Vidya Pratishthan's

Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

(An Autonomous Institute)

Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering & Technology

Syllabus Structure

M. Tech Civil

(Structural Engineering)

Department of Civil Engineering

(With effect from July 2023)

VP's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

(An Autonomous Institute)

Department of Civil Engineering

M. Tech Civil (Structural Engineering)

(with effect from A.Y. 2023-24)

Semester I

Course Code	Course	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks						Credit Scheme	
		TH	PR	Activity	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR
MSE231|01	Numerical Methods in Civil Engineering	4		20	30	60				110	4	
MSE231|02	Advanced Design of Steel Structures	4		20	30	60				110	4	
MSE231|03	Structural Dynamics	3		20	30	60				110	3	
MSE231|04	MDS-1	2		10	20	40				70	2	
MSE231|05	Research Methodology	3		10	30	60				100	3	
MSE231|06	Laboratory Proficiency - I		08				50		50	100		04
MHS231|01	Indian Knowledge System	2		20					30	50	2	
	Total	**18**	**08**	**100**	**140**	**280**	**50**	**00**	**80**	**650**	**18**	**04**
Total Credit											22	

MDS-1

MSE231|04-A	Green Building	MSE231|04-B	Optimization Technique
MSE231|04-C	Artificial Neural Networks	MSE231|04-D	Introduction to Smart Material

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M. Tech- (Structural Engineering)

(with effect from A.Y. 2023-24)

Semester II

Course Code	Course	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks						Credit Scheme	
		TH	PR	Activity	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR
MSE231|11	Finite Element Method	4		20	30	60				110	4	
MSE231|12	Theory of Plates & Shells	4		20	30	60				110	4	
MSE231|13	Advanced Design of Concrete Structures	4		20	30	60				110	4	
MSE231|14	Program Elective - I	4		20	30	60				110	4	
MSE231|15	Laboratory Proficiency -II	0	08				50		50	100		04
MSE231|16	Environmental studies	2		30					30	60	2	
	Total	**18**	**08**	**110**	**120**	**180**	**50**		**80**	**600**	**18**	**04**
Total Credit											22	

Program Elective I

MSE231|14-A	Design of Pre-Engineered Buildings	MSE231|14-B	Structural Stability
MSE231|14-C	Design of Foundations	MSE231|14-D	Retrofitting and Strengthening of R C Structure

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VPKBIET BARAMATI
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PUNE (MS.)

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Semester III

Course Code	Course	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks						Credit Scheme	
		TH	PR	Activity	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR
MSE23201	Analysis and Design of Earthquake-Resistant Structures	04		20	30	60				110	04	
MSE23202	Theory of Elasticity	04		20	30	60				110	04	
MSE23203	Program Elective II	04		20	30	60				110	04	
MSE23204	Dissertation Stage I		08				100		50	150		04
MHS23201	Constitution of India	02		10					25	35	02	
MRA23205	Industrial Management	02		10					25	35	02	
	Total	**16**	**08**	**80**	**90**	**180**	**100**		**100**	**550**	**16**	**4**
Total Credit											**20**	

Program Elective II

MSE23203-A	Bridge Engineering	MSE24203-B	Design of Prestressed Concrete Structures
MSE23203-C	Mechanics of Modern Materials	MSE24203-D	Ferrocrete Technology

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Semester IV

Course Code	Course	Teaching Scheme (Hrs./Week)			Examination Scheme and Marks						Credit Scheme	
		TH	PR	Activity	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR
MSE23211	Seminar		04				50		50	100		02
MSE23212	Industry Internship / Inhouse research project		20				150		100	250		10
MSE23213	Dissertation Stage- II		16				100		100	200		08
	Total		**40**				**350**		**250**	**550**		**20**
Total Credit											**20**	

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MSE23101- Numerical Methods in Civil Engineering

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hrs/week	TH:4	Activity Marks = 20 Marks
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites: Basic concept of differentiation and integration, differential equations, system of linear equations

Course Objective:
To make the students familiarize with various Numerical methods which will be useful in finding approximate solution of complex Civil Engineering Problems where analytical methods failed. Also identify the difference between analytical and Numerical methods.

Course Outcome: On completion of the course, student 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 (6 Hrs)
Forward, backward and centered finite difference approximations to the derivatives. Applications to indeterminate beams, columns and plates.

Unit 1I: Matrix operations (Flexibility Method) (6 Hrs)
Flexibility matrices, numerical examples of application of Flexibility method to beams and plane trusses

Unit III: Matrix operations (Stiffness Method) (6 Hrs)
Stiffness matrices, numerical examples of application of stiffness method to beams and plane trusses, concept of transformation matrix, stiffness matrix for plane frame and space frame.

Unit IV: Solution of linear equations (6 Hrs)
Gauss elimination method, Gauss – Jordan method, Jacobi's method and Gauss – Seidel method, Numerical computation of Eigen values and Eigen vector by Power method, Householder method and Given's method.

Unit V: Solution of differential equations (6 Hrs)
Review of Taylor's series and Euler's method. Runge – Kutta fourth order method, predictor – corrector method. Solution of Eigen value problems by Power method.

Unit VI: Numerical integration (6 Hrs)
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.)

MSE23102- Advanced Design of Steel Structures

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hrs/week	TH:4	Activity Marks = 20 Marks
		In-sem-30 Marks
		End-sem-60 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 **[6 Hrs]**

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 **[6 Hrs]**

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 **[6 Hrs]**

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

Unit IV **[6 Hrs]**

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 **[6 Hrs]**

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

Unit VI **[6 Hrs]**

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

Activity:

1. Analysis and design of hoarding structures using any finite element software.
2. Design of industrial steel structures using any finite element software. Submission and presentation of the design report is desirable.

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.

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MSE23103- Structural Dynamics

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hrs/week	TH:3	Activity Marks = 20 Marks
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites:
Basics structural analysis, basics of mathematics, matrix method of analysis.

Course Objective:
The Objective of this course is to realize the seismic hazards and identify structural dynamic methods for safety and stability of civil engineering structures.

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

CO1: Analyze degrees of freedom and analyse forced & free vibrations.
CO2: Assess the harmonic excitations and apply Duhamel's integral.
CO3: Apply forced vibration & free vibration to multistorey building.
CO4: Identify the clauses from I.S. 1893, and distinguish between E.S.L. method & R.S. method.
CO5: Utilize and apply capacity-based design method w.r.to I.S. 13920.
CO6: Execute nonlinear analysis & interpret the results.

Course Contents

UNIT-I Basics of Structural Dynamics **(6 Hrs)**

Fundamental concepts of vibrations, Degrees of freedom & mathematical modelling of dynamic systems. SDOF An undamped& damped free vibration, viscosity & coulomb's damping.

UNIT-II Single Degree of Freedom System (SDOF System) **(6 Hrs)**

SDOF System: Undamped & damped forced vibrations to harmonic excitations. Response to until impulse and arbitrary loading by Duhamel's integral and analyses for Nonlinear analysis.

UNIT-III Multi Degree of Freedom System (MDOF System) **(6 Hrs)**

MDOF System: Forced vibrations and free vibrations of shear building orthogonally of mode shapes &concept & T.M.D

UNIT-IV Seismic Analysis Methods. **(6 Hrs)**

Design of multi-story RC Structure with I.S. 1893, by equivalent static lateral load method& R.S. method

UNIT-V Shear wall and Ductile detailing **(6 Hrs)**

Introduction to time history method, capacity-based design of soft story RC Buildings, Design of shear wall, Ductile detailing as per I.S. 13920.

UNIT-VI Non-Linear Analysis **(6 Hrs)**

Non-Linear Analysis, free vibration of cantilever beam by Rayleigh Ritz method.

Activity:

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

Books & Other Resources:

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.

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MDS-I

MSE23104-A- Green Building

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 2 hrs/week	TH: 2	Activity Marks- 10 Marks
		In-sem-20 Marks
		End-sem-40 Marks

Course Objective:

The Objective of this course is to realize the use of green building to reduce global warming.

Course Outcome:

On completion of the course, student 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 alternate source of energy.

Course Contents

Unit I: Introduction to the concept of cost effective construction **[6 Hrs]**

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 II: Global Warming **[6 Hrs]**

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 III: Green Building Rating Systems **[6 Hrs]**

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 IV: Utility of Solar Energy in Buildings **[6 Hrs]**

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.

Activity:

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

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.

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MDS-I

MSE23104-B- Optimization Technique

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 2 hrs/week	TH: 2	Activity Marks- 10 Marks
		In-sem-20 Marks
		End-sem-40 Marks

Course Objectives: To know optimization techniques to be used for Civil Engineering applications.

Course Outcomes:

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 the transportation and assignment related problems

Course Contents

Unit I: **(6 Hrs)**
Introduction to optimization techniques, Applications to various civil engineering problems, Statement of optimization problem, Constraints of LP, NLP problems.

Unit II: **(6 Hrs)**
Classical optimization methods: Single and multiple problems with equality and inequality constraints, Hessian matrix and its use, Lagrangian method, Convex and concave functions.

Unit III: **(6 Hrs)**
Linear programming: 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 IV: **(6 Hrs)**
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 problem, degeneracy.

Activity:
Solve transportation and assignment related problem using optimazation techniques in Civil Engineering (Activity to be done individually).

Books & Other Resources:

1. Engineering Optimization: Theory & Practice, S. S . Rao., Wiely.
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.

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Unit IV: Utility of Solar Energy in Buildings **[6 Hrs]**

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.

Activity:

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

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.

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MDS-I

MSE2304-C- ARTIFICIAL NEURAL NETWORKS

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 2 hrs/week	TH: 2	Activity Marks- 10 Marks
		In-sem-20 Marks
		End-sem-40 Marks

Course Objectives: To know applications of ANN in Structural Engineering.

Course Outcomes:

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: **6 Hrs**

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

Unit II: **6 Hrs**

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

Unit III: **6 Hrs**

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 IV: **6 Hrs**

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

Activity:

Solve Civil engineering problem using ANN

Books and 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

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MDS-I

MSE2[illegible]104-D- Introduction to Smart Material

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 2 hrs/week	TH: 2	Activity Marks- 10 Marks
		In-sem-20 Marks
		End-sem-40 Marks

Course Objectives

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

Course Outcomes

By the end of course students will able to

1. Understand various smart material and its importance in engineering application
2. Know various processing technics of smart materials
3. Get knowledge of use of smart material as sensors and actuators.

UNIT I: **4Hrs**

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 II: **4Hrs**

Electrostrictive Materials, Magnetoelectric materials, Magnetorheological fluids, Electrorheological fluids, Shape Memory materials.

UNIT III: **4Hrs**

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 IV: **4Hrs**

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.

Activity:

1. Case study on application of smart materials

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.

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MSE23105-Research Methodology

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 Hrs/week	TH:3	Activity Marks: 10
		In-sem :30 Marks
		End-sem :60 Marks

Course Objective:
The objective of the course is to explain the basics of research, the process involved; identify appropriate research topics, sampling techniques, and data interpretation.

Course Outcome: On completion of the course, students will be able to–

CO1: Know the meaning of research, research proposal format, and funding agencies.

CO2: Perform literature reviews using print and online databases and follow research ethics.

CO3: Demonstrate knowledge of research processes; describe sampling methods, measurement scales, and instruments and appropriate uses of each.

CO4: Able to validate and test the research data with qualitative and quantitative analysis.

CO5: Know the various advanced data analysis techniques.

CO6: Prepare an effective research report and paper.

Unit 1: Introduction to Research **[6 Hrs]**
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 **[6 Hrs]**
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 collection, Measuring, Sampling and Scaling **[6 Hrs]**
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: Preliminary data analysis **[6 Hrs]**
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: Advanced data analysis techniques **[6 Hrs]**

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 **[6 Hrs]**

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.

Activity:

Perform any two of the following activities.

1. Writing of research proposal.
2. Writing of funding proposal.
3. Use of any advanced data analysis techniques (Machine learning, Cluster analysis, Data visualization, Regression analysis, Sentiment analysis, Quantitative analysis or any suitable.)

References

1. Research Methodology: concepts and cases, Deepak Chawla and Neena Sondhi, Vikas Publishing House Pvt. Ltd.
2. Research Methods for Business, Sekaran Uma and Rogure Boudie, Wiley, India.
3. Research Methodology: Methods and Trends, by Dr. C. R. Kothari, New Age International Publishers.
4. Research Methods in Education, Louis Cohen, Manion, Morrison, Routledge (Taylor &Francis Group)/ Cambridge University Press India Pvt. Ltd.
5. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville.
6. Research Methodology: A Step by Step Guide for Beginners, by Ranjit Kumar
7. Research in Education, John Best and James Kahn, Prentice Hall of India Pvt. Ltd.

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MSE23106-Laboratory Proficiency I

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 8 hrs/week	PR:4	TW-50 Marks
		OR- 50 Marks

Course Contents

1 a) Completion of assignments

b) Review of technical documentaries/review of case studies /failure case studies/observation on case studies.

2. Technical review and critique of a research article/paper on any topic from the refereed journal paper related to the program content.

3. Design of earthquake-resistant structures using any civil 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

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MHS2101-Indian Knowledge System

Teaching Scheme	Credit Scheme	Examination Scheme
Theory: 2 hrs/week	TH:2	Activity Marks = 20
		Oral -30 Marks

Course Objectives:

1. To create awareness about the history and rich culture of the Country.
2. To introduce Vedic mathematics principles for faster calculations.
3. To know the science and Astronomy contributions of the traditional knowledge of Bhārata.
4. To learn engineering and technology contributions of the traditional knowledge of Bhārata.

Course Outcomes:

Students will be able to

CO1: Explain the historicity of the Indian Knowledge System and the broad classification of Indian philosophical systems.

CO2: Apply Vedic Mathematics for faster calculations.

CO3: Understand the importance of science and astronomy concepts developed byBhārata.

CO4: To understand the contributions in the engineering, technology,and architectural heritage of ancient Bharata.

UNIT -I: Bhāratīya Civilization and Development of Knowledge System (4 hours)

Genesis of the land, Antiquity of civilization, the Saraswatī-Sindhu Civilization, Traditional Knowledge System, The Vedas, Main Schools of Philosophy, Ancient Education System, the Takṣaśilā University, the Nālandā University, Ethnic Studies, Life Science studies, Agriculture, Ecology and Environment, Āyurveda, Integrated Approach to Healthcare, Medicine, Microbiology, Surgery, and Yoga. Life and works of Agastya,Patanjali,Lopamudra,Ghosha, GargiMaitreyi, Adishankaracharya, Panini,Aryabhatta,Kanada, Kautilya, Vishwakarma, Sushruta,Charaka, Bhaskaracharya, Madhavacharya.

UNIT-II: Vedic Mathematics (8 hours)

Indian Mathematicians: Varahmihir, Brahmagupta, SrinivasaRamanujan, NeelkanthSomayya, 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-Srautha Sutras and Sulbha Sutras

UNIT-III: Science, Astronomy (4 hours)

Concepts of Matter, Life and Universe, Gravity, Sage Agastya's Model of Battery, Velocity of Light, Vimāna: Aeronautics, Vedic Cosmology and Modern Concepts, BhāratīyaKāla-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 (4 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–Dwārkā.

Textbooks:

1.Textbook on The Knowledge System of Bhārata by Bhag Chand Chauhan,

2.Engineering and Technology in Ancient India by Ravi Prakash Arya

3. History of Science in India Volume-1, Part-I, Part-II, Volume VIII, by SibajiRaha, 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, MotilalBanarsidass, New Delhi.

Reference Books:

1. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. SamskritBharati (2006).

2. Vedic Physics by Keshav Dev Verma, MotilalBanarsidass 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/preview

8. RigvedadiBhashyaBhumika: Swami Dayananda Saraswati publisher Arya samaj, Vedic Mission West Midlands.

9. PatanjaliYogsutra a commentary by Shri ShriRavishankar,Arktos media.

10. NPTEL Course: SohoniPushkar, Introduction to the History of Architecture in India, IISER Pune, 2020.https://onlinecourses.nptel.ac.in/noc22_ar03/preview

Examination Scheme:

Activity **20 Marks**

Activity includes survey/ research, models, charts, and implementations on topics mentioned or relevant to the syllabus. Students need to present their work at the end of the term.

Oral **30 Marks**

Oral examination will be conducted by external and internal examiners.

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MSE23111- Finite Element Method

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 Hrs./week	TH:4	Activity: 20 Marks
		In-sem: 30 Marks
		End-sem: 60 Marks

Prerequisite: Engineering Mathematics, Structural Analysis, Numerical Methods.

Course Objectives:

1. To understand and apply variational methods for structural analysis using different approximation techniques.
2. To analyze two-dimensional finite element problems using standard element types and modeling techniques.
3. To understand and apply shape functions for various finite element types and dimensions.
4. To understand and apply isoparametric mapping concepts for two- and three-dimensional finite elements.
5. To analyze thin plate bending elements using different triangular and rectangular finite element types.
6. To understand and 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 and formulate stiffness matrices for two-dimensional elements.
3. Formulate stiffness matrices using shape functions for one, two, and 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 **6 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 **6 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 **6 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 **6 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 **6 Hrs**

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

UNIT-VI Axisymmetric and Shell Elements **6 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.

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.

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.

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MSE2112- Theory of Plates & Shells

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hrs/week	TH:4	Activity Marks-20
		In-sem Marks-30
		End-sem Marks-60

Prerequisite: Engineering Mathematics, Structural Analysis.

Course Outcomes:
On successful completion of this course, the learner will be able to:
1. Understand the simple bending of plates and different boundary conditions for plates.
2. Understand the different theories associated with plate analysis.
3. Derive equations for circular plates and different boundary conditions for circular plates.
4. Understand different types of shells and analyse deformation theories of shells.
5. Design various types of shells structures, pipes and pressure vessels.
6. Analyse different methods of analysis and applications of shells.

Course Content

Unit I [6 Hrs]
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 II [6 Hrs]
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, Reissener - Mindlin theory, moment curvature relationship for First order shear deformation theory.

Unit III [6 Hrs]
Circular Plates: Analysis of circular plates under axi-symmetric 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 IV [6 Hrs]
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 V [6 Hrs]
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 VI [6 Hrs]
Beam theory of cylindrical shells: Principles of Lundgren's beam theory, beam analysis, arch analysis, and application to cylindrical roof shells.

Actvity:

1. Skill based activity on any topic from syllabus.
2. Use of software to obtain stress resultants for any plates/shells problems.

Books & Other Resources:

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

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MSE23113- Advanced Design of Concrete Structures

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hrs/week	TH:4	Activity Marks-20 Marks
		In-sem-30 Marks
		End-sem-60 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:

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

1 Analyzed and design of various types of slab

2 Analyzed and design of grid slab

3 Analyzed and design of flat slab

4 Analyzed and design of Elevated Service Reservoir

5 Analyzed and design of Bunkers, and Silos

6 Analyzed and design raft and pile foundation

Unit 1 **6Hrs**

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 **6Hrs**

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

Unit 3 **6Hrs**

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 **6Hrs**

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

Unit 5: **6Hrs**

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

Unit 6: **6Hrs**

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

Activity:

1. Analysis and design of any two structures from the syllabus using any finite element software.
2. Design of RC building using any finite element software. Submission and presentation of the design report is desirable.

References

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, NewDelhi
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. Ramaamruthum, 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

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Program Elective-1

MSE2114-A- Design of Pre-Engineered Buildings

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures:4 hrs/week	TH:4	Activity Marks = 20
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites: Limit State Design of steel structures.

Course Objective: To understand fabrication aspects, inculcate analytical and design aptitude and be able to prepare fabrication drawing and detailing of Pre-Engineered Buildings.

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

CO1: Understand fabrication aspects of pre-engineered buildings.

CO2: Analyze strategies of pre-engineered steel buildings.

CO3: Understand Code provisions of pre-engineered buildings.

CO4: Design strategies of pre-engineered steel buildings.

CO5: Optimize design to have optimum cost of material.

CO6: Produce fabrication drawings of pre-engineered building components.

UNIT I: Introduction to pre-engineered buildings : **[6 Hrs]**

History Concept, Difference between Conventional Steel Buildings and Pre-Engineered buildings, components of pre-engineered buildings, material and connections used for manufacturing of PEB, Advantages of PEB, Applications of PEB, Pre-Engineered Building Components.

UNIT II: Analysis of the Pre-Engineered buildings: **[6 Hrs]**

Plastic analysis, Analysis for wind load, Seismic analysis.

UNIT III: Code stipulations: **[6 Hrs]**

Code Provisions: AISC, AISI, MBMA, ANSI, ASCE, UBC and IS codes, Design for stability, flexure, shear and deflections.

UNIT IV: Design of components: **[6 Hrs]**

Design of primary frame, Gable end framing, Secondary framing, Bracing systems.

UNIT V: Design optimization: **[6 Hrs]**

Iterative design procedure to arrive at optimum section sizes

UNIT VI: Fabrication drawings and detailing: **[6 Hrs]**

Components of fabrication drawings, Fabrication details of various components of the pre-engineered buildings.

Activity:

1.Design Pre-engineered building using STADD –PRO software

2. Site visits: Report based on 2 site visits to Pre-engineered buildings.

Books and Other Resources:

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.

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Program Elective-I
MSE23114-B- Structural Stability

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures:4 hrs/week	TH :4	Activity Marks = 20
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites:
Types of conventional material, elastic properties of materials, effect of force systems on structural members.

Course Objective:
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 Outcome:
On completion of the course, student 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: **6 Hours**
Concepts of elastic structural stability and instability, analytical methods for the stability analysis, equilibrium, imperfections and energy methods.

Unit II: **6 Hours**
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 III: **6 Hours**
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 IV: **6 Hours**
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 V: **6 Hours**
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 Gelerkin, large deformation theory of plates and effective width concept, post buckling the behavior of plates.

Unit VI: **6 Hours**
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.

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)

Books & Other Resources:

References

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

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Program Elective-1

MSE2114-C- Design of Foundations

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures:4 hrs/week	TH:4	Activity Marks = 20
		In-sem-30 Marks
		End-sem-60 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–

CO1: Identify type of soil and foundation.
CO2: Identify types of raft and able to design raft foundation.
CO3: Able to design foundations for rotary machines / impact machine.
CO4: Identify the types of piles and design of pile foundation.
CO5: Utilize and apply ASD/LRFD method for design of drilled shafts.
CO6: Able to analysis and interpret the results.

Unit I: Introduction and Soil Structure Interaction [6 Hrs]

a. Foundation objectives and their importance, Classification of foundations, Soil classification, Geotechnical design parameters, bearing capacity, Foundation settlements.
b. Loads for design, Depth of foundation, and depth of soil exploration, parameters for 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 [6 Hrs]

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 [6 Hrs]

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 [6 Hrs]

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 - [6 Hrs]
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 - [6 Hrs]
a. Review of Case Studies of – Shallow and Deep Foundations
b. Review of Failures of - Shallow and Deep Foundations

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

References:

1. Kurain N.P, Modern Foundations: Introduction to Advance Techniques: Tat aMcGraw 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. Poulose 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. Shamsher Prakash, Soil Dynamics, McGraw Hill
10. Sreenivasalu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill
11. O'Neil, M.W. and Reese, L.C. —Drilled Shafts: Construction Procedures and Design Methodsǁ, FHWA Publication No. FHWA-IF-99-025, Federal Highway Administration, Washington, D.C., USA, 1999.
12. P. C. Varghese, —Design of Reinforced Concrete Foundationsǁ, 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)

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Program Elective-I

MSE22114-D- Retrofitting and Strengthening of R C Structure

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures:4 hrs/week	TH:4	Activity Marks = 20
		In-sem-30 Marks
		End-sem-60 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–

CO1: Analyze need for repair and rehabilitations.

CO2: Apply NDT methods on the structure.

CO3: Apply various method for repairing of the structure.

CO4: Identify design methods for strengthening of the structure.

CO5: Identify design methods for strengthening of the structure for FRP.

CO6: Execute quality control construction.

Unit 1 **[6Hrs]**

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

Unit 2 **[6Hrs]**

Evaluation of concrete structures: 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 nondestructive, semi destructive, corrosion test, chemical test and NDT for cracks, flaws and voids in concrete.

Unit 3 **[6Hrs]**

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 4 **[6Hrs]**

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

Unit 5 **[6Hrs]**

Strengthening of R C members: Strengthening of beams: flexural and shear, slab, columns, footings and seismic retrofitting of R C structures using FRP.

Unit 6 **[6Hrs]**

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.

Activity:

1. V Lab- 2 Experiments
2. Site Visit for structural audit and preparation of report for the same. (Visualization)

Reference Books

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

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MSE23115-Laboratory Proficiency II

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 8hrs/week	PR:4	TW-50 Marks
		OR-50 Marks

1. A mini-project to be completed individually which shall be based on the analysis and design of a G + 10 storeys 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. Mini project on analysis of chimney, Water Tank, retaining wall, RCC Dam, Industrial steel structure using ABAQUS software (Any one).

3. Site visits: Report based on three site visits.

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Course Name with Code: Environmental Studies (MSE23116)		
Teaching Scheme Lectures: 2 hrs/week	Credits 02	Examination Scheme Activity : 30 Marks OR : 30 Marks

Course Objectives

- To acquire a basic understanding and knowledge about the environment and its allied problems.
- Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
- Develop the ability to evaluate measures for the improvement and protection of environment.

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

- Understand environmental problems arising due to developmental activities.
- Identify the natural resources and suitable methods for conservation and sustainable development.
- Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
- Identify the environmental pollutants and abatement methods.

Environmental Studies

Unit I: Introduction to Environmental studies **(06 Hrs)**

Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.

Ecosystems

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit II: Natural Resources: Renewable and Non-renewable Resources **(06 Hrs)**

Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods droughts, conflicts over water (international & inter-state). Heating of earth and

circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit III: Biodiversity and Conservation **(06 Hrs)**

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity; In-situ and Ex situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit IV: Environmental Pollution **(06 Hrs)**

Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear radiation hazards, solid waste management, sources of solid waste effects and control measures of urban industrial wastes: Pollution case studies, disaster management- floods, earthquakes, cyclones and landslides. Environmental Protection Act. Air (Prevention and control of pollution), Water (Prevention and control of pollution) Act, Wildlife Protection Act, Forest Conservation Act, issue involved in enforcement of environmental legalizations, population growth, variation among nations, Environment and human health, epidemics, Women and child welfare, Role of information technology in environment and human health.

Activities:

1. Visit to Local Polluted Site: Urban/Rural/Industrial
2. Visit to Landfill Site
3. Use of Smart Technologies in Solid Waste Management Sector

List of Reference Books and other Resources:

Text Books:

1. Bharucha, E., Textbook of "Environmental Studies", Universities Press (2005), ISBN-10:8173715408
2. Mahua Basu, "Environmental Studies", Cambridge University Press, ISBN-978-1-107-5317-3

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://archive.nptel.ac.in/courses/127/105/127105018/

Suggested Readings:

1. Carson, R. 2002. Silent spring. Houghton Mifflin Harcourt.

2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.

3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.

4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principals of Conservation Biology. Sunderland: Sinauer Associates, 2006.

6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339:36-37.

7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp.29-64). Zed Books.

8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

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MSE23201- Analysis and Design of Earthquake Resistant Structures

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 Hrs./week	TH:4	Activity: 20 Marks
		In-sem: 30 Marks
		End-sem: 60 Marks

Prerequisite: Engineering Mechanics, Structural Design, Fundamentals of Structural Dynamics.

Course Objectives:

1. To understand the fundamentals of earthquake-resistant design and relevant IS code provisions.
2. To analyze structural behavior during earthquakes and identify earthquake-resistant features.
3. To understand seismic-resistant building architecture and effective lateral load-resisting systems.
4. To analyze ductility requirements for earthquake-resistant design of RCC buildings.
5. To design and detail a two-story RCC building for earthquake resistance.
6. To understand the principles and design considerations for base isolation in structures.

Course Outcomes:

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

1. Explain earthquake-resistant design principles and apply code requirements effectively.
2. Evaluate structural performance and apply earthquake-resistant design principles.
3. Assess and design structures with optimal seismic-resistant architectural features.
4. Evaluate and apply ductility provisions in RCC structures as per IS 13920.
5. Design and detail RCC building components using seismic analysis methods.
6. Analyze and apply base isolation techniques for improved seismic performance.

UNIT-I Design philosophy **6 Hrs**

Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration), seismic structural configuration, Introduction to IS: 1893 (Part I), IS: 875 (Part V), and IS code provisions.

UNIT-II Behavior of structures during earthquake and earthquake resistant features of structure **6 Hrs**

Inertia forces in structures, Behavior of brick and stone masonry structures: behavior of brick and stone masonry walls, box action, different types of bands, earthquake resistant features of stone masonry structures. Behavior of RC structures: load transfer path, strength hierarchy, reversal of stresses, importance of beam-column joints, importance of stiffness and ductility (Capacity Design Concept) in structures, effect of short column, effect of soft storey, improper detailing, effect of

masonry infill walls, effect of eccentricity.

UNIT-III Seismic-resistant building architecture **6 Hrs**

Introduction; Lateral load resisting systems- moment resisting frame, building with shear wall or bearing wall system, building with dual system; building configuration- problems and solutions; Building characteristics- Mode shape and fundamental period, building frequency and ground period, damping, ductility, seismic weight, hyperstability /redundancy, non-structural elements.

UNIT-IV Ductility considerations in earthquake resistant design of RCC buildings **6 Hrs**

Introduction; impact of ductility; requirements for ductility; assessment of ductility-member/element ductility, structural ductility; ductility factors; factor affecting ductility; ductility considerations as per IS13920.

UNIT-V Earthquake resistant design of a long two-story, two-bay RCC building **6 Hrs**

Determination of lateral forces on an intermediate plane frame using equivalent static method and response spectrum method; analysis of the intermediate frame for various load combinations as per IS1893(Part 1); identification of design forces and moments in the members; design and detailing of typical flexural member, typical column, footing and detailing of an exterior joint as per IS13920.

UNIT-VI Base isolation of structures **6 Hrs**

Introduction; considerations for seismic isolation; basic elements of seismic isolation; seismic isolation design principle; feasibility of seismic isolation; seismic-isolation configurations.

Activity: Perform any two of the following activities

1. Conduct a seismic analysis of a multi-storey building using the equivalent static method with commercial finite element software. Prepare and present an analysis report for submission.
2. Conduct a seismic analysis of a multi-storey building using the response spectrum method with commercial finite element software. Prepare and present an analysis report for submission.
3. Visit an earthquake-resistant designed structure and prepare a report detailing the design of typical flexural members, columns, footings, and exterior joints according to IS 13920.

Books & Other Resources:

1. Dynamics of Structures- Theory and Applications to Earthquake Engineering, Anil K. Chopra, Pearson, 3rd Edition, 2011.
2. Structural Dynamics- Theory and Computation, Mario Paz and William Leigh, updated with SAP 2000, 5th Edition, Kluwer Academic Publishers.
3. Dynamics of Structures, Clough and J. Penzien, Computers & Structures, Inc., University Ave, Berkeley, USA, 1995.
4. Earthquake Resistant Design of Structures, S. K. Duggal, Oxford Publications.
5. Earthquake Resistant Design of Structures, Pankaj Agarwal and Manish Shrikhande, Prentice Hall India Learning Private Limited.
6. IS 1893 (2016) Criteria for Earthquake Resistant design of buildings (Part I): General Provisions and Building – Code of Practice (Sixth Revision), Bureau of Indian Standards, New Delhi.
7. IS 13920: 2016 Reaffirmed in 2021, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision), Bureau of Indian Standards, New Delhi. India.

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MSE23202- Theory of Elasticity

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hrs/week	TH:4	Activity Marks: 20 Marks
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites: Basics of stress and strain, deflection of body under various load, boundary conditions, shear force and bending moment diagram

Course Objective: The objective of this course is to impart knowledge of theory of elasticity to analyze civil engineering problems with parameters such as geometry, material properties and boundary conditions.

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

CO1: Study the effect of forces on elastic materials in terms of stress and strain.

CO2: Analyze the stresses as per position on elastic body.

CO3: Analyze the strains as per position on elastic body.

CO4: Evaluate stress-strain relationship for elastic material.

CO5: Apply the rectangular coordinate system to solve two dimensional problem.

CO6: Apply the polar coordinate system to solve two dimensional problem.

Course Contents

UNIT-I- Concept of Stresses and Strains **06 Hours**

Types of elastic materials, body forces and stresses, stress components, components of strain, Modulus of elasticity.

UNIT-II State of Stress **06 Hours**

Stress at point, stress equilibrium equations, transformation of stresses, stress invariants, concept of plane stress, stress boundary condition, Airy's stress function.

UNIT-III State of Strain **06 Hours**

Strain at point, strain displacement relations, strain compatibility condition, strain invariants, deviatoric strain, and concept of plane strain.

UNIT-IV Linear Elasticity **06 Hours**

Generalized Hook's law, stress-strain relationship for isotropic materials, stress-strain relationship for anisotropic materials, problems.

UNIT-V Rectangular coordinate system for two dimensional problem **06 Hours**

Solution by polynomial, Saint-Venant's Principle, determination of displacements, bending of cantilever loaded at the end.

UNIT-V Polar coordinate system for two dimensional problem **06 Hours**

General equation in polar coordinates, stress distribution symmetrical about axis, strain components in polar coordinates. Applications of the general solution in polar coordinates.

Activity-

1. Power point presentation on application of state of stress for any one of the structural member or structure.(10 Marks)
2. Drawing Mohr's circle on quarter sheet to demonstrate for variable stress-strain conditions. (10 Marks)

Books & Other Resources:

Reference Books:

1: Timoshenko and Goodier, "Theory of Elasticity", McGraw-Hill Publications.
2: C. Wang, "Applied Elasticity", Dover Publications.
3: Enrico Volterra and J. H. Gaines, "Advanced Strength of Materials", Prentice Hall.
4: S. M. Akazimi, "Solid Mechanics", Tata McGraw-Hill Publications.
5.Sokolnikoff, I.S., Mathematical Theory of Elasticity, Tata Mc Graw Hill, India, 1974
6.Leipholz, H., Theory of Elasticity, Noordhoff International Publishing, Layden, 1974
7.Xu, Z., Applied Elasticity, Wiley Eastern Ltd, India, 1992.

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Program Elective-II

MSE23203-A- Bridge Engineering

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 4 hrs/week	TH:4	Activity Marks: 20 Marks
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites:
IRC provisions for bridges, loading standards, IS Codes, Different Loadings, Types of foundations

Course Objective:
To design concrete bridge components and provide cost-effective solutions for bridge construction.

Course Outcome:
On completion of the course, student will be able to–
CO1: Determine the economic span for bridges as per site condition and IS standards.
CO2: Analysis and design of deck slabs using different methods.
CO3: Design of T-beam deck slab and girders.
CO4: Analysis and design of rigid frame bridges.
CO5: Design of abutments and piers.
CO6: Design of bearings for RC bridges.

UNIT-I Introduction **06 Hours**

Classification of concrete bridges, components of bridge and related structures, economic spans. Factors affecting the selection of site, hydrological data, waterway, scour depth. IRC provisions, loading standards.

UNIT-II Analysis of Deck Slab **06 Hours**

Load distribution on deck slabs, distribution of loads to longitudinal girders, Little-Morrice-Rowe method, Courbon's method, Guy on Massenet method and Hendry Jaegar method, Design of slab and box culverts for highway loadings.

UNIT-III Design of Deck Slab & Girders **06 Hours**

Design of T-beam deck slab bridge: design of RC deck slab, design of post- tensioned longitudinal girder and cross girders.

UNIT-IV Design of Rigid Frame Bridges **06 Hours**

Analysis and design of rigid frame bridges

UNIT-V Design of Abutments and Piers **06 Hours**

Types of abutments, piers, loads acting on pier and abutments, design of abutments and piers

UNIT-VI Design of Bearings **06 Hours**

Functions of bearings, types, design of elastomeric bearings, design of PTFE-pot bearings

Activity-

1. Power point presentation on working of the bearings/ calculation of economic span of any one of the type of bridges as per site data.(10 Marks)
2. Preparation of model of any RC bridge to demonstrate the various components of bridge. (10 Marks)

Books & Other Resources:

Reference Books:

1: N. Rajagopalan, "Bridge Superstructure", Alpha Science International, Technology and Engineering 2006.

2: D.J. Victor, "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

3: N. Krishna Raju. "Design of Bridges", fourth edition Oxford and IBM Publishing Co, Bombay, 2009.

4: V.K. Raina, "Concrete Bridge Practice", Tata McGraw Hill Publishing Co., New Delhi 1991

5: F.W Taylor, S.E. Thomson and E. Smulski, "Reinforced Concrete Bridges", John Wiley & Sons, New York 1955.

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Program Elective-II

MSE23203-B- Design of Prestressed Concrete structures

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hrs/week	TH:4	Activity Marks: 20 Marks
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites: Behaviour of prestressed concrete, methods of prestressing, loss and stress calculation in prestressed members

Course Objective: To analyse the behaviour of different prestressed concrete element, enable to detail different prestressed concrete elements and composite sections

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

CO1: Analyze and design of pre tensioned flexural members.

CO2: Analyze and design of post tensioned flexural member.

CO3: Analyze and design of post tensioned slab.

CO4: Design composite sections.

CO5: Analyse and design of statically indeterminate prestressed members like continuous beam and frame.

CO6: Analyze and design of prestressed pipes and circular tanks.

Course Contents

UNIT-I Pre-tensioned Flexural members **[06 Hours]**

Design of Pre-tensioned Flexural members: Design of pole, sleepers, pipes, cylinders and lintels.

UNIT-II Post tensioned Flexural members **[06 Hours]**

Design of Post tensioned Flexural members: Design Tee, Iand box section girders

UNIT-III Post tensioned Prestressed Concrete Slabs **[06 Hours]**

Design of Post tensioned Prestressed Concrete Slabs: Introduction, Design of one way, two way and flat slabs.

UNIT-IV Composite Beams **[06 Hours]**

Composite Beams: Composite sections of Prestressed concrete beam and cast in-situ RC slab Analysis of stress, Differential shrinkage, Deflections, Flexural and Shear strength of composite sections, Design of composite sections.

UNIT-V Statically Indeterminate Structures **[06 Hours]**

Statically Indeterminate Structures: Analysis and Design of continuous beams and Frames including choice of cable profile, linear transformations, concordance of cable and shift calculations

UNIT-VI Prestressed Concrete Pipes and Tanks **[06 Hours]**

Prestressed Concrete Pipes and Tanks: Circular prestressing, types of Prestressed concrete pipes. Prestressed Concrete tanks: General features, Analysis and design of circular tanks.

Activity:

1. Visit to Prestressed Concrete pipes industry and prepare a report
2. Design and analyse Prestressed Concrete Slab using software.

Books & Other Resources:

Reference Books:

1: N. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill Publication Co.

2: B. C. Punmia, A. K. Jain and Arun K. Jain, "Reinforced Concrete Structures Vol. II", Laxmi Publications, New Delhi.

3: T. Y. Lin & N. H. Burns, "Design of Prestressed Concrete Structures", John Wiley.

4: E. G. Nawy, "Prestressed Concrete- A Fundamental Approach", Practice Hall International

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Program Elective-II

MSE23203-C- Mechanics of Modern Materials

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hrs/week	TH:4	Activity Marks: 20 Marks
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites: Types of conventional material, elastic properties of materials

Course Objective: To have an overview of Material Science and Engineering as a basis for understanding how structure/property/processing relationships are developed and used for different types of materials. Illustrates the role of materials in modern society of advances in new materials and processes to apply them for advanced manufacturing processing for various structural engineering applications.

Course Outcome: Course Outcome: On completion of the course, student will be able to– CO1: Explain classification and applications of modern materials.

CO2: Understand the engineering properties of modern materials

CO3: Determine the failure theories.

CO4: Identify the behaviour of Composite Laminates.

CO5: Analyze and design of Composite Structures.

CO6: Experimental analysis of various modern materials.

Course Contents

UNIT-I Introduction to Modern Materials **06 Hours**

Fiber-Reinforced Polymer Composite (FRPC) Materials: definition, historical development, applications. Fibers and Matrix: types and their properties, manufacturing process and methods for composites. Types and classification of composite materials, properties, advantages over conventional materials. Piezoelectric Materials: History, crystal structure, applications. Shape Memory Alloys (SMA), Functionally Graded Materials (FGM): definition and applications.

UNIT-II Engineering Properties of Modern Materials **06 Hours**

FRPC Composite Lamina: Micromechanics approach, methods. Longitudinal and transverse elastic properties of composite lamina, in- plane shear modulus for continuous fibres. Stress-strain relationship, compliance and stiffness matrices for generally anisotropic, especially orthotropic material, transversely isotropic material, orthotropic, isotropic materials, Plane stress condition for thin lamina, transformation of stress and elastic properties. Three dimensional transformations. Stiffness matrix for Functionally Graded Materials.

UNIT-III Strength of Composite Lamina **06 Hours**

Introduction. Failure theories, Maximum stress theory, Maximum strain theory, Energy based interaction theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu), Failure mode-based theory (Hasin-Rotem). Computation of lamina strength by Tsai-Wu theory for plane stress condition. Comparison of various failure theories.

Program Elective-II

MSE203-D- Ferrocrete Technology

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 3 hrs/week	TH:4	Activity Marks: 20 Marks
		In-sem-30 Marks
		End-sem-60 Marks

Course Prerequisites: Basic properties of concrete ingredients, Analysis methods for structural members

Course Objective: To have an overview of Ferrocrete material as structural smart material for innovative constructions and infrastructural developments.

Course Outcome: On completion of the course, students will be able to–

CO1: Comprehend different types of Ferrocement concrete, its typical properties and proportion of mortar

CO2: Recognize the mechanical properties and different construction method using ferrocement.

CO3: Design of structure based on form, shape, various structural forms and their behaviour.

CO4: Analyze the costs assicated with conventional and ferrocement structure.

CO5: Apply the concept of ferrocement to various water retaining structures.

CO6: Differentiate the ferrocement and precast froceement structures.

Course Contents

UNIT-I Introduction of concrete in structure **06 Hours**

Definition. Basic concept like bond increase. Comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement. Definition of ferrocement anf ferrocrete. Special types of ferrocement. Ferrocement as substitute for conventional building materials. Typical characteristics and their applications. Raw materials, skills, tools and plants.Ferrocement as material of construction. Forming a ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants

UNIT-II Ferro cementing Method **06 Hours**

Mechanical properties and typical features affecting design. Properties under static and dynamic loading. Shrinkage and creep. Testing of ferrocement. Experimenting the methods of constructing ferrocement structures. Standardizing method of construction. Planning the work. Fabricating skeleton, tying meshes and mortaring. Curing. Maintenance. Protective surface treatments. Damage to ferrocement structures

UNIT-III Design methods for various Structure **06 Hours**

Strength through shape. Design of structure based on form and shape. Forms in nature. Various structural forma and their behaviour. Typical strengths of different materials. Comparative study of various forms. Design of ferrocement structures. Design, analysis and optimization. Special design considerations for ferrocement. Typical features of ferrocement affecting design.

Conventional design methods like working stress, load factor, applied to ferrocement. Design based on equivalent area method for compression, tension and flexural members. Specific surface method and crack control method, Design of structures subjected to membrane stresses. Design of shaped structures in ferrocement like stiffened plates, arch faced walls, stiffened cavity walls and hollow floors and beams.

UNIT-IV Cost Analysis **06 Hours**

Cost analysis: Factors governing cost analysis. Special considerations for ferrocement structures. Cost comparison with conventional construction. Specifications for ferrocement structures. Quantity analysis of material and labour for ferrocement items. Cost and value of ferrocement construction. Ferrocement in building construction. Ferrocement in foundations, walls, floors roofs. Ferrocement single wall construction. Design and construction of houses with cavity walls, hollow floors and hollow beams. Staircases and other building accessories. Earthquake resisting structures. Special characteristics of ferrocement to resist shock loading. Design and construction of quake proof structures

UNIT-V Water and Soil retaining structure **06 Hours**

Hydraulic structures. Why ferrocement? Water retaining structures. Storage tanks of various types. Structures across streams. Ferrocement in layered form used for lining, water proofing and surface coating. Soil retaining structures. Types of retaining walls and their comparison with ferrocement arch faced wall. Design and method of fabrication and casting. ferrocement counter fort retaining wall. Ferrocement containers for storing granular materials.

UNIT-VI Precast ferrocement products **06 Hours**

Ferrocement large size special purpose structures. Space structures like shells, pyramids, domes corrugated catenaries. Precast ferrocement products: Why ferrocement for precasting? Methods of precasting. Design of precast elements. Ferrocement precast walling and flooring panels. Joints in precast ferrocement elements.

Books & Other Resources:

1: B. N. Divekar, "Ferrocrete Technology- A Construction Manual".

2: S. P. Shah and P. N. Balaguru "Concrete Technology and Design Vol. II".

3: Proceedings of International Symposiums on 'Ferrocement and thin reinforced composites. - Ferro 1 to Ferro 10. International Ferrocement Information Centre, A I T Bangkok, Thailand.

4: "Construction and Repairs of Ferrocement", ACI committee Report. No ACI549R- 88 and ACI 549.1R.88. Published by American Concrete Institute, Detroit, USA

5: B. R. Paul and R. P. Pama, "Ferrocement Authors", International Ferrocement Information Centre. A. I. T. Bangkok, Thailand.

6: A. E. Naaman, "Ferrocement and Laminated Cementitious Composite", Techno-press, Ann Arbor, Michigan, U S A. R7: "Ferrocement- Materials and applications", SP 61, A C I Detroit. U S A.

Activity:

1.Case study analysis

2.Research paper analysis

NOTE- Individually analyze the case study and research paper related to Ferro cement/ ferrocrete technology.

MSE22204-Dissertation Stage I

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 8 hrs./week	PR:4	TW-100 Marks
		OR-100 Marks

Dissertation Stage-I is the integral part of the dissertation work. The dissertation work should be based on the knowledge acquired by the students during the coursework and should contribute to the needs of the society. The dissertation work aims to provide an opportunity of designing and building complete system or subsystems in an area where the students like to acquire specialized skills. The student shall submit the report (printed on both sides) of dissertation work completed partly in standard format approved by the department as per the following.

1. Introduction including aim and objective of the dissertation topic
2. Review of literature
3. Problem statement and methodology
4. Theoretical contents associated with the dissertation topic
5. Data collection from field or organization / experimental set-up developed if any / part analysis
6. Limitations of study / difficulties encountered if any
7. Progress achieved
8. Future plan of action
9. References

The candidate shall deliver a presentation as a part of the progress report of Dissertation Stage-I in front of panel of examine.

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MHS23201-Constitution of India

Teaching Scheme	Credit Scheme	Examination Scheme
Lecture: 2 Hrs/week	TH:2	Activity Marks = 10
		Oral -25 Marks

Prerequisite:

1. History of India.
2. Social science of school

Course Objectives:

1. To know about Indian constitution
2. To know about central and state government functionalities in India
3. To know about election commission

Course Outcomes:

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

1. Understand history of Making of the Indian Constitution
2. Learn features of Indian constitution
3. Understand and abide the rules of the Indian constitution
4. Understand the functioning of Union Government
5. Understand the functioning of Local Government in Indian federal system.
6. To learn composition and activities of election commission.

Unit-I: History of Making of the Indian Constitution [4 Hrs]

History -Drafting Committee, (Composition & Working)

Unit-II: Philosophy of the Indian Constitution [4 Hrs]

Preamble Salient, Features

Unit-III: Contours of Constitutional Rights & Duties [4 Hrs]

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.

Unit-IV: Organs of Governance [4 Hrs]

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

Unit-V: Local Administration [4 Hrs]

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

Unit-VI: Election Commission **[4 Hrs]**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.

Activity:

1. Presentation on one given topic from Syllabus and submit report on it.
2. Individual visit to nearby court, law college and have discussion on topics from syllabus with field experts, advocates and prepare a report on it photos and knowledge gained.
3. Theory assignments submission on each Unit.
4. Marks obtained in Quiz conducted at the end of semester

Oral: Oral will be in form of question answers based on topics from syllabus and its applications.

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MRA23205- Industrial Management

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 2 hrs/week	TH:2	Activity Marks = 10 Marks
		Oral=25 Marks

Course Objectives:

- Engineering disciplines are expected to work during most of their career at middle level. They are also expected to deal with workforce and management problems.
- In the present era of competition, optimum utilization of the resources with achieving higher productivity is essential for any industry to survive. Quality and cost controls are also other important factors which contribute to the day to day supervision issues.

Course Outcome-On completion of the course students will be able

Co1-To interpret and acquire major management skills, familiarize with different leadership styles

CO2-To acquire the knowledge of different types of plant layout, Production modes and PPC functions

CO3-To understand the need of Total Quality management and appreciate the usage of TQM tools in quality control

CO4-To acquire the knowledge of different types of Plant maintenance and measures and procedure observed in industry towards safety

Course Contents

Unit I: Basics of Management **06hrs**

Management - Definition – Administration- Definition – Henry-Fayol's principles of management- Business Organization-Types- Proprietorship-Partnership- Joint stock-Cooperative Society-Advantages and disadvantages -Functions of Management –

Organization-Definition- types of organization –Line-Functional-Line &staff-advantages and disadvantages- Leadership -Types –Quality of good leader

Motivation - Maslow's Theory of Motivation -Hierarchy of needs- Communication - Process of Communication – Barriers for effective communication.

Unit II: Production Management 06hrs

Concept of project work - Project planning -Market survey- Project capacity-selection of site for project Plant layout-Types of Plant layout

Product design-Stages in product design drawing-Specifications-Material requirement-operation-Planning-Production-definition-Job, Batch & Mass production with their advantages and disadvantages-

Productivity-definition factors to improve productivity- Production planning and Control (PPC)-definition-Functions of PPC- planning, routing, scheduling. dispatching and Inspection-

Unit III: Total quality management 06 Hrs

Quality–Concept-Quality control- Definition - Factors affecting quality- Advantages of quality control –Inspection-Different types of inspection

Total Quality Management-Meaning- Principles of total quality management-PDCA cycles Quality Circles-definition-Function.

TQM Tools- Flow charts, Control charts, Histograms, Pareto charts, Cause and effect diagram-5-S- Kaizen, and Six-sigma

Quality Certification Systems- ISO 9000 series quality standards

Unit IV: Plant maintenance and industrial safety 06 Hrs

Plant maintenance-Definition -Types of maintenance-Preventive maintenance- Break down maintenance-Advantages and disadvantages-

Total Productive Maintenance-Meaning benefits of TPM -Tools of TPM- planned maintenance and predictive maintenance.

Industrial safety –Meaning - Accident- causes for accident- Direct and indirect losses due to an accident-Personal protective devices for preventions of accidents-

Safety department- role of safety officer – safety supervisor -safety committee – Fire prevention and Protection- Fire triangle-principles of fire extinguishing- various classes of fire- A, B,C, D types of fire extinguishers

Text books and references

1. Industrial Organization and Engineering Economics T.R.Banga & S C Sharma Khanna.Publishers
2. Industrial management and organizational behavior K.K.Ahuja
3. Industrial management and engineering economics O.P.khanna Khanna publishers
4. Production and operations management -Dr .K.Aswathappa and Dr.Sreedhar Bhatt Himalaya publishers
5. Safety Management in Industry Krishnan.N V Jaico Publishing House, Bombay, 1997
6. Total Quality Management S Raja Ram, Shivashankar

Kale.

Mrs. P.D.Kale
PG Coordinator

for

Department of Mechanical Engineering
VPKBIET Baramati-413133

Jagdale U.T.

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MSE22311- Seminar

Teaching Scheme	Credit Scheme	Examination Scheme
Practical : 4 hrs/week	PR: 2	TW-50 Marks
		OR-50 Marks

Conduction guidelines:

1. This is a 2-credit course aimed at teaching 2nd year MTech students to make research presentations.
2. Each student has to choose a paper / topic related to Structural Engineering. It need not be related to the M. Tech project. Some suggestions are
    a. A detailed literature review of a specific research problem. This can include: background related to the problem, categorization of approaches, specific approaches, etc.
    b. One selected journal/TOP-tier conference paper published by others.
3. Each student is allotted EXACTLY 15 minutes for presentation; and 5 minutes for Q&A. Marks will be given based on content, organization, clarity of delivery and ability to answer questions.
4. A report must be submitted based on the content of the seminar duly signed by the guide and Head of Department.

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MSE23212-Industry Internship/ In-house Research Project

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 20 hrs/week	PR:10	TW-150 Marks
		OR-100 Marks

Conduction guidelines: Industry or research internship should include partial/ complete project implementation. Student should be allocated to the research guide in first semester itself and same guide should be continued for the: Industry Internship-/ In house Research Project. Otherwise the preferences/ choices of the domain should be taken from the students. The guide needs to be allocated based on the preference/ choices. The research project should be assigned to students. In case of Industry Internship, the assigned guide from college has to monitor and evaluate the progress of the student. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation. The continuous assessment of the progress needs to be documented unambiguously.

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MSE23213-Dissertation Stage II

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 16 hrs/week	PR:08	TW-100 Marks
		OR-100 Marks

Guidelines:

In Dissertation Work Stage–II, the student shall consolidate and complete the remaining part of the dissertation which will consist of Selection of Technology, Installations, implementations, testing, results, measuring performance, discussions using data tables per parameter considered for the improvement with existing/ known algorithms/ systems, comparative analysis, validation of results and conclusions. The student shall prepare the duly certified final report of Dissertation in standard format for satisfactory completion of the work by the concerned guide and head of the Department/ Institute. The students are expected to validate their study undertaken by publishing it at standard platforms. The investigations and findings need to be validated appropriately at standard platforms – conference and/or scopus indexed journal. The student has to exhibit continuous progress through regular reporting and presentations and proper documentation of the frequency of the activities in the sole discretion of the PG coordination. The continuous assessment of the progress needs to be documented unambiguously.

In Dissertation Work Stage II, the student shall complete the dissertation. The student shall prepare the final report of dissertation work in standard format duly certified for satisfactory completion of the work by the concerned guide and Head of the Department/Institute. The report shall consist of the following as applicable:

1. Introduction including aim and objective of the dissertation topic
2. Review of literature
3. Problem statement
4. Theoretical contents associated with the dissertation topic
5. Methodology adopted
6. Data collection from field or organization / experimental set up preparation if any/analysis
7. Results and discussion

8. Validation of results if applicable

9. Conclusions and future scope of work

10. References

The final dissertation shall be submitted in hard bound copy as well as a soft copy on CD. The Term Work of Dissertation of semester IV shall be assessed jointly by the pair of internal and external examiners, along with oral examination of the same. The candidate shall deliver a presentation on report of Dissertation Work Stage–II in front of external and internal examiner.

It is recommended that at least one paper on the dissertation topic to be presented in a conference or published in a referred journal.

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