SARDAR PATEL UNIVERSITY, BALAGHAT (MP)

School of Engineering and Technology

Syllabus

Course: M. Tech. Branch: Structural Engineering Semester: III[rd]

Academic Session: 2024-25 w.e.f - Date-02-09-2024

MSE3011 Advanced FEM and Programming

Course Contents

Course Objectives:

1. Understand the mathematical principles underlying the finite element method.
2. Analyze different types of elements (1D, 2D, 3D) and their properties.
3. Explore numerical integration techniques and their applications in FEM.
4. Develop skills in formulating and solving boundary value problems.

UNIT -I

Iso-parametric formulation for plate and shell elements; various types of elements ; Hybridelements; .

UNIT -II

FEM in dynamic problems, consistent mass matrix; Vibration of bars, beams and plateelements.

UNIT -III

FEM in buckling problems, geometric matrix, buckling of struts and plate elements.

UNIT -IV

Structural modeling by FEM for structures such as shear walls, core walls, bridges andcooling towers.

UNIT -V

Computational aspects; interpretation of results; comparison with other methods.

Course Outcome :

CO1- Develop finite element formulations of 1 degree of freedom problems and solve them.

CO2 -Understand any Finite Element software to perform stress, thermal and modal analysis.

CO3 -Compute the stiffness matrices of different elements and system.

CO4 -Interpret displacements, strains and stress resultants.

CO5- Computational aspects; interpretation of results; comparison with other methods.

Reference Books:

1. Weaver, Johnson, Finite element and structural analysis
2. HC Martin, Matrix structural analysis
3. CF Abel, CS Desai, Finite element methods

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MSE3012 Advanced FoundationEngineering

Course Contents

Course Objectives:

1. Ability to evaluate Bearing capacity factors
2. Ability to evaluate the Pile group bearing capacity and settlement
3. Ability to understand Well foundation
4. Ability to understand dynamic loads on soil foundation system

UNIT -I

Deep Open Cuts: Introduction, Types of Coffer Dams, Design data for cellular cofferdam,Stability analysis of cofferdam, interlock stresses. Soil Exploration: Introduction, Methods of exploration, Direct Methods and techniques of exploration, Methods of boring types of samples, Disturbance of soil sample, Soil samplers and sampling techniques, Ground water observations, Boring records, Spacing and depth of bore holes, Indirect methods of soil exploration, Penetration tests, Geophysical methods, Dynamics methods, Sequence of exploration programs

UNIT -II

Shallow Foundations: Introduction, General Requirements, Depth of foundation, Bearing capacity, Eccentric Inclined loads, Bearing capacity of stratified soils, Settlement of footings, Settlement of footings from constitutive laws, Settlement and tilt of eccentrically loaded footings, Allowable settlement, Plate bearing test, Standard penetration test Effect of water table, shallow foundation classification, Modulus of sub-grade reaction, Beams on elastic foundation, Raft foundation.

UNIT -III

Pile Foundation: Introduction, Uses of piles, Types of piles, pile drivers, Bearing capacity of piles, Static analysis, Pile load test, Dynamic methods, Other methods, 24 Negative skin friction, Pile group, Ultimate bearing capacity of pile groups, Settlement of pile group, Influence of pile cap. Laterally loaded piles, Ultimate resistance, Elastic methods, Pile groups under lateral load, batter pile under lateral load, Batter pile groups under inclined loads, pile under dynamic loads.

UNIT -IV

Coffer Dams: Introduction, types of Coffer Dams, Design data for cellular cofferdam, Stability analysis of cofferdam, Interlock stresses.

UNIT -V

Machine Foundations : Introduction, Criteria for satisfactory action of a machine foundation, Definitions, Degrees of freedom of a block foundation, Analysis of block foundation, Theory of linear weightless spring, Equivalent soil springs, Vertical vibration, Rocking vibration, Vibration in shear, Simultaneous rocking sliding and vertical vibrations for a foundation, Indian standard on design and construction of foundations for reciprocating machines, Foundations for impact type machines, Indian Standard on design and construction of foundations for impact type machines, Analysis of block foundation based on elastic half space theory.

Course Outcome :

CO1 -Select a suitable foundation from the myriad choices available for a tricky structure on difficult ground.
CO2 -Design safe, cost-effective, durable and buildable Foundation.
CO3- Create, communicate and execute designed foundation at site.
CO4- Analyze and design real time complex foundation problem and give its solution.
CO5 -Analysis of block foundation, Theory of linear weightless spring, Equivalent soil springs, Vertical vibration.

References Books:

1. Bowles, Foundation: Analysis and Design, McGraw Hill Book CO. Inc.

2. Peck , R.B. , W.E. Hanson and T.H. Thornburn, Foundation Engineering, Wiley , NewYork

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Course: M. Tech. Branch: Structural Engineering Semester: III[rd]

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MSE3013 Design of Steel Structures

Course Contents

Course Objective:

1. To produce a coherent development to the scholars for the courses in sector of coming up with of the Steel Structures.
2. To present the foundations of the many basic Engineering ideas connected style of Steel Structures.
3. To present associate degree expertise within the implementation of engineering ideas that square measure applied in field of Steel Structures.
4. To involve the appliance of scientific and technological principles of designing, analysis, design of buildings.

UNIT -I

Introduction to Limit States: Introduction, Standardization, allowable stress design, limit statedesign, partial safety factors, concept of section, classification; Plastic, compact semi- compact & slender.

UNIT -II

Columns: Basic concepts, strength curve for an ideal strut, strength of column members inpractice effect of eccentricity of applied loading. Effect of residual stresses, concept of effective lengths, no sway columns, torsional and torsion flexural buckling of columns, Robertson's design curve, modification to Robertson approach, design of columns using Robertson approach.

UNIT -III

Laterally Restrained Beams: Flexural & shear behavior, web buckling & web crippling, effect of local buckling in laterally restrained plastic' or 'compact' beams, combined bending & shear, unsymmetrical bending. Unrestrained Beams: Similarity of column buckling of beams, lateral torsional buckling of symmetric section, factors affecting lateral stability, buckling of real beams , design of cantilever beams, continuous beams.

UNIT -IV

Beams Columns: Short & long beam columns, effects of slenderness ratio and axial force on modes of failure, beam column under biaxial bending, strength of beam columns, local section failure & overall member failure.

UNIT -V

Beams Subjected to Torsion and Bending: Introduction, pure torsion and warping, combined bending torsion, capacity check, buckling check, design methods for lateral torsional buckling.

Course Outcome :

CO1- Choose appropriate Light Guage Steel Sections for flexural and compression members
CO2 -Design a plate girder bridge
CO3 -Design of composite slabs
CO4- Evaluate the shape factor and collapse loads
CO5- Design of Gantry Girder

Reference Books:

1. Morsis L.J. Plum, D.R., Structural Steel Work Design
2. Sinha D.A. , Design of Steel Structures
3. Yu, W.W. , Cold Formed Steel Structures Design

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Course: M. Tech. Branch: Structural Engineering Semester: III[rd]

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MSE3014 Design of Earthquake Resistant Structures

Course Contents

Course Objectives:

1. To provide a coherent development to the students for the courses in sector of earthquake engineering.
2. To present the foundations of many basic engineering concepts related earthquake Engineering.
3. To give an experience in the implementation of engineering concepts which are applied in field of earthquake engineering.
4. To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

UNIT -I

Seismic Strengthening of Existing Buildings: Cases histories-Learning from earthquakes, seismic strengthening procedures.

UNIT -II

Torsion & Rigidity: Rigid Diaphragms, Torsional moment, Center of mass and center of rigidity torsion effects. Lateral Analysis of Building Systems: Lateral load distribution with rigid floor diaphragms, moment resisting frames, shear walls, lateral stiffness of shear walls,shear wall-frame combination, examples.

UNIT -III

Concept of Earthquake Resistant Design: Objectives of seismic design , Ductility, Hysteric response & energy dissipation, response modifications factor, design spectrum, capacity design, classification of structural system, IS code provisions for seismic design of structures,multi-storied buildings, design criteria, P-A effects, storey drift, design examples ductile detailing of RCC structures.

UNIT -IV

Seismic Design of Special Structures: Elevated liquid storage tanks, Hydrodynamic pressure in tanks, stack like structures, IS-1893 code provisions for bridges; Superstructures, sub- structures, submersible bridges, dams; Hydrodynamic effect due to reservoir, concrete gravitydams.

UNIT -V

Engineering Seismology: Basic terms, seismic waves, earthquake magnitude and intensity, ground motion, dynamic response of structures, normalized response spectra, seismic coefficients and seismic zone coefficients.

Course Outcome : After completion of the course student will be able for

CO1- Summarize the causes of earthquake and its consequences.

CO2- Distinguish between response spectra and design spectra.

CO3- Apply the concepts of Earthquake Resistant Design to real life structures.

CO4 -Classify between Response History and response spectra analysis

CO5 -Design of Water towers & Stack like structures for Seismic excitation

Reference Books:

1. Chopra A.K., Dynamics of Structures', Theory & Applications to EqrthquakeEngineering , Prentice Hall India, New Delhi-1995
2. Clough & Penzien, Dynamics of Structures , McGraw Hill Book CO. Inc.
3. Paz M, Structural Dynamics, , Van Nostrand Reinhold, New York
4. Paz, M, International Handbook of Earthquake Engineering, Chapman & Hall, NewYork.
5. IS-1893-1984, Indian Standard Criteria for Earthquake Resistant Design of Structures,B.I.S., New Delhi.
6. IS-4326-1993, Indian Standard Code of Practice for Earthquake Resistant Design andConstruction of Buildings, B.I.S., New Delhi.

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MSE3015 Rock Mechanics and Foundation Engineering

Course Contents

Course Objectives:

1. Develop skills in geological site investigation techniques, including sampling and testing methods for rock and soil.
2. Analyze and evaluate the physical and mechanical properties of rock materials and their implications for engineering applications.
3. Grasp the basic principles of rock mechanics, including stress, strain, and the mechanical behavior of rocks.

UNIT -I

Introduction to rock mechanics, geology, rock mechanics and foundation.

UNIT -II

Engineering properties of intact rock, mechanical behavior of joints in rock marks.

UNIT -III

FEM approach, seismic considerations, measurement of stress and stress in rocks, rock fracturing in compression, stress distribution in rocks and soils.

UNIT -IV

Selection of suitable foundation, spread foundation, pile caisson foundation, machine foundations.

Course Outcome:

CO1- To understand Introduction to rock mechanics, geology, rock mechanics and foundation
CO2- To understand mechanical behavior of joints in rock marks, FEM approach, seismic considerations
CO3- Analysis stress distribution in rocks and soils, selection of suitable foundation,
CO4 –Classify Pile caisson foundation, machine foundations.

Reference Books:

1. Billings, Structural Geology, PHI

2. E Hock, J Bray, Rock slope engineering

3. T Schebotarioti, Soil Mechanics, TMH

4. W Dunham, Foundations of structure clearance, TMH

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Course: M. Tech. Branch: Structural Engineering Semester: III[rd]

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MSE3021 Stability Theory in Structural Engineering

Course Contents

Course Objectives:

1. Study the buckling phenomena in structural elements, including columns and beams, and understand critical load calculations.
2. Understand the basic concepts of stability, including equilibrium, load paths, and types of structural failures.
3. Learn various analytical methods for assessing structural stability, including linear and nonlinear analysis approaches.
4. Explore the effects of dynamic loads, such as seismic and wind forces, on structural stability.

UNIT -I

Concepts of Stability, Euler Buckling Load, Critical Load of Laced, Battened andTapped columns, Inelastic Buckling of column.

UNIT -II

Torsional Buckling, Torsional Flexural Buckling.

UNIT -III

Lateral Instability of Beams, Beam Columns.

UNIT -IV

Local Buckling and post buckling behaviour of plates.

UNIT -V

Application of Energy method and matrix method in stability problems.

Course Outcome :

CO1- Determine stability of columns and frames

CO2- Determine stability of beams and plates

CO3- Use stability criteria for analysing and designing discrete and continuous systems.

CO4 -To be well versed in the lateral buckling, torsional buckling, Flexural torsional buckling of various beams and non- circular sections.

CO5- Examine the behavior of beam columns and frames with and without side sway using classical and stiffness methods

Reference Books:

1. Theory of Elastic Stability by Timoshenko, TMH Pub.

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MSE3022 Design of Tall Structures

Course Contents

Course Objectives:

1. Explain the fundamental principles of structural engineering as they apply to tall buildings, including load distribution, lateral stability, and material behavior.
2. Apply various analytical methods to evaluate the structural performance of tall buildings under different loading conditions, including wind, seismic, and live loads.
3. Evaluate strategies for sustainable design in tall buildings, including energy efficiency, material conservation, and environmental impact.
4. Assess the properties of different materials (e.g., steel, concrete, composites) used in tall building construction and their implications for design.

UNIT -I

Behavior of tall structures under static and dynamic loads, model analysis.

UNIT -II

Characteristics of Wind and Earthquake Forces. Gust Factor and Karman Vortices. Approximate and Regorlons Methods of analysis for wind and Earthquake Forces.

UNIT -III

Shear walls, Frame Structures, Coupled shear walls, Tabular Structures, Ductility andreinforcement details at joint.

UNIT -IV

Criteria for design of Chimneys, T.V. Towers and other Tall Structure.

UNIT -V

Modeling of tall structures, case studies.

Course Outcome :

CO1- Determine the wind load on structures based on relevant standards
CO2 -Understanding the behavior of Rigid-Frame Structures and Shear Wall Structures
CO3- Infer the various loads acting on towers and their effect on the design of towers
CO4- Understanding the behavior of Tubular Structures
CO5- Dynamic analysis on Tall structures

Reference Books:

1. Coull, Smith, Design of tall buildings
2. Taranath, Design of tall buildings

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MSE3023 Design of Offshore Structures

Course Contents

Course Objectives:

1. Gain a comprehensive understanding of the fundamental principles of structural engineering as they apply to offshore environments.
2. Familiarize students with relevant design standards, codes, and regulations governing offshore structures, including those from organizations like ISO and API.
3. Learn to select appropriate materials for offshore structures, considering factors such as corrosion, fatigue, and environmental impact.
4. Develop skills in various structural analysis techniques specifically tailored for offshore applications, including static and dynamic analysis.

UNIT -I

Loads and structural forms of different types of offshore structures; Elements of single d.o.f. system subjected to free and forced vibration.

UNIT -II

Analysis for transient and steady state force; Equivalent damping for nonlinear systems; Dynamics of multi d.o.f. systems; Eigen values and vectors; Iterative andtransformation methods.

UNIT -III

Mode superposition. Fourier series and spectral method for response of single d.o.f.systems; Vibrations of bars, beams and cones with reference to soil as half space.

UNIT -IV

Behavior of concrete gravity platform as a rigid body on soil as a continuum; shortand long term statistics of wind;

UNIT -V

Static wind load; Effect of size, shape and frequency; Aerodynamic admittance function and gust factor, spectral response due to wind for various types of structures; Wave loads by Morison's equation; Static and dynamic analysis of fixedstructures; Use of approximate methods.

Course Outcome :

CO1- Perform concept development of offshore structure
CO2- Find the wave force on vertical cylinder
CO3 -Perform static and dynamic analysis of fixed offshore structure
CO4 -Understand the Wave Theories and Forces On Offshore Structures
CO5 -Understand the Offshore Soil and Structure Modeling

Reference Books:

1. Brebbia C.A. Walker, Dynamic Analysis of Offshore Str., Newnes Butterworth
2.Sarpakaya T and Isaacson M., Mechanics of wave forces on offshore structures, Van Nostrand Reinhold New York,
3.Hallam M.G. Heaf N.J. and Wootton, L.R., Dynamics of Marine Structures, CIRIAPublications Underwater Engg., Group , London
4.Graff W.J., Introduction to offshore Structures, Gulf Publishing Co., Houston, Taxas
5.Clough R.W. and Penzine J., Dynamic of Structures - II Ed., McGraw Hill Book CO.
6.Simiu E. and Scanlan R.H., Wind Effects on Structures, Wiley, New York 1978
7.Codes of Practice (latest versions) , Such as API RP-2A ,Bureau Veritas etc.

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MSE3024 Reliability Based Civil Engineering Design

Course Contents

Course objectives:

1. To study diverse misery and damages to concrete and masonry systems.
2. To recognize the significance of upkeep of systems.
3. To have a look at the diverse kinds and houses of restore substances.
4. To assess the harm to systems the use of diverse tests.
5. To study the significance and techniques of substrate preparation.
6. To study diverse restore strategies of broken systems, corroded systems.

UNIT -I

Probability Theory : Mutually exclusice events, set theory, sample points and sample spece, laws of probability, toal probability theorem, Bayes□ rule, random variablesdiscreate and continuous, jointly distributed discrete variables, marginal distribution, conditional distribution, jointly distributed continuous variables functions of random variables, moments and expectations, common probability distribution normal Iognormal, Gamma and Beta distributions, external distributions.

UNIT -II

Resistance Distribution and Parameters: Statics of properties of concrete and steel, statics of strength of bricks and mortal, Characterization of variables, allowable stresses based on specified reliability. Probabilistic Analysis of loads: Load as a stochastic process, dead load, statistical analysis of live loads-maximum sustained load intensity model, maximum total load model, wind load-probability model for wind load.

UNIT -III

Structural Reliability : General expression for reliability , expression for probability of failure: reliability when strength (S) and load (L) follow normal distribution, lognormal distribution, exponential distribution, extreme value distributions, factor of safety corresponding to a given reliability. Monte Carlo Study of Reliability: Monte Carlo Method-Inverse transformation technique, Application to columns beams and frames. Level 2 Reliability Method: Basic variables and failure surface, first order second moment methods-Hasofer and lind□s method, Non normal distributions; determinationof reliability index of structural elements.

UNIT -IV

Reliability Based Design: Determination of partial safety checking formats, development of reliability based criteria, optimal safety factors, calibration of IS 456and IS 800.

UNIT -V

Reliability of Structural Systems: System reliability, modeling of structural systems, bounds on system reliability, automatic generation of a mechanism, generation of dominant mechanisms , reliability analysis of R.C.C. and Steel Frames.

Course Outcome :

CO1- Recognize the mechanisms of degradation of concrete structures and to design durable concrete structures.

CO2 - Design and suggest repair strategies for deteriorated concrete structures including repairing with composites

CO3 - Assessment of the serviceability and residual life span of concrete structures by Visual inspection and in situ tests

CO4- Evaluation of causes and mechanism of damage

C05 - Evaluation of actual capacity of the concrete structure Maintenance strategies.

Reference Books:

1. Ranganathan, R. Reliability Analysis and Design of Structures, TMH
2. Rao. S.S. Reliability Based Design , McGraw Hill Book CO. Inc.
3. Ghosh , D.I., A Primer of Reliability Theory, john Wiley , New York
4. Lewis, E.E., Introduction to Reliability Engineering , John Wiley New Y