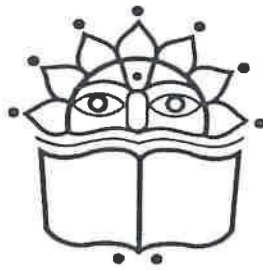


**Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and
Technology, Baramati
(An Autonomous Institute)**



Board of Studies

**M. Tech (Structural Engineering)
Department of Civil Engineering
Syllabus**

(2026 Pattern w.e.f. AY:2026-2027)



VP's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati
(An Autonomous Institute)
Department of Civil Engineering
M. Tech- (Structural Engineering) [2026 pattern]
(with effect from A.Y. 2026-27)

Semester I

Course Code	Course Category	Course	Teaching Scheme (Hrs/Week)		Examination Scheme and Marks							Credit Scheme	
			TH	PR	CAA	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR
MSE26101TH	PCC	Numerical Methods in Civil Engineering	04		20	30	70				120	04	
MSE26102TH	PCC	Advanced Design of Steel Structures	04		20	30	70				120	04	
MSE26103TH	PCC	Structural Dynamics	03		20		70				90	03	
MSE26104TH	MDM	MDM	02		10		50				60	02	
MSE26105PR	VSEC	Skill development lab -I	-	04				30		30	60		02
MHS26101TH	Exp. Learn.	Research Methodology	03		30		70				100	03	
MHS26102TH	HSSM	Indian Knowledge System	02		20	30					50	02	
		Total	18	04	120	90	330	30		30	600	18	02
Total Credits												20	
MDM Basket													
MSE26104A	Green Building					MSE26104B			Optimization Technique				
MSE26104C	Artificial Neural Network					MSE26104D			Introduction to Smart Materials				

Semester II

Semester II													
Course Code	Course Category	Course	Teaching Scheme (Hrs./Week)		Examination Scheme and Marks							Credit Scheme	
			TH	PR	CAA	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR
MSE26111TH	PCC	Finite Element Method	04	-	20	30	70	-	-	-	120	04	-
MSE26112TH	PCC	Theory of Plates & Shells	04	-	20	30	70	-	-	-	120	04	-
MSE26113TH	PCC	Advanced Design of Concrete Structures	04	-	20	30	70	-	-	-	120	04	-
MSE26114TH	PEC	Program Elective - I	04	-	20	30	70	-	-	-	120	04	-
MSE26115PR	VSEC	Skill development lab -II	-	04	-	-	-	30	-	30	60		02
MSE26116TH	VEC	Environmental studies	02	-	20	30	-	-	-	-	50	02	-
MHS26111TH	HSSM	Human rights	02	-	30	30	-	-	-	-	60	02	-
		Total	20	04	130	180	280	30	-	30	650	20	02
Total Credits												22	
Program Elective- I Basket													
MSE26114A		Design of Pre-Engineered Buildings				MSE26114B			Structural Stability				
MSE26114C		Design of Foundations				MSE26114D			Retrofitting and Strengthening of RC Structure				

Dr. P. K. Singh
Academic Coordinator

Dr. C. B. Nayak
Head of Department

Dr. S. M. Bhosle
Dean Academics

Dr. A. H. Kolekar
Controller of Examination

Head
Department of Civil Engineering
VPKBIET, Baramati-413133

Dr. S. B. Lande
Principal

Principal
Vidya Pratishthan's

Important Note: The In-Semester Examination (ISE) for the following courses will be conducted in an MCQ-based test pattern.

Semester I: Indian Knowledge System

Semester II: Environmental Studies, Human Rights



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Semester III

Course Code	Course category	Course	Teaching Scheme (Hrs./Week)		Examination Scheme and Marks							Credit Scheme	
			TH	PR	CAA	In- Sem	End-Sem	TW	PR	OR	Total	TH	PR
MSE26201TH	PCC	Analysis and Design of Earthquake-Resistant Structures	04	-	20	30	70	-	-	-	120	04	-
MSE26202TH	PCC	Theory of Elasticity	04	-	20	30	70	-	-	-	120	04	-
MSE26203TH	PEC	Program Elective-II	04	-	20	30	70	-	-	-	120	04	-
MSE26204PR	Exp. Learn	Dissertation Stage I	-	08	20	-	-	50	-	50	120	-	04
MSE26205PR	SEC	Seminar	-	04	-	-	-	25	-	25	50	-	02
MHS26201TH	AEC/VAC	Introduction to Constitution of India	02	-	30	30	-	-	-	-	60	02	-
MRA26205TH	SEC	Industrial Management	02	-	30	30	-	-	-	-	60	02	-
Total			16	12	140	150	210	75		75	650	16	06
Total Credit												22	
Program Elective II													
MSE26203A	Bridge Engineering				MSE26203B			Design of Prestressed concrete Structures					
MSE26203C	Mechanics of Modern Materials				MSE26203D			Ferrocete Technology					

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Semester IV

Course Code	Course category	Course	Teaching Scheme (Hrs./Week)		Examination Scheme and Marks							Credit Scheme	
			TH	PR	CAA	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR
MSE26211PR	Internship/OJT	Industry Internship / In-house research project	-	20	100	-	-	100		100	300	-	10
MSE26212PR	Exp. Learn	Dissertation Stage- II	-	16	50	-	-	100		100	250	-	08
Total			-	36	150	-	-	200		200	550	-	18
	SEC	Introduction to Cyber Security (Online to be taken from the SPPU Portal)	04	-	-	-	-	-	-	-	-	-	04
Total Credit												22	

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Important Note: The In-Semester Examination (ISE) for the following courses will be conducted in an MCQ-based test pattern.

Semester III: Introduction to Constitution of India, Industrial Management



MSE26101TH- Numerical Methods in Civil Engineering

Teaching Scheme:

Credits: 4

Examination Scheme:

TH: 4 Hrs./week

Theory: 4

CAA: 20 Marks

In-sem-30 Marks

End Semester: 70 Marks

Prerequisite:

1. Basic concept of differentiation and integration, differential equations, system of linear equations

Course Objectives:

To familiarize students with various Numerical methods that will be useful for finding approximate solutions to complex Civil Engineering Problems where analytical methods fail. Also, identify the difference between analytical and Numerical methods.

Course Outcomes: After Completion of course, students will be able to

CO1: Apply finite difference method to indeterminate beams, columns and plates.

CO2: Understand the applications of flexibility method to beams and plane trusses.

CO3: Understand the applications of Stiffness method to plane and space frame.

CO4: Learn solution of simultaneous linear equation and Eigen value problem using numerical methods.

CO5: Apply Numerical methods to find approximate solution ordinary differential equation occurring in Indeterminate Beams, Columns.

CO6: Apply Numerical methods to find approximate solution numerical integration occurring in Indeterminate Beams, Columns.

Course Contents

Unit I: Finite difference method

9 Hours

Forward, backward and centered finite difference approximations to the derivatives. Applications to indeterminate beams, columns, and plates.

Unit 1I: Matrix operations (Flexibility method)

9 Hours

Flexibility matrices, numerical examples of application of the flexibility method to beams and plane trusses.

Unit 3: Matrix operations (Stiffness method)

9 Hours

Stiffness matrices, numerical examples of application of the stiffness method to beams and plane trusses, concept of transformation matrix, stiffness matrix for plane frame, and space frame.

Unit 4: Solution of linear equations

9 Hours

Gauss elimination method, Gauss – Jordan method, Jacobi's method, and Gauss – Seidel method, Numerical computation of Eigen values and Eigen vectors by the Power method, Householder method, and the Givens method.

Unit 5: Solution of differential equations**9 Hours**

Review of Taylor's series and Euler's method. Runge – Kutta fourth order method, predictor – corrector method. Solution of eigenvalue problems by the power method.

Unit 6: Numerical integration**9 Hours**

Trapezoidal and Simpson's methods, Gauss quadrature method, Newton's – Cotes method.

Books & Other Resources:**Reference Books:**

1. E. Ward Cheney, David R. Kincaid, Numerical Methods and Applications, Brooks Cole / Cengage Learning India.
2. S. C. Chapra & R. P. Canale, Numerical Methods for Engineering, TMH Publications
3. E. Balgurusamy, Numerical Methods, TMH Publications.
4. Krishna Raju, Numerical Methods in Civil Engineering, CBS Kale and S. Y. Patki, New Delhi, Tata McGraw-Hill. (5th edition).

Activity:

1. Using Numerical methods, find an approximate solution to an ordinary differential equation occurring in Indeterminate Beams or Columns.
2. Using Numerical methods, find an approximate solution to a partial differential equation occurring in problems of a plate.

MSE26102TH-Advanced Design of Steel Structures

Teaching Scheme
TH: 4 Hrs./week

Credit Scheme
04

Examination Scheme
CAA: 20 Marks
In-sem-30 Marks
End Semester: 70 Marks

Prerequisite:

1. Fundamentals of steel design.

Course Objectives:

1. This course is designed to provide understanding of various IS code provisions, fundamentals and advanced structural steel design and its applications for design of various steel structures
2. Students should be able to understand design of various advanced steel structures and its arrangements.

Course Outcomes:

On successful completion of this course, the learner will be able to:

1. Analyzed and design of hoarding structures and castellated beams.
2. Design of microwave towers and tubular structures
3. Design of transmission towers
4. Demonstrate knowledge about the cold form light gauge steel section, steel code provisions and design of the light gauge section.
5. Design of steel chimney.
6. Design of base plate and foundation for steel chimney.

Course Contents

Unit I Design of Hoarding Structures and Castellated Beams (9 Hours)

- a) Hoarding Structures: Analysis and design of hoarding structures under dead, live and wind load as per the latest IS:875 by limit state method.
- b) Castellated beams: Concept, fabrication of the castellated beam from rolled steel section, design of castellated beam for bending and shear as per latest code by limit state method.

Unit II Design of Microwave Towers and Tubular Structures (9 Hours)

- a) Microwave Towers: Introduction, structural configuration, function, analysis and design.
- b) Tubular Structures: Design of tubular Trusses and scaffoldings using circular hollow, rectangular hollow sections as per code, detailing of joints.

Unit III Design of Transmission Towers (9 Hours)

Transmission Towers: Introduction, structural configuration, bracing systems, analysis and design as per code. Use working stress method.

Unit IV Design of Cold-formed Steel Sections (9 Hours)

Cold form light gauge section: Advantage, type of cross section, stiffened, multiple stiffened and un-stiffened element, flat-width ratio, effective design width, design of light gauge compression, tension and flexural members as per code.

Unit V Design of Steel Chimneys**(8 Hours)**

Design of chimneys: Introduction, type, joints, lining, ladder, forces acting on chimney, design of thickness of steel plates for self-supporting chimney.

Unit VI Design of Base Plate of Steel Chimneys**(8 Hours)**

Design of base plate of chimney, design of anchor bolt, design of foundation and stability of Steel chimneys.

Books & Other Resources:

1. Ram Chandra, Design of steel Structures, Volume II, Standard Book House, New Delhi.
2. Punmia and Jain, Comprehensive Design of steel structure, Laxmi Publication, New Delhi.
3. M Raghupathi, Design of steel structures, Tata McGraw Hill, New Delhi.
4. S K Duggal, Limit state design of steel structures, Tata McGraw Hill Education.
5. N Subramanian, Design of steel structures, Oxford University Press.
6. IS: 800 - 2007, Code of Practice for General Construction in Steel, BIS, New Delhi.
7. IS: 801 - 1975, Code of Practice for use of cold formed light gauge steel structural member's in general building construction, BIS, New Delhi.
8. IS: 802 (Part I and II)-1978, Code of practice for use of structural steel in overhead transmission line towers, BIS, New Delhi.
9. IS: 806-1988, Code of practice for use of steel tubes in general building construction, BIS, New Delhi.
10. IS: 811-1987, Specification for cold formed light gauge structural steel sections, BIS, New Delhi.
11. IS: 875 (Part 1, 2 and 3) – 1987, Code of practice for design loads for buildings and structures, BIS, New Delhi.

Activity

An activity can be designed such as to enhance students learning experience. The students need to submit assignment on each unit as part of activity.

MSE26103TH– Structural Dynamics

Teaching Scheme:

Credits: 03

Examination Scheme:

TH: 03 Hrs./week

Theory: 03

CAA: 20 Marks

End Semester: 70 Marks

Prerequisite:

1. Basics structural analysis, basics of mathematics, matrix method of analysis.

Course Objectives:

1. Understand the fundamentals of structural dynamics.
2. Develop mathematical modeling skills.
3. Analyze vibratory behavior of structures.

Course Outcomes: After Completion of course students will be able to

CO1: Understand the fundamental concepts of structural dynamics and distinguish between static and dynamic structural behavior.

CO2: Explain the behavior of damped free vibration and its effect on system response.

CO3: Analyze the response of single-degree-of-freedom systems subjected to undamped and damped forced vibrations

CO4: Formulate and analyze multi-degree-of-freedom (MDOF) systems by developing and solving equations of motion

CO5: Evaluate structural response under dynamic loading using response spectrum methods by interpreting spectrum concepts and special cases,

CO6: Apply advanced structural dynamics and seismic design principles by performing time history and nonlinear analysis

Course Contents

Unit 1: Basics of Structural Dynamics

07 Hours

Introduction of Structural Dynamics, differential equations in Civil Engineering, types of analysis for Static and Dynamic load, degrees of Freedom, dynamic equilibrium equation, solution of equilibrium equation.

Unit 2: Free Vibration of SDOF

06 Hours

Undamped free vibration, solution, natural Period/frequency, energy in Free Vibration, damped free vibration, types of damping, logarithmic decrement equation.

Unit 3: Forced Vibration of SDOF**07 Hours**

Undamped forced vibration, amplitude & phase angle, dynamic amplification factor for deflection (R_d), damped forced vibration, relationship between R_d , R_v and R_a .

Unit 4: Multi-Degree of Freedom Systems**06 Hours**

Equation of motion for MDOF system, solution of equation, natural frequencies and mode shapes, modal orthogonality, approximate method for finding natural frequency.

Unit 5: Response Spectrum**07 Hours**

Concept of response spectrum, uses of response spectrum, special cases in spectrum, development of tripartite plot, base shear and base moment, response of structure in frequency.

Unit 6: Shear wall and Non-Linear Analysis**06 Hours**

a) Introduction to time history method, capacity-based design of soft story RC buildings, design of shear wall, ductile detailing as per I.S. 13920.

b) Non-linear analysis, free vibration of cantilever beam by Rayleigh ritz method.

Books & Other Resources:**Textbooks**

1. Structural Dynamics Concepts and Applications by Busby & Staab.
2. Structural Dynamics Vibrations and Systems by Madhujit Mukhopadhyay.
3. Structural Dynamics by Einar N Strommen.
4. Experimental Structural Dynamics: An Introduction to Experimental Methods of Characterizing Vibrating Structures by Robert E Coleman.

Reference Books

1. S.N. Poultre "Dynamics of structures", Wiley India.
2. M. Paz, "Structural Dynamics Theory and Computation", CBS Publications.
3. A. K. Chopra, "Dynamics of Structures Theory and Applications to Earthquake Engineering", Prentice-Hall Publications.
4. R.W. Clough and J. Penzin, "Dynamics of Structures", McGraw Hill Publications.
5. R.C. Roy, "Structural Dynamics an Introduction to Computer Methods", John Wiley & Sons Publications.
6. P. Agarwal and M. Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall Publications.
7. Hosure, "Earthquake resistant design of building structures building", Wiley India.
8. IS 13920, "Indian Standard Criteria for Ductile Detailing of RC Structure", Bureau of Indian Standards, New Delhi.
9. IS: 1893, "Indian Standard Criteria for Earthquake Resistant Design of Structures", Bureau

of Indian Standards, New Delhi.

10. IS: 13935, “Repair and Seismic Strengthening of Buildings”, Guidelines, 1993. R11: IS: 4326, “Earthquake Resistant Design and Construction of Buildings” Code of practices.

Activity:

1. V-Lab – 5 Practical’s.
2. Seismic analysis of a structure by using software.

MSE26104A- Green Building

Teaching Scheme:

Credits: 2

Examination Scheme:

TH: 2Hrs./week

Theory: 2

CAA: 10 Marks

End Semester: 50 Marks

Total: 60 Marks

Course Objectives:

1. The objective of this course is to realize the use of green buildings to reduce global warming.

Course Outcomes: After Completion of course, students will be able to

CO1: Select different building materials for construction.

CO2: Analyze global warming due to different materials in construction.

CO3: Analyse buildings for green rating

CO4: Use an alternate source of energy.

Course Contents

Unit 1: Introduction to the concept of cost-effective construction

6 Hours

Uses of different types of materials and their availability -Stone and Laterite Blocks, Burned Bricks, Concrete Blocks, Stabilized Mud Blocks, Lime Pozzolana Cement, Gypsum Board, Light Weight Beams, Fiber Reinforced Cement Components, Fiber Reinforced Polymer Composite, Bamboo-Availability of different Materials-Recycling of building materials –Brick, Concrete, Steel, Plastics -Environmental issues related to quarrying of building materials.

Unit 2: Global Warming

6 Hours

Definition -Causes and Effects -Contribution of Buildings towards Global Warming -Carbon Footprint –Global Efforts to reduce carbon Emissions Green Buildings –Definition -Features-Necessity –Environmental benefit -Economical benefits -Health and Social benefits -Major Energy efficient areas for buildings –Embodied Energy in Materials, Green Materials -Comparison of Initial cost of Green V/s Conventional Building -Life cycle cost of Buildings.

Unit 3: Green Building Rating Systems

6 Hours

BREEAM –LEED -GREEN STAR -GRIHA (Green Rating for Integrated Habitat Assessment) for new buildings –Purpose -Key highlights -Point System with Differential weight age. Green Design –Definition -Principles of sustainable development in Building Design -Characteristics of Sustainable Buildings –Sustainably managed Materials -Integrated Lifecycle design of Materials and Structures (Concepts only).

Unit 4: Utility of Solar Energy in Buildings

6 Hours

Utility of solar energy in buildings: concepts of Solar Passive Cooling and Heating of Buildings.
Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

Books & Other Resources:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. Alternative building materials and technologies by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. Non-Conventional Energy Resources by G. D. Rai, Khanna Publishers.
5. Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, Green Building Fundamentals, Pearson, USA, 2010.
7. Charles J. Kibert, Sustainable Construction – Green Building Design and Delivery, John Wiley & Sons, New York, 2008.
8. Regina Leffers, Sustainable Construction and Design, Pearson / Prentice Hall, USA, 2009.

Activity:

- 1- Students have to visit a building which is a green rated and prepare a report.

MSE26104B- Optimization Technique

Teaching Scheme:

Credits: 2

Examination Scheme:

TH: 2 Hrs./week

Theory: 2

CAA: 10 Marks

End Semester: 50 Marks

Total: 60 Marks

Course Objectives:

1. To know optimization techniques to be used for Civil Engineering applications.

Course Outcomes: After Completion of course students will be able to,

CO1: Able to explain optimization problems and constraints

CO2: Able to use classical optimization methods

CO3: Able to apply optimization methods to solve LP problems

CO4: Able to give the solution to transportation and assignment-related problems

Course Contents

Unit 1: Introduction to Optimization Techniques

6 Hours

Introduction to optimization techniques, Applications to various civil engineering problems, Statement of the optimization problem, Constraints of LP, NLP problems.

Unit 2: Optimization methods

6 Hours

Single and multiple problems with equality and inequality constraints, Hessian matrix and its use, Lagrangian method, convex and concave functions.

Unit 3:

6 Hours

Standard LP problem, Assumptions in LP, Geometry and graphical solutions of LP problem, Canonical form of linear simultaneous equations, Simplex method to solve LP problems, Use of big M and two-phase methods.

Unit 4: Additional topics in LP

6 Hours

Additional topics in LP: Duality in LP, Transportation problem, Assignment problem, Mathematical methods of transportation and assignment problem, Methods of solution, Variation in transportation, and assignment problems such as unbalanced problems, and degeneracy.

Books & Other Resources:

1. Engineering Optimization: Theory & Practice, S. S. Rao., Wiley.
2. Engineering Optimization: Methods and Applications, Ravindran, Wiely
3. Operation Research, Taha Hamdey A.

4. Principles of Operation Research, Wagner, Prentice Hall.
5. Operation Research, Hira and Gupta, S. Chand
6. Operation Research-Ravindran, Wiely.

Activity:

Solve transportation and assignment-related problems using optimization techniques in Civil Engineering (Activity to be done individually).

MSE26104C - ARTIFICIAL NEURAL NETWORKS

Teaching Scheme:

Credits: 2

Examination Scheme:

TH: 2 Hrs./week

Theory: 2

CAA: 10 Marks

End Semester: 50 Marks

Total: 60 Marks

Course Objectives:

To know applications of ANN in Structural Engineering

Course Outcomes: After Completion of course students will be able to

CO1: Able to know various terms used in ANN

CO2: Able to learn types of networks used in ANN

CO3: Able to analyse optimization problems solving using neural networks.

CO4: Able to apply applications of ANN to identify various patterns.

Course Contents

Unit 1: Introduction

6 Hours

Introduction to Neural Networks, Biological Neurons and Neural Networks, Networks of Artificial Neurons. Single Layer Perceptron, Learning and Generalization in Single Layer Perceptron.

Unit 2: Applications

6 Hours

Applications of Multi-layer Perceptrons. Basic learning models Associative Learning, Competitive Networks, Winner-take-all networks, Adaptive Resonance Theory (ART)

Unit 3: Neural networks

6 Hours

Neural networks as associative memories, Hopfield network, BAM, Self-Organizing Maps: Fundamentals, Algorithms and Applications. Learning Vector Quantization, Optimization problems solving using neural networks.

Unit 4: Applications of Artificial Neural Networks

6 Hours

Applications of Artificial Neural Networks: Application areas like system identification and control, decision-making, pattern recognition, and sequence recognition.

Books & Other Resources:

Text Book(s)

1. B. Yegnanarayana - Artificial neural network PHI Publication.2005
2. S. Raj sekaran, Vijayalakshmi Pari - Neural networks, Fuzzy logic and Genetic Algorithms

Reference Books

1. Kevin L. Priddy, Paul E. Keller – Artificial neural networks: An Introduction - SPIE Press, 2005.
2. Mohammad H. Hassoun – Fundamentals of artificial neural networks - MIT Press, 1995

e- Resources and other Digital Material

1. <https://ocw.mit.edu/courses/9-641j-introduction-to-neural-networks-spring-2005/>
2. <https://nptel.ac.in/courses/117105084>

Activity:

Solve Civil engineering problem using ANN.

MSE26104D- Introduction to Smart Materials

Teaching Scheme:

Credits: 2

Examination Scheme:

TH: 2 Hrs./week

Theory: 2

CAA: 10 Marks

End Semester: 50 Marks

Total: 60 Marks

Course Objectives:

1. To study various types of smart materials used in engineering applications
2. To study the processing of smart materials
3. To study the basics of sensors and their engineering application
4. To study the basics of actuators and their engineering application

Course Outcomes: After Completion of course, students will be able to,

CO1: Understand various smart materials and their importance in engineering applications

CO2: Know various processing techniques of smart materials

CO3: Get knowledge of the use of smart materials as sensors and actuators.

Course Contents

Unit 1: Introduction

6 Hours

Introduction Characteristics of metals, polymers, and ceramics. Introduction to smart materials. Classification of smart materials, Components of a smart System, Applications of smart material.

Unit 2: Smart Materials

6 Hours

Electro-strictive Materials, Magnetoelectric materials, Magnetorheological fluids, Electrorheological fluids, and Shape Memory materials.

Unit 3: Processing of Smart Materials

6 Hours

Processing of Smart Materials, Semiconductors and their processing, Metals and metallization techniques, Ceramics and their processing, Polymers and their synthesis, UV radiation curing of polymers

Unit 4: Types of Sensors

6 Hours

Sensors Introduction, Conductometric sensors, Capacitive sensors, Piezoelectric sensors, Magnetostrictive sensors, Piezoresistive sensors, Optical sensors, Resonant sensors, semiconductor-based sensors, Acoustic sensors, polymerize sensors, Carbon nanotube sensors.

Books & Other Resources:

Text Books:

1. Smart Material Systems and MEMS: Design and Development Methodologies, V. K. Varadan, K. J. Vinoy, S. Gopalakrishnan, John Wiley and Sons, England, 2006.

2. Smart Structures and Materials, Brain Culshaw, Artech House, London, 1996.
3. Smart Materials and Structures, Mukesh V. Gandhi, Brian S. Thompson, , Springer, May 1992

Reference Books:

1. Smart Structures: Analysis and Design, A. V. Srinivasan, Cambridge University Press, Cambridge, New York, 2001.
2. Smart Structures, P. Gauenzi, Wiley, 2009
3. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic Emission Sensors, Materials and Amplifiers, G. Gautschi, Springer, Berlin, New York, 2002.
4. Analysis and Performance of Fiber Composites, B. D. Agarwal and L. J. Broutman, John Wiley & Sons.

Activity:

Case study on application of smart materials

MSE26105PR-Skill Development Lab I

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 8 hrs/week	PR:4	TW-30 Marks OR- 30 Marks

Course Contents

- 1 a) Completion of assignments
b) Review of 2 technical documentaries/review of case studies /failure case studies/observation on case studies.
2. Technical review and critique of a 2-research article/paper on any topic from the refereed journal paper related to the program content.
3. Design of earthquake-resistant structures using ETAB/STAAD PRO engineering software.
4. Site visits: Report based on three site visits.

The Oral/TW exam for LP -I should be based on the completion of assignments /review of technical documentaries/review of case studies/research paper review/failure of case studies/Design of structure

MHS26101TH – Research Methodology

Teaching Scheme:

Credits: 3

Examination Scheme:

TH: 3 Hrs./week

Theory: 3

CAA: 30 Marks

End Semester: 70 Marks

Prerequisite:

1. Basic Engineering Knowledge, Basic Mathematics & Statistics, Fundamentals of Research, Computer Skills, Analytical & Logical Thinking.

Course Objectives:

1. To introduce research fundamentals, problem selection criteria, hypothesis formulation, and proposal development processes for funding and planning.
2. To familiarize students with literature survey techniques, sources, and strategies essential for comprehensive research reviews.
3. To teach data classification, collection methods, sampling designs, and measurement/scaling principles for reliable research data.
4. To enable application of hypothesis testing, ANOVA, non-parametric methods, and preliminary analysis for data validation.
5. To develop proficiency in multivariate statistical tools like regression, factor analysis, and inferential methods for complex data interpretation.
6. To train in report structuring, plagiarism avoidance, presentation skills, and procedures for publishing papers and patents.

Course Outcomes: After Completion of course students will be able to

- CO1: Develop comprehensive research proposals by identifying problems, formulating hypotheses, and outlining funding frameworks.
- CO2: Conduct effective literature surveys using appropriate sources, styles, and strategies to support research objectives.
- CO3: Design data collection strategies including sampling, scaling, and measurement techniques while evaluating data quality.
- CO4: Perform hypothesis testing, ANOVA, and preliminary data analyses to assess validity and reliability of research findings.
- CO5: Analyze complex datasets using multivariate techniques like regression, factor analysis, and inferential statistics.
- CO6: Prepare plagiarism-free research reports, deliver impactful presentations, and outline procedures for paper publication and patents.

Course Contents

Unit 1: Fundamentals of Research and Proposal Development

6 Hours

Meaning of research, types of research, process of research, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, formulation of research hypotheses. Search for causation. Developing a Research Proposal Format of an individual research proposal, Significance, objectives, methodology, Funding for the proposal, and Different funding agencies. Framework for the planning.

Unit 2: Literature Survey Techniques**6 Hours**

Definition of literature and literature survey, need of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, and strategies of literature survey.

Unit 3: Data Acquisition and Measurement Methods**6 Hours**

Classification of data, benefits and drawbacks of data, evaluation of data, qualitative methods of data collection, methods of qualitative research, Sampling, sample size, sampling strategy, attitude measurement, and scaling, types of measurements, criteria of good measurements, classification of scales.

Unit 4: Hypothesis Testing and Preliminary Analysis**7 Hours**

Testing of hypothesis- concepts and testing, analysis of variance techniques, introduction to non-parametric tests. Validity and reliability, Approaches to qualitative and quantitative data analysis.

Unit 5: Multivariate and Inferential Statistics**7 Hours**

Correlation and regression analysis, Introduction to factor analysis, discriminant analysis, cluster analysis, multidimensional scaling, Descriptive statistics, Inferential statistics, multi-dimensional measurement and factor analysis.

Unit 6: Report Writing**7 Hours**

Need of effective documentation, importance of report writing, types of reports, report structure, report formulation, Plagiarism. Research briefing, presentation styles, impact of presentation, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure.

Books & Other Resources:**Reference Books**

1. Research Methodology: Methods and Techniques by C.R. Kothari (4th Edition, New Age International).
2. Engineering Research Methodology by D. Thiel. Tailored for engineers.
3. Research Methodology: A Step-by-Step Guide for Beginners by Ranjit Kumar (5th Edition, SAGE Publications).
4. Statistics for Engineers and Scientists by William Navidi (6th Edition, McGraw-Hill).
5. Engineering Research Methodology by Dipak C. Roy (IK International).
6. Research Methods for Engineers by David V. Thiel (Cambridge University Press).

Activity (CAA):

1. Draft a research proposal on a civil engineering topic, covering problem selection, hypotheses, methodology, and funding.
2. Conduct a literature survey matrix on structural retrofitting, identifying sources, gaps, and strategies.

3. Design sampling for civil engineering topic, perform hypothesis testing with Python analysis, and prepare a plagiarism-free report.

MHS26102TH-Indian Knowledge System

Teaching Scheme:

Examination Scheme:

Theory: 2 Hours/Week

Credits: 02

CAA: 20 Marks

Insem Exam: 30 Marks

Course Objectives:

1. To create awareness about the history and rich cultural heritage of Bharata.
2. To introduce the principles of Vedic mathematics for faster calculations.
3. To explore the contributions of traditional Bharatiya knowledge in science and astronomy.
4. To understand the contributions of traditional Bharatiya knowledge in engineering and technology.

Course Outcomes:

Students will be able to

1. Understand the antiquity of Bharatiya civilization, traditional knowledge systems, ancient education institutions, and contributions to life sciences, healthcare, and philosophy.
2. Apply the principles of Vedic mathematics for efficient problem-solving in arithmetic, algebra, geometry.
3. Analyze the scientific and astronomical advancements of ancient Bharata, including concepts of matter, gravity, aeronautics, and cosmology, and their relevance to modern science.
4. Explore the engineering, technological, and architectural innovations of ancient Bharata,

Course Syllabus

UNIT -I: Bharatiya Civilization and Development of Knowledge System:

(6 hours)

Genesis of the land, Antiquity of civilization, the Saraswati-Sindhu Civilization, Traditional Knowledge System, The Vedas, Main Schools of Philosophy, Ancient Education System, the Takṣaśīla University, the Nālandā University. Ethnic Studies, Life Science studies, Agriculture, Ecology and Environment, Ayurveda, Integrated Approach to Healthcare, Medicine, Microbiology, Surgery, and Yoga. Life and work of Rishi's, Brahmadini.

UNIT-II: Vedic Mathematics:

(6 hours)

Indian Mathematicians: Varahmihir, Brahmagupta, Srinivasa Ramanujan, Neelkanth Somayya, Bharti Krishna Tirtha, Introduction to sutras, and sub sutras, Methods for Addition, Multiplication, division, squaring and square roots, cube and cube roots, Factorization. Differentiation and Integration methods. Easy Solution of linear equations, Quadratic equations,

High-Speed Matrix. Algebra.

Vedic Geometry: Different forms of straight lines, The Triangle, The Cyclic Quadrilateral, Squares, and the Circle, Geometrical constructions (such as Altars), Transformation of simple shapes, Kalpa Sutras, Srauta Sutras and Sulbha Sutras.

UNIT-III: Science, Astronomy:

(6 hours)

Concepts of Matter. Life and Universe, Gravity, Sage Agastya's Model of Battery, Velocity of Light, Vimāna: Aeronautics (Sundar Vimana, Rukma Vimana, Tripur Vimana Vedic Cosmology and Modern Concepts, Bhāratīya Kāla-gaṇanā, History and Culture of Astronomy, Sun, Earth, Moon, and Eclipses, Earth is Spherical and Rotation of Earth, Archeoastronomy.

UNIT-IV: Engineering, Technology and Architecture:

(6 hours)

Pre-Harappan and Sindhu Valley Civilization, Laboratory and Apparatus, Juices, Dyes, Paints and Cements, Glass and pottery, Metallurgy, Engineering Science and Technology in the Vedic Age and Post-Vedic Records, Iron Pillar of Delhi, Rakhigarhi, Mehrgarh, Sindhu Valley Civilization, Marine Technology, and Bet-Dwārka. Vastu Shastra, Architecture the Root of Civilization and Art work of Bharatiya Knowledge.

Textbooks:

1. Textbook on The Knowledge System of Bharata by Bhag Chand Chauhan,
2. Engineering and Technology in Ancient India by Ravi Prakash Arya
3. History of Science in India Volume-1, Part-1, Part-II, Volume VIII, by Sibaji Raha, et al. National Academy of Sciences, India and The Ramakrishna Mission Institute of Culture, Kolkata (2014).
4. Science and Technology in Ancient Indian Texts by Bal Ram Singh, Nath Girish. Umesh Kumar Singh
5. Vedic Mathematics, Swami Bharati Krishna Trithaji, Motilal Banarsidass, New Delhi.
6. Mayamatam – Indian Treatise on Housing, Architecture and Iconography (2 volumes), Bruno Daegens, Indira Gandhi National centre for Arts. 2007
7. Glimpse into Kautilya's Arthashastra, Ramachandrudu P., Sanskrit Academy, Hyderabad. 2010
8. Supriya Lakshmi Mishra, Culture and History of Ancient India (With Special Reference of Sudras), 2020.
9. Ranganathananda, Swami. The Message of the Upanishads. Bombay: Bharathya Vidya

Bhavan, 1985

Reference Books:

1. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati (2006).
2. Vedic Physics by Keshav Dev Verma, Motilal Banarsidass Publishers (2012).
3. India's Glorious Scientific Tradition by Suresh Soni, Ocean Books Pvt. Ltd. (2010).
4. Modern Introduction to Ancient Indian Mathematics, T S Bhanumurthy, Wiley Eastern Limited, New Delhi
5. Advanced Vedic Mathematics, Rajkumar Thakur, Rupa Publications India Pvt. Ltd 2019
6. Vedic Geometry Course, S. K. Kapoor, Lotus Press
7. NPTEL Course: Indian Knowledge System (IKS): Concepts and Applications in Engineering https://onlinecourses.swayam2.ac.in/imb23_mg53/pre view
8. Rigvedadi Bhashya Bhumika: Swami Dayananda Saraswati publisher Arya samaj, Vedic Mission West Midlands.
9. Patanjali Yoga Sutra a commentary by Shri Shri Ravishankar, Arktos media.
10. NPTEL Course: Sohoni Pushkar, Introduction to the History of Architecture in India, IISER Pune, 2020. https://onlinecourses.nptel.ac.in/noc22_ar03/preview.

Examination Scheme:

1. Course Activity Work: (20 Marks)

- **Attendance:** 5 Marks
- **Vedic Mathematics Test:** 5 Marks
- **Activity:** Participation in courses like NPTEL Art of Living Poster, Presentations, Models Making. 10 Marks

2. Insem Exam : (30 Marks)

Insem Examination will be conducted on the complete syllabus. (MCQ Based).

Course Coordinator

In-charge (HSSM)

HoD

Principal

MSE26111TH- Finite Element Method

Teaching Scheme
TH: 4 Hrs./week

Credits- 04
Theory: 4 Credits

Examination Scheme
Activity: 20 Marks
In-sem: 30 Marks
End-sem: 70 Marks

Prerequisite: Engineering Mathematics, Structural Analysis, Numerical Methods.

Course Objectives:

1. To understand & apply variational methods for structural analysis using different approximation techniques.
2. To analyze two-dimensional finite element problems using standard element types & modeling techniques.
3. To understand & apply shape functions for various finite element types and dimensions.
4. To understand & apply isoparametric mapping concepts for two & three-dimensional finite elements.
5. To analyze thin plate bending elements using different triangular & rectangular finite element types.
6. To understand & apply finite element methods for axisymmetric and shell structures.

Course Outcomes:

On successful completion of this course, the learner will be able to:

1. Formulate stiffness matrices and solve structural problems using variational methods.
2. Solve plane stress/strain problems & formulate stiffness matrices for 2-dimensional elements.
3. Formulate stiffness matrices using shape functions for one, two, & three-dimensional elements.
4. Formulate isoparametric elements and use the Jacobian matrix in finite element analysis.
5. Evaluate bending behavior of plates using ACM, BFS, and node elements.
6. Analyze stress-strain relations in axisymmetric and shell elements using appropriate finite element techniques.

UNIT-I Variational Methods in Structural Analysis

[9 Hrs]

Background on variational calculus, Galerkin method, collocation method, least squares methods, Variational methods of approximation, Rayleigh-Ritz method, Variational theorem, principle of minimum potential energy, use of polynomial displacement function, variational approach for formulation of element stiffness matrix for truss and beam elements, Strong and Weak formulation.

UNIT-II Two-Dimensional Finite Element Analysis

[9 Hrs]

Two dimensional elements in plane stress / plane strain problems. CST, LST and rectangular elements, modelling considerations, aspect ratio, use of polynomial displacement functions, Pascal's triangle. Requirements for convergence, geometric invariance, grid refinement. Standard stiffness and load vector formulation procedures using variational principle. Condensation of

internal degrees of freedom-Summary of analysis procedure.

UNIT-III Shape Functions and Elements

[9 Hrs]

Shape functions in Cartesian and natural coordinate systems, shape functions for one, two and three-dimensional elements. Higher order elements- Lagrange- Serendipity- Interpolation-formulation of element stiffness.

UNIT-IV Isoparametric Elements and Mapping

[9 Hrs]

Concept of isoperimetric elements and isoparametric mapping, Jacobian matrix, formulation of two dimensional quadrilateral isoparametric element in plane elasticity problem, 3-D isoperimetric elements.

UNIT-V Thin Plate Bending Elements

[8 Hrs]

Thin Plate bending elements, various triangular and rectangular elements, ACM (Adini, Clough, Melosh) and BFS (Bogner, Fox, Schimdt) elements. Conforming and nonconforming elements, concept of four node and eight nodes.

UNIT-VI Axisymmetric and Shell Elements

[8 Hrs]

Axisymmetric elements in axisymmetric problems, stress strain relations, triangular and Quadrilateral elements. Flat and curved shell element, elements for cylindered shells, curved solid elements.

Books & Other Resources:

1. J. N. Reddy, An Introduction to the finite element method, Tata McGraw Hill Publishing Co. Ltd.
2. C. S. Krishnamoorthy, Finite Element Analysis: Theory & Programming, Tata McGraw Hill Publishing Co. Ltd.
3. Zienkiewicz & Taylor, The Finite Element Method 4th Edition: Vol. I & II – McGraw Hill International Edition.
4. G. R. Buchanan, Finite Element Analysis Schaum's outlines, Tata McGraw Hill Publishing Co. Ltd.
5. Daryl L. Logan, A First Course in Finite Element Method, Cengage Learning.
6. S. S. Bhavikatti, Finite Element Analysis – New Age International Publishers, Delhi.
7. S. S. Rao, The Finite Element Method in Engineering 4th Edition – Elsevier Publication.

Activity: Perform any two of the following activities

1. Plane stress finite element analysis using commercial finite element software.
2. Plane strain finite element analysis using commercial finite element software.
3. Develop computer programs using one-dimensional and two-dimensional elements.

MSE26112TH – Theory of Plates & Shells

Teaching Scheme:

Credits: 4

Examination Scheme:

TH: 4 Hrs./week

Theory: 4

CAA: 20 Marks

In semester: 30 Marks

End Semester: 70 Marks

Prerequisite:

1. Knowledge of Engineering Mathematics, Structural Analysis

Course Objectives:

1. To introduce thin plate theory fundamentals, including assumptions, stress resultants, and Navier solutions for rectangular plates under diverse loading and boundary conditions.
2. To enable application of Levy's method, energy-based Rayleigh-Ritz approaches, and introductory shear deformation theories for advanced plate analysis.
3. To formulate and solve axisymmetric problems in circular plates using polar coordinates, covering various edge supports and load configurations.
4. To classify shell geometries and derive core thin shell theory equations, emphasizing membrane behavior in shells of revolution.
5. To analyze cylindrical shells via membrane theory, including equilibrium, strain relations, and applications to pressure vessels and pipes.
6. To apply bending and beam theories, including Lundgren's principles, for comprehensive analysis of cylindrical shells in structural applications like roofs.

Course Outcomes: After Completion of course students will be able to

- CO1: Explain thin plate assumptions, derive governing equations, and apply Navier solutions to analyze rectangular plates under various boundary conditions and loads.
- CO2: Apply Levy's method to rectangular plates with distributed/line loads and edge moments; use Rayleigh-Ritz energy methods and introduce shear deformation theories like Reissner-Mindlin.
- CO3: Derive polar coordinate equations for circular plates; analyze axisymmetric loading cases including simply supported/fixed edges, ring loads, and plates with central holes.
- CO4: Classify shell geometries; formulate thin shell theory equations including stress resultants, compatibility, equilibrium, and membrane theory for shells of revolution.
- CO5: Solve membrane theory for cylindrical shells under equilibrium/strain relations; apply boundary conditions to pipes, pressure vessels, conical, and spherical shells.
- CO6: Develop bending and beam theories for cylindrical shells; implement Lundgren's principles for beam/arch analysis in applications like roof shells.

Course Contents

Unit 1: Fundamentals of Thin Plate Theory

9 Hours

Introduction: Thin and thick plates, small and large deflections, small deflection theory of thin plates: assumptions, moment curvature relations, stress resultants, governing differential equation in Cartesian co-ordinates, various boundary conditions, pure bending of plates. Analysis of rectangular plates: Navier solution for plates with all edges simply supported, distributed loads, point loads and

rectangular patch load.

Unit 2: Levy's Method and Energy Approaches

9 Hours

Levy's Method: Distributed load and line load, plates under distributed edge moments. Raleigh- Ritz approach for simple cases in rectangular plates. Introduction to shear deformation theories, Reissner - Mindlin theory, moment curvature relationship for First order shear deformation theory.

Unit 3: Axisymmetric Circular Plates

9 Hours

Circular Plates: Analysis of circular plates under axisymmetric loading, moment curvature relations, governing differential equation in polar co-ordinates. Simply supported and fixed edges, distributed load, ring load, a plate with a central hole.

Unit 4: Introduction to Shell Theory

9 Hours

Introduction: Classification of shells on geometry, thin shell theory, equations to shell surfaces, stress resultants, stress- displacement relations, compatibility and equilibrium equations. Shells of revolution: Membrane theory, equilibrium equations, strain displacement relations, boundary conditions, cylindrical, conical and spherical shells.

Unit 5: Membrane Theory of Cylindrical Shells

8 Hours

Circular cylindrical shells: Membrane theory: Equilibrium equations, strain displacement relations, boundary conditions. Bending Theory: Equilibrium equation, strain displacement relations, governing differential equation, solution for a simply supported cylindrical shell, various boundary conditions and application to pipes and pressure vessels.

Unit 6: Bending and Beam Theory of Shells

8 Hours

Beam theory of cylindrical shells: Principles of Lundgren's beam theory, beam analysis, arch analysis, and application to cylindrical roof shells.

Books & Other Resources:

Reference Books

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

Activity (CAA):

1. Using FEA software (e.g., ANSYS), model a simply-supported rectangular plate under uniform/point loads, compare Navier analytical solutions vs. simulation deflections/moments, and verify boundary conditions.
2. Derive Levy's solutions for a plate with partial edge supports under line loads, implement in

MATLAB/Python, plot stress resultants, and validate against Rayleigh-Ritz energy approximations.

MSE26113TH: Advanced Design of Concrete Structures

Teaching Scheme:

Credits: 4

Examination Scheme:

TH: 4 Hrs./week

Theory: 4

CAA: 20 Marks

In semester: 30 Marks

End Semester: 70 Marks

Prerequisite:

1. Fundamentals of RC design.

Course Objectives:

1. This course is designed to provide understanding of various IS code provisions, fundamentals and advanced RC design and its applications for design of various RC structures.
2. Students should be able to understand design of various advanced RC structures and its arrangements.

Course Outcomes: After Completion of course students will be able to:

- CO1: Analyzed and design of various types of slab
- CO2: Analyzed and design of grid slab
- CO3: Analyzed and design of flat slab
- CO4: Analyzed and design of Elevated Service Reservoir
- CO5: Analyzed and design of Bunkers, and Silos
- CO6: Analyzed and design raft and pile foundation
- CO2: Design of microwave towers and tubular structures

Course Contents

Unit 1: Yield Line Theory and Design of Slab

09 Hours

Yield line theory for analysis of slabs, various patterns of yield lines, assumptions in yield line theory, characteristics of yield lines, equilibrium and virtual work method of analysis. Design of various slabs such as rectangular, triangular, circular with various edge conditions using yield line theory, Design for limit state of strength and serviceability of ortho-tropically reinforced slabs.

Unit 2: Design of Grid Slab

09 Hours

Grid and coffered slabs, general features, rigorous and approximate method of analysis, design of grid floor by approximate method.

Unit 3: Design of Flat Slab

09 Hours

Flat slabs, types, design methods, column and middle strip, proportioning of flat slab element, total design moment, distribution of moments, effect of pattern loading, design for shear, design of intermediate and end panel by direct method only

Unit 4 Design of Elevated Service Reservoir

09 Hours

Elevated service reservoir: Rectangular and circular type only flat bottom, Design of staging for wind and earthquake forces.

Unit 5: Design of Bunkers and Silos

08 Hours

Design of bunkers, and Silos, square and circular bunkers, silos shallow and deep beams.

Unit 6: Design of Raft and Pile Foundations

08 Hours

Design of raft foundations, pile foundations, single pile, group of piles, Pile cap, design of form work for slabs, girders and, columns.

Books & Other Resources:

1. Advance R. C. C. Design, S. S. Bhavikatti, New Age International Publishers
2. B.C. Punmia, Ashok K. Jain, Arun K. Jain, Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi
3. N. C. Sinha, S.K. Roy, Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New Delhi
4. P. C. Varghese, Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi
5. Dr .H.J.Shah, Reinforced Concrete design, Charotar publishing house
6. Design of R. C. C, S. Ramaamrutham, Dhanpat Rai publications
7. IS: 456-2000, Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
8. IS: 1893:-2017, Indian Standard Code of practice for criteria for Earthquake resistant design of Structures, Bureau of Indian Standards, New Delhi.
9. IS: 3370, Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi

Activity (CAA):

Students shall complete one assignment for each of the six units as mandatory requirement under this academic activity.

MSE26114A- Design of Pre-Engineered Buildings

Teaching Scheme:

Credits

Examination Scheme:

TH: 4 Hrs. / week

4

CAA: 20 Marks

Insem: 30 Marks

Endsem: 70 Marks

Prerequisite:

Limit State Design of Steel Structures

Course Objectives:

1. To introduce students to the concept, history, advantages, components, and applications of Pre-Engineered Buildings (PEB).
2. To understand the design loads, load combinations, and design parameters used in the analysis and design of PEB frames as per relevant IS codes.
3. To develop knowledge about connection design in PEB structures, including moment connections, shear connections, and bolted connections.
4. To study the structural stability aspects of PEB systems, including buckling behavior, bracing systems, and crane supporting structures.
5. To understand the design and application of mezzanine floor systems and base plate connections in industrial buildings.
6. To enable students to perform analysis and design of PEB structures using structural software and understand fabrication and erection procedures.

Course Outcomes: students will be able

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

1. Explain the concept, components, materials, and advantages of Pre-Engineered Buildings and differentiate them from conventional steel structures.
2. Analyze design loads and serviceability requirements for PEB frames according to relevant design standards.
3. Design moment connections, shear connections, and bolted connections used in PEB structures.
4. Evaluate structural stability, bracing systems, and crane-supporting structures in pre-engineered buildings.
5. Design mezzanine floor systems and base plate connections for PEB structures.
6. Perform structural analysis and design of PEB frames using software tools and interpret the results for practical engineering applications.

Course Contents

UNIT 1: INTRODUCTION TO PRE-ENGINEERED BUILDINGS AND ITS COMPONENTS

09 Hours

Introduction – History - Advantages of PEB - Applications of PEB – Materials used for manufacturing of PEB. Difference between Conventional Steel Buildings and Pre-Engineered Buildings.

PEB Components: Primary System: Main frames, Gable End Frame - Secondary frame system: Sizes and Properties of Purlins & Girts – Bracing System: Rod, angle, Portal, Pipe bracing – Sheeting and Cladding: Roof Sheeting and Wall sheeting – Accessories: Turbo Ventilators, Ridge vents, Sky Lights, Louvers, Insulation, Stair cases.

UNIT 2 : DESIGN LOADS METHODOLOGY OF PRE-ENGINEERED BUILDINGS 09 Hours

Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic, and Other applicable Loads. Serviceability Limits as per code. Design Parameters of PEB Frames - Depth of the section, Depth to Flange width ratios, Thickness of Flange to thickness of Web ratio. d/tw , bf/tf ratios of sections as per IS code. Section Sizes as per Manufacturing Limitations. Analysis and Design of Rigid Frames.

UNIT 3: PEB FRAME CONNECTION DESIGN METHODOLOGY

09 Hours

Rigid Frame Moment Connection, Shear Connection, High-strength bolts & grades, Lever arm, bolt Pattern its effect on connection design, thickness of connection plate. Selection of governing forces for connection design.

UNIT 4: STRUCTURAL STABILITY AND CRANE SYSTEM OF PEB

09 Hours

Shear buckling effect (d/t ratio exceeding 67ϵ), Effective Cross-sectional area concept for Compression Members d/t ratio exceeding 42ϵ ; Effect of d/t ratio for flexural members according to section classifications, Lateral Torsional Restraint system: Flange Bracing and design considerations. Global and Local behavior of the frame system depending on the slenderness ratio, d/t and b/t ratio. Bracing system: Rod Bracing, Angle Bracing, Portal Bracing, EOT Cranes, Monorail Cranes, Underslung and Wall-mounted - Design of Crane beams with and without Top Channels (Surge Beam), Design of Crane Brackets – Frame design with different types of Cranes using software.

UNIT 5: MEZZANINE FLOOR SYSTEMS

09 Hours

Design of Mezzanine Beams, Columns, and joists – Mezzanine decking, Different types of Mezzanine Floor systems – Grating, Chequered plate, and Rigid floor System. UNIT-IV: PEB BASE PLATE DESIGN METHODOLOGY Types of base plate: Pinned, Fixed, strength bolts, different types of bolts & grades, Lever arm, bolt Pattern, its effect on connection design, thickness of connection plate, base plate size, Selection of governing forces for base connection design, & Anchor bolt.

UNIT 6: ANALYSIS AND DESIGN OF PRE-ENGINEERED BUILDINGS**09 Hours**

2D and 3D Modelling of Portal Frames, Optimization Techniques, Comparison of software output with manual calculations. Design of Cold Formed Sections, i.e., Purlins and Girts, Design of Roof Sheeting, trapezoidal, Standing seam sheeting, Welding technology, Manufacturing process, Erection Procedures.

Textbooks:

1. A Newman, Metal Building Systems Design and Specifications, McGraw-Hill publication, ISBN 978-0-07-177664-6
2. N Subramanian, Design of Steel Structures, OUP India publication, ISBN 978-0-19-567681
3. K. S. Vivek and P. Vaishnavi, Pre-Engineered Steel Buildings, Lambert Academic Publishing Supplementary Reading: <http://nptel.ac.in/courses/105106113/3>.

Activity:

1. Design Pre-engineered building using STADD –PRO software.
2. Site visits: Report based on 2 site visits to Pre-engineered buildings.

MSE26114B – Structural Stability

Teaching Scheme:

Credits: 04

Examination Scheme:

TH: 04 Hrs./week

Theory: 04

CAA: 20 Marks

In semester: 30 Marks

End Semester: 70Marks

Prerequisite:

1. Types of conventional material, elastic properties of materials, effect of force systems on structural members.

Course Objectives:

1. It is a course based on fundamental mechanics of structural members that is designed to give the theoretical background to the more practical design-based module

Course Outcomes: After Completion of course students will be able to

- CO1: Identify the stability and instability for structures
- CO2: Apply finite element approach for stability analysis
- CO3: Apply differential equation to analyze the beam-column joints
- CO4: Determine the buckling loads for optimization of stability
- CO5: Apply energy methods for thin plate problems and beam-column members
- CO6: Analyze the stability of beam-column members

Course Contents

Unit 1: Elastic Stability of Structures

06 Hours

Concepts of elastic structural stability and instability, analytical methods for the stability analysis, equilibrium, imperfections and energy methods.

Unit 2: Elastic Buckling of Columns

06Hours

Elastic buckling of columns, assumptions, critical load for various boundary conditions, columns with geometric imperfection, large deflection theory of columns, Southwell plot, Orthogonally of buckling modes, eccentrically loaded columns, numerical techniques – Finite difference and Finite element approach.

Unit 3: Elastic Buckling of Beam-Columns

06Hours

Elastic buckling of beam-column, differential equations of beam-column, beam column with concentrated point load, several point loads, continuous lateral load, single couple, uniformly distributed load, end couples.

Unit 4: Elastic Buckling of Frames

06Hours

Elastic buckling of frames, triangular, partial, multi-storey portal and box frames with symmetric and anti-symmetric buckling, stiffness method approaches, approximate method, buckling of open sections, torsional buckling.

Unit 5: Elastic Buckling of Thin Plates

06Hours

Elastic buckling of thin plates, equilibrium approach, rectangular plate with axial load in one and two directions, various boundary conditions, Energy methods – Rayleigh Ritz and Galerkin, large deformation theory of plates and effective width concept, post buckling the behavior of plates.

Unit 6: Lateral-Torsional Buckling and Beam-Column Behavior

06Hours

Structural design for stability of Members, Lateral torsional buckling of beams, lateral torsional buckling of cantilever and S.S. beams, stability design of beam-column member.

Books & Other Resources:

Textbooks

1. Timoshenko S. P. and Gere J. M., Theory of Elastic Stability, Mc Graw Hill, Singapore
2. George Gerard, Introduction to Structural Stability Theory, Mc Graw Hill, New York

Reference Books

1. N. G. Iyengar., “Elastic Stability of Structural elements”, McMillan, India.
2. A. Kumar, “Stability of Structures”, Allied Publishers, New Delhi.
3. M. L. Gambhir, “Stability Analysis and Design of Structures”, Springer-Verlag (2004).

Activity:

1. Power point presentation on structural stability and instability for any one of the structural member or structure. (10 Marks)
2. Preparation of model for structural member or any structure to demonstrate the stability and instability. (10 Marks)

MSE26114C- Design of Foundations

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures:4 hrs/week	TH:4	Activity-20 Marks In-sem-30 Marks End-sem-70 Marks

Course Prerequisites:

Geotechnical Engineering, Foundation Engineering

Course Objective:

The Objective of this course is to able to perform geotechnical design of different foundation systems, and choose the most appropriate one.

Course Outcome:

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

- 1: Identify type of soil and foundation.
- 2: Identify types of raft and able to design raft foundation.
- 3: Able to design foundations for rotary machines / impact machine.
- 4: Identify the types of piles and design of pile foundation.
- 5: Utilize and apply ASD/LRFD method for design of drilled shafts.
- 6: Able to analysis and interpret the results.

Unit I: Introduction and Soil-Structure Interaction

[9

Hours]

- A. Foundation Objectives and Their Importance, Classification of Foundations, Soil Classification, Geotechnical Design Parameters, Bearing Capacity, And Foundation Settlements.
- B. Loads for Design, Depth of Foundation, Depth of Soil Exploration, Parameters for The Design of Foundation on Various Types of Soil, Introduction to Soil Structure Interaction.
- C. Review of IS Code Provisions: IS 1892, IS 1904, IS 6403, IS 8009 (Part-I & II).

Unit II: Design of Raft Foundations

[9

Hours]

- A. Types of Rafts, Relative Stiffness Considering: Superstructure-Foundation-Soil System, Soil-Structure Interaction Approach, Raft on Clayey and Sandy Soils.
- B. Review of IS Code Provisions: Is 2950 (Part-I).
- C. Design of Flat Slab Raft Foundation (Rigid Method/Elastic Line Method).

Unit III: Machine Foundation**[9****Hours]**

A. Introduction, Machine Vibrations, Vibration Characteristics, Design Consideration for Machine Foundations.

B. Review of Is Code Provisions: Is 2974 (Part-II, III & IV).

C. Design of Foundations for Rotary Machines / Impact Machine.

Unit IV: Pile Foundation**[9****Hours]**

A. Function and Classification of Piles, Static Point and Skin Resistance Capacity of a Pile, Negative Skin Friction, Vertically and Laterally Loaded Piles, Pile Settlements.

B. Pile Cap, Pile Group, Efficiency of Piles in a Group.

C. Review of IS Code Provisions: IS 2911 (All Related Parts).

Unit V: Design of Drilled Shaft (Caissons/Well) Foundations -**[8****Hours]**

A. Drilled Shafts (Caissons/Well) Foundations: Introduction, Types, and Applications of Drilled Shafts, Construction Procedures – Dry, Wet and Casing Methods of Construction.

B. Soil-Structure Interaction Considerations, Design Considerations Under Axial and Lateral Forces, ASD/LRFD Method of Design-General Principles and Steps.

Unit VI: Case Studies and Failures of Foundations -**[8****Hours]**

a. Review of Case Studies of Shallow and Deep Foundations.

b. Review of Failures of Shallow and Deep Foundations.

References:

1. Kurain N.P, Modern Foundations: Introduction to Advance Techniques: Tata McGraw Hill, 1982
2. Kurain N. P, Design of foundation systems Principles and Practice, Narosa Publishing house, New Delhi, 2005.
3. Nayak N. V., Foundation Design Manual, Dhanpat Rai and Sons, Delhi.
4. Shah H. J., Reinforced Concrete, Vol II, Charotar Publishing House.
5. Winterkorn H.F. and Fang H.Y. Ed., Foundation Engineering Hand Book, Van-Nostrand Reynold, 1975
6. Bowles J. E., Foundation Analysis and Design (4th Ed.), Mc. Graw –Hill, NY, 1996
7. Poulos H. G. and Davis E. H., Pile foundation Analysis and Design, John-Wiley Sons,

Neyork, 1980.

8. Leonards G. Ed., Foundation Engineering, Mc. Graw-Hill, NY, 1962
9. Shamsheer Prakash, Soil Dynamics, McGraw Hill
10. Sreenivasulu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill
11. O'Neil, M.W. and Reese, L.C. —Drilled Shafts: Construction Procedures and Design Methods, FHWA Publication No. FHWA-IF-99-025, Federal Highway Administration, Washington, D.C., USA, 1999.
12. P. C. Varghese, —Design of Reinforced Concrete Foundations, PHI Learning Pvt. Ltd., New Delhi, 2009.
13. IS 1892, IS 1904, IS 6403, IS 8009 (Part-I & II); IS 2950 (Part-I); IS 2974 (Part-II, III & IV); IS 2911 (all related parts).

Activity:

1. Soil Mechanics V Lab- 5 Practical
2. Site Visit and Report Writing

MSE26114D- Retrofitting and Strengthening of RC Structure

Teaching Scheme:

Credit: 4

Examination Scheme:

TH: 4 Hrs./week

Theory- 4

CAA: 20 Marks

In semester: 30 Marks

End Semester: 70 Marks

Course Prerequisites:

Basics Structural Analysis, Basics of Mathematics, Matrix Method of Analysis.

Course Objective:

The objective of this course is to improve the strength, ductility and stiffness of the structure.

Course Outcome:

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

1. Analyze need for repair and rehabilitations.
2. Apply NDT methods on the structure.
3. Apply various method for repairing of the structure.
4. Identify design methods for strengthening of the structure.
5. Identify design methods for strengthening of the structure for FRP.
6. Execute quality control construction.

Unit-I Fundamental Concepts of RC Distress and Deterioration

[9 Hrs]

Needs for repair and rehabilitations of RC structure, degradation of reinforced concrete structure, major causes and sign, deterioration of concrete structures, causes of deterioration, cracking-type, causes and characteristics.

Unit-II Condition Assessment of Concrete Structures

[9 Hrs]

Conditional evaluation- definition, objectives and stages of conditional assessment, preliminary investigation-scope, methodology and output, detailed investigation-scope and methodology, In-situ and laboratory testing such as non-destructive, semi destructive, corrosion test, chemical test and NDT for cracks, flaws and voids in concrete.

Unit-III Repair Systems, Materials and Techniques

[9 Hrs]

Repair system, material and techniques: Repair methodology, compatibility of repair material and concrete, material for repair-cement base, polymer modified, resin base, micro concrete and composite, repair techniques.

Unit-IV Retrofitting and Strengthening of Concrete Structures

[9 Hrs]

Design philosophy of strengthening, strengthening technique: section enlargement, composite construction, post tensioning, stress reduction, strengthening by reinforcement, strength by FRP.

Unit-V Strengthening of RC Members**[8 Hrs]**

Strengthening of RC Members, strengthening of beams: flexural and shear, slab, columns, footings and seismic retrofitting of RC structures using FRP.

Unit-VI Maintenance, Monitoring and Demolition**[8 Hrs]**

Quality control in concrete construction, maintenance, water leakage-detection and mitigation, fire damage-detection and reparation, corrosion-detection and mitigation, demolition of concrete structures and structural health monitoring.

Books & Other Resources:

1. Concrete Repair and Maintenance, P. H. Emmons and G M Sabnis, Galgotia Publication.
2. Repairs and Rehabilitation – Compilation from Indian Concrete Journals.
3. Management of Deteriorating Concrete Structures, George Somerville, Taylor and Francis, Publication.
4. Concrete Building Pathology, Susan Macdonald, Blackwell Publishing.
5. Durability of Cement and Cement Composites, C. L. Page, M. M. Page, Wood Head, Publishing.
6. ACI 440.2R-08, Guide for the design and construction of externally bonded FRP systems for strengthening concrete structures, American Concrete Institute.
7. Xilin lu (2010), Retrofitting design of building structures, Science Press, New York.
8. Strengthening and Rehabilitation of Civil Infrastructures using Fibre-Reinforced Polymer (FRP) Composites, L. C. Hollaway and J. G. Teng, Woodhead Publishing Series in Civil and Structural Engineering.
9. Maintenance, Repair & Rehabilitation & Minor Works of Building, by P. C. Varghese, PHI.

Activity:

1. Virtual Lab Experiments (Minimum 2).
2. Structural Audit Site Visit and Report Preparation.

MSE26115PR- Skill Development Lab II

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 8hrs/week	PR:4	TW-30 Marks OR-30 Marks

1. A mini-project to be completed individually which shall be based on the analysis and design of a G + 10 stories commercial building. The analysis shall be done using any commercially available software and the design of all structural members shall be done manually. The detailing shall be prepared using any commercially available drafting software.
2. A mini-project to be completed individually which shall be based on the analysis and design of a steel building. The analysis shall be done using any commercially available software and the design of all structural members shall be done manually. The detailing shall be prepared using any commercially available drafting software.
3. Mini project on analysis of chimney, Water Tank, retaining wall, RCC Dam, and Industrial steel structure using ABAQUS software (Any one).
4. Site visits: Report based on three site visits.

MSE26116TH-Environmental Studies

Teaching Scheme

Lectures: 2
hrs./week

Credit Scheme

TH:2

Examination Scheme

CAA-20 Marks

ISE-30 Marks

Course objectives: The Objective of this course is to impart knowledge of environment and ecosystems. It also creates awareness among the students about conservations of the resources, pollutions and different environmental acts.

Course Outcomes: After completion of this course, students will able to,

1. Understand importance of environment and natural resources.
2. Study different ecosystems and prepare a detailed report.
3. Identify the causes of pollution and suggest remedial actions.
4. Address social issues and understand the various environmental acts.

Unit I: Introduction

Multidisciplinary nature of environmental studies:

[7 Hours]

Definition, scope, and importance, Need for public awareness.

Resources types and conservation: Renewable and non-renewable resources, Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

Unit II: Ecosystems & Biodiversity

[7 Hours]

Concept of an ecosystem, Structure, and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure, and function of the various ecosystems. Biodiversity: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, India as a mega-diversity nation.

Unit III: Environmental Pollution

[7 Hours]

Definition, Cause, effects, and control measures of a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. nuclear hazards, Solid

Waste Management, Pollution case studies.

Unit IV: Social Issues and the Environmental acts

[7 Hours]

Urban problems related to energy, Water conservation, rainwater harvesting, watershed management, Environmental ethics: Issues and possible solutions, Environment Protection Act. Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.

References:

1. Suman Gupta, 2024. Environmental studies, S. Chand publication.
2. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
5. Rosencranz, A., Divan, S., & Noble, M.L. 2001. Environmental law and policy in India. Tripathi 1992.
6. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.

Important Note:

CAA:

Report writing and Poster making & presentation:

Students are required **to prepare one report** and **one poster** with presentation on **two** different activities selected from the list given below. **The report and poster should not be based on the same activity.**

- i) Record the **biodiversity of any visited area** and prepare a detailed report.
- ii) Identify the **natural resources and ecosystems** of your area and prepare a detailed report.
- iii) Identify the **sources of pollution** in your area and prepare a detailed report.
- iv) Study **environmental ethics and environmental acts**.

ISE:

The In-Semester Examination (ISE) will be conducted in an **MCQ-based test pattern**.

MHS26111TH- Human Rights

Teaching Scheme:

Theory: 2 Hours/Week

Credits: 02

Examination Scheme:

In-Semester Exam: 30 Marks

Course Activity: 30 Marks

Total: 60 Marks

Course Objectives:

To introduce students to the concept and evolution of human rights. Understand constitutional provisions related to human rights in India. Develop awareness about human rights in professional and technical environments. Analyze contemporary human rights issues in science, technology, and industry.

Course Outcomes: After successful completion of the course, students will be able to:

CO1: Explain the concept, historical development and classification of human rights, including the principles of the Universal Declaration of Human Rights (UDHR).

CO2: Interpret the human rights provisions in the Indian Constitution and evaluate the role of institutions such as NHRC and human rights courts in protecting vulnerable groups.

CO3: Apply human rights principles in technical and professional settings, including workplace ethics, labor rights, environmental sustainability, and AI/data privacy issues.

CO4: Analyze contemporary human rights issues in the global and digital context, including cyber security, intellectual property rights, refugees, and the role of international organizations.

Course Contents

Unit 1: Introduction to Human Rights

[06 Hours]

Meaning, Nature and Scope of Human Rights, Evolution and Historical Development
Universalism vs Cultural Relativism, Classification: Civil, Political, Economic, Social and Cultural Rights, International Bill of Human Rights, Universal Declaration of Human Rights (UDHR)

Unit 2: Human Rights and Indian Constitution

[06 Hours]

Fundamental Rights under Constitution of India, Directive Principles of State Policy, Fundamental Duties, Kinds of Writ Petition, Role of National Human Rights Commission (NHRC), Human Rights Courts in India, Rights of Women, Children, SC/ST and Minorities

Unit 3: Human Rights in Technical and Professional Environment

[06 Hours]

Right to Equality and Non-Discrimination in Workplace, Labor Rights and Industrial Safety, Right to Information and Transparency, Environmental Protection and Sustainable Development, National Institutions for the Protection and Promotion of Human Rights, National Human Rights Commission, -Corporate Social Responsibility (CSR), Ethical issues in Engineering, AI & Data Privacy

Unit 4: Contemporary Issues and Global Perspective

[06 Hours]

Globalization, Multinational Corporations and Human Rights, Rights in the Digital Era, Cyber Security and Privacy Rights, Implications of Technological Advancements on Society, Expectations from the Technocrats, Effects of Robotics, Automation, and Artificial Intelligence on Daily Life, Surveillance Capitalism, Need of Code of Ethics for Engineers, Content Policing, Content Moderation, Effect of Emergence of Engineering and Technology on Human Rights in Warfare and Correctional Services

Text Books:

1. Human Rights Law and Practice –By Jatindra Kumar Das, PHI Learning, New Delhi
2. International Law and Human Rights, By Dr. S.K. Kapoor, Published by central law agency, 22nd edition - 2021

Reference Books:

1. Human Rights in Constitutional Law By D.D. Basu, (3rd ed., 2008) published by LexisNexis
2. International Law & Human Rights by Dr. H.O. Agarwal is published by Central Law Publications.
3. Human Rights and Law Justice P.S. Narayana –

Activity:

1. Case study on data privacy in AI systems/ content moderation on social media platforms and freedom of expression
2. Analysis of industrial safety standards/social dilemma critically reflecting working of digital platform
3. Report on environmental compliance of industries
4. Study of CSR initiatives of technical companies
5. Assignments on case studies related to technology abuse.
6. Poster designing or Seminars on specific rights.