Uncertainties in the Projected Impacts of Climate Change - Risk of irreversible changes.

MODULE IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES **9**

Adaptation Strategy/options in various sectors - Water - Agriculture - Infrastructure and Settlement including coastal zones. Human Health - Tourism - Transport - Energy - Key Mitigation Technologies and practices - Energy supply - Transport – Buildings - Industry - Agriculture - Forestry - Carbon sequestration - Carbon Capture and Storage (CCS) - Waste (MSW & Biowaste, Biomedical, Industrial waste - International and Regional cooperation.

MODULE V CLEAN TECHNOLOGY AND ENERGY **9**

Clean Development Mechanism - Carbon Trading - Examples of future Clean Technology - Biodiesel - Natural Compost - Eco- friendly Plastic - Alternative Energy - Hydrogen - Biofuels - Solar Energy - Wind - Hydroelectric Power.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Explain earth's climate system and the concept of global warming.

CO2: Infer the causes for climate change on the earth's surface.

CO3: Comprehend the impact of climate change on society.

CO4: Select appropriate adaptation and mitigation measures based on specific climate risks and vulnerabilities.

CO5: Evaluate the role of clean technology in climate change adaptation.

TOTAL: 45 PERIODS

REFERENCES:

1. "Climate Change: The Science of Global Warming and Our Energy Future", Edmond A. Mathez, 2nd Edition, Columbia University Press, 2021.
2. "Introduction to Modern Climate Change", Andrew Dessler, 3rd Edition, Cambridge University Press, 2021
3. "The Climate Crisis: An Introductory Guide to Climate Change", David Archer and Stefan Rahmstorf, 1st Edition, Cambridge University Press, 2010
4. "Global Warming: Understanding the Forecast", David Archer, 2nd Edition, Wiley Publication, 2011.
5. "Climate Change and Society: Sociological Perspectives", Riley E. Dunlap and Robert J. Brulle, 1st Edition, Oxford University Press, 2015
6. "Climate Change Adaptation in Developed Nations: From Theory to Practice", James D. Ford and Lea Berrang-Ford, 1st Edition, Springer, 2011

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	2	2	2	3	2	1
2	3	2	2	3	2	1
3	3	2	2	3	2	1
4	3	3	3	3	3	2
5	3	2	2	3	2	1
Avg.	**2.8**	**2.2**	**2.2**	**3**	**2.2**	**1.2**

1-low, 2-medium, 3-high

23MCOC01	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		0	0	2	1

ONE CREDIT COURSES

MODULE I INTRODUCTION TO RESEARCH PAPER WRITING **5**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

MODULE II PRESENTATION SKILLS **5**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

MODULE III WRITING SKILLS **5**

Key skills needed when writing a Title, key skills needed when writing an Abstract, key skills a needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Develop the ability to present their research findings clearly and coherently

CO2: Demonstrate essential writing skills, including crafting attention-grabbing titles, writing concise and informative abstracts, engaging introductions, thorough literature reviews, methods, results, discussions, and well-supported conclusions.

CO3: Proficient in conducting the final review and proofreading of their research papers, ensuring accuracy, coherence, and adherence to formatting and citation guidelines before submission.

TOTAL: 15 PERIODS

REFERENCES:

1. “Academic Writing for Graduate Students”, John M. Swales and Christine B. Feak, 2018.
2. “The Craft of Research”, Wayne C. Booth, Gregory Colomb, and Joseph Williams, 2020.
3. “Writing for Social Scientists”, Howard Becker, 2017.
4. “Bird by Bird: Some Instructions on Writing and Life”, Anne Lamott, 2019.
5. “The Elements of Style”, William Strunk Jr. and E.B. White, 2017.

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	1	3	2	2	1	1
2	1	3	2	2	1	1
3	1	2	2	2	1	1

Avg.	1	2.7	2	2	1	1

23MCOC02	CONSTITUTION OF INDIA	L	T	P	C
		0	0	2	1

1-low, 2-medium, 3-high

MODULE I HISTORY OF MAKING OF THE INDIAN CONSTITUTION **5**

History, Drafting Committee, (Composition & Working), Preamble, Salient Features, Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

MODULE II ORGANS OF GOVERNANCE **5**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

MODULE III LOCAL ADMINISTRATION & ELECTION COMMISSION **5**

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat- Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Demonstrate a comprehensive understanding of the key features and principles enshrined in the Indian Constitution.

CO2: Assess the knowledge of the structure and functions of various organs of governance in India, such as Parliament, Executive, and Judiciary.

CO3: Compare the powers and functions of different levels of local administration, including Municipalities and Panchayati Raj.

TOTAL: 15 PERIODS

REFERENCES:

1. "The Constitution of India, (Bare Act)", Government Publication, 1950.
2. "Indian Constitution Law", M.P. Jain, 7th Edition, Lexis Nexis, 2014.
3. "Framing of Indian Constitution", Dr.S.N.Busi, Dr.B. R.Ambedkar, 1st Edition, 2015.
4. "Introduction to the Constitution of India", D.D. Basu, Lexis Nexis, 2015.

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	2	2	2	1	1	1
2	2	2	2	1	1	1

3	2	2	2	1	1	1
Avg.	**2**	**2**	**2**	**1**	**1**	**1**

23MCOC03	**GREEN BUILDINGS**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

1-low, 2-medium, 3-high

MODULE I INTRODUCTION **5**

Life Cycle impacts of materials and products - sustainable design concepts - strategies of design for the Environment -The sun- earth relationship and the energy balance on the earth's surface, climate, wind - Solar radiation and solar temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings - Thermal properties of building materials.

MODULE II ENERGY EFFICIENT BUILDINGS **5**

Passive cooling and day lighting - Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency Energy audit and energy targeting- Technological options for energy management.

MODULE III INDOOR ENVIRONMENTAL QUALITY MANAGEMENT **5**

Psychometry- Comfort conditions- Thermal comfort- Ventilation and air quality-Air conditioning requirement- Visual perception- Illumination requirement-Auditory requirement- Energy management options- Air conditioning systems- Energy conservation in pumps- Fans and blowers- Refrigerating machines - Heat rejection equipment- Energy efficient motors- Insulation.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Interpret the impact of different construction materials and methods on embodied energy and carbon footprint apply different energy analysis methods and standards to assess building performance.

CO2: Develop strategies for managing energy quality in buildings, including efficient systems and user behaviour

CO3: Design and implement sustainable building solutions that minimize energy use while optimizing occupant comfort and environmental well-being.

TOTAL: 15 PERIODS

REFERENCES:

1. "Sustainable Construction: Green Building Design and Delivery", Kibert, C. John Wiley & Sons, 2016.
2. "Building Energy Modeling with EQUEST", Crawley et al. 2017.
3. "Green Building Design and Delivery", Cole, 5th Edition, 2017.
4. "Green Building Regulations: An International Comparison", Feria & Martinez, 2nd Edition, 2018.
5. "A Proven Approach to Energy Efficient Construction", Bareither et al., 4th Edition, 2019.

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	2	1
2	3	2	3	3	2	1
3	2	1	2	3	2	1
Avg.	**2.7**	**1.7**	**2.7**	**3**	**2**	**1**

1-low, 2-medium, 3-high

23MCOC04	PRACTICAL GEOTECHNICAL ENGINEERING	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Soil Exploration and Site Characterization.
2. Assessment of Index Properties of Soil.
3. Assessment of Flow and Consolidation Properties of Soil.
4. Assessment of Shear Strength Parameters of Soil.
5. Assessment of Bearing Capacity of Soil.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: Select the most appropriate method(s) based on the specific site conditions and project requirements.
CO2: Apply knowledge to distinguish between major soil types based on their index properties.
CO3: Interpret strength and settlement characteristics of soils and determine Safe Bearing Capacity of soils and select appropriate foundations

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	2	1	3	3	2	1
2	2	1	2	3	2	1
3	3	1	3	3	2	1
Avg.	**2.3**	**1**	**2.7**	**3**	**2**	**1**

1-low, 2-medium, 3-high

23MCOC05	GEO INFORMATICS LABORATORY	L	T	P	C
		0	0	2	1

MODULE I GIS INTRODUCTION **5**

Exploring - GIS functions - features - layers - map scale - connecting to folder - reordering of layers - symbolize layer - identify features - using of identify tool - hyperlink tool - zoom pan tools - map document saving.

MODULE II GIS MAP **5**

Layer attribute table - feature attribute relationship- creating map layout - making map layout in reverse - pinning down geographic data.

MODULE III GEOGRAPHY STUDY **5**

Vector and raster data - geographic data work with item description - query based on attributes and locations - analyze data using buffer and overlay - applying GIS analysis process.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Apply remote sensing and GIS techniques to address diverse industrial requirements. Evaluate environmental changes through various methods.

CO2: Evaluate environmental changes through various methods.

CO3: Explain the pivotal role of these techniques in supporting decision-making systems.

TOTAL: 15 PERIODS

REFERENCES:

1. “Mastering ArcGIS Pro”, Bishop & Davis, 8th Edition, 2023.
2. “The GIS Handbook”, Sheppard & Crighton, 4th Edition, 2021.
3. “Spatial Analysis in Ecology and Agriculture: A Beginner's Guide”, Fortin & Dale, 2nd Edition, 2020.
4. “ArcGIS Pro: The Essential Guide for GIS Professionals”, Esri Press, 2nd Edition, 2020.
5. “Spatial Analysis Methods for Social and Environmental Sciences”, Dorling & Thrift, 2nd Edition, 2021.

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	2	3	2	1
2	3	1	2	3	2	1
3	3	2	2	3	2	1
Avg.	**3**	**1.3**	**2**	**3**	**2**	**1**

23MCOC06	SUSTAINABLE ARCHITECTURE	L	T	P	C
		0	0	2	1

1-low, 2-medium, 3-high

MODULE I SUSTAINABLE CONCEPTS - PEOPLE, ENVIRONMENT AND BUILDING **5**

Introduction -sustainable development goals- Components and factors governing sustainable development- Relationship between people and environment, impact of people on environment and vice versa, extent of the energy and environmental crises facing the world, Need for implementing energy efficiency on an international, national and individual basis in the context of the building industry & environmental issues. Introduction to Indoor environment - spatial environment, Thermal environment, visual environment, sonic environment and olfactory environment.

MODULE II ENERGY AUDIT & ENVIRONMENTAL IMPACT ASSESSMENT **5**

General Aspects of Energy Management & Energy Audit. Energy Efficiency in Thermal Utilities and Energy Efficiency in Electrical Utilities, Energy Performance Assessment for building envelope, fenestration and embodied energy. - Introduction and components such as physical, biological and socio-economical of Environmental impact assessment (EIA) in India based on the Environmental Protection Act (EPA), 1986, Ministry of Environment and Forest (MoEF) January 1994 for Environmental Clearance (EC) known as EIA Notification, 1994

MODULE III WASTE UTILIZATION & MANAGEMENT, WATER AND BUILT FORMS **5**

The primary goal is to provide a comprehensive understanding of waste management from an environmental public health perspective. Sustainable techniques in municipal solid waste management. Recycling and Reuse. Energy development and Management of urban waste services. - water demand, growing water misuse, pollution, threat to environment, social implications, sustainability of water resources, ground water management, issues related to urban water supply.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Analyze the interdependencies between people, environment, and buildings within the context of sustainable development goals, energy efficiency, and indoor environmental quality.

CO2: Conduct basic energy audits and understand the principles of environmental impact assessment (EIA) within the legal framework of India, applying these concepts to evaluate building energy performance and potential environmental impacts.

CO3: Propose sustainable strategies for waste management and water conservation, considering their impact on built forms and urban environments.

TOTAL: 15 PERIODS

REFERENCES:

1. “Sustainable Architecture with Wood”, Depla & Bahri, 2nd Edition, 2018.
2. “Principles and Practice for a Sustainable Future”, Kibert, 3rd Edition, 2020.
3. “Water in Sustainable Architecture”, Rogers & Kopf, 2nd Edition, 2017.
4. “The Living Building Challenge”, International Living Future Institute, Vol. 3.1 (2020)
5. “Life Cycle Assessment for Building and Construction”, Hauschild & Rossier, 2nd Edition, 2017.

CO-PO & PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	2	1
2	3	2	3	3	2	1
3	3	1	2	3	2	1
Avg.	**3**	**1.7**	**2.7**	**3**	**2**	**1**

1-low, 2-medium, 3-high