

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQN-501

Course Title: Dynamics of Soils and Structures

L-T-P: 3-0-2

Credits:04

Subject Area: PCC

Course Outlines:

Vibrations and the nature of time-dependent phenomena, mathematical models of physical systems; energy storage and dissipation mechanisms; idealization of soils and structures; damping; Dynamics of Single Degree of Freedom Systems; Numerical methods for solution of linear and non-linear equations of motion; Dynamics of Multi-Degree of Freedom Systems: Lagrange's equations; equations of motion for MDOF systems; Dynamics of Continuous Systems.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Department of Earthquake Engineering

Subject Code: EQX-XXX

Course Title: Finite Element Method

L-T-P: 3-0-2

Credits: 04

Subject Area: PCC

Course Outlines:

Method of weighted residuals; Variational principles and approximate solutions; Convergence of approximate solutions; Rules of domain discretization; discretization errors. Continuity requirement; Truss/rod/shaft, beam bending; Modeling of framed structures; Skewed boundary conditions; plane stress, plane strain and axi-symmetric idealizations; Triangular and rectangular elements; Interpolation functions; Evaluation of domain and surface integrals; Tetrahedral and brick elements; Numerical integration; Full reduced and selective integration; Finite elements for plates and shells; Semi-analytical procedure for axi-symmetric shells. Consistent mass matrix; lumping procedures.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Department of Earthquake Engineering

Subject Code: EQX-XXX

Course Title: Geotechnical Earthquake Engineering

L-T-P: 3-0-2

Credits:04

Subject Area: PCC

Course Outlines:

Seismic hazards and lessons learnt from past earthquakes; Wave Propagation; Seismic response of soil at low and high strains using field and laboratory tests; Stress-strain behavior of cyclically loaded soils; Ground Response Analysis; Liquefaction; Earth Pressure; Seismic design of retaining wall; Seismic Slope Stability: Types of earthquake induced landslides; Evaluation of seismic slope stability, yield acceleration, displacement analysis; Ground Improvement Techniques: Densification, reinforcement, and grouting and mixing, drainage.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQX-XXX

Course Title: Earthquake Resistant Design of Foundations

L-T-P: 2-1-0

Credits:03

Subject Area: PCC

Course Outlines:

Design Seismic Data; Seismic analysis and design of shallow Foundations; Seismic analysis and design of pile Foundations; Laterally loaded piles, elastic analysis; Reese and Matlock approach, fixity of pile heads, dimensionless factors; Well Foundations & Caissons: Types of wells, casting, floating and sinking of caissons; Well sinking scour depth, depth & bearing capacity of wells; Pseudo-static analysis with earthquake induced loads, displacement dependent earth pressures for wells; Lateral load resistance of well foundation; IRC, IS and Indian Railway Codes, their limitations.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQX-XXX

Course Title: Dynamic Soil Structure Interaction

L-T-P: 3-1-0

Credits:04

Subject Area: PEC

Course Outlines:

Objectives and practical significance and importance of soil-structure-interaction (SSI); Fixed base structure, structures on soft ground; Modeling of unbounded media. Direct and substructure methods of analysis; Continuous models, discrete models (lumped mass) and finite element models; Dispersion and attenuation of waves; Half-space, single layer on half-space; Material nonlinearity of soil, geometrical nonlinearity; Nonlinear structure with linear soil considering both soil and structure nonlinearity. Engineering Applications of Dynamic Soil Structure Interaction.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQX-XXX

Course Title: Ground Improvement Techniques

L-T-P: 3-1-0

Credits:04

Subject Area: PEC

Course Outlines:

Classifications of ground improvement techniques; Compaction techniques for surface soil improvement; In-situ Densification Techniques; Geosynthetics; Soil nailing; Analysis and design of steep open cuts. Reinforced Earth Walls; Drainage Methods; Precompression; Grouting and Injection: types of grouts, desirable characteristics of grouts, injection methods, Aspects of grouting; Grouting procedure; Applications.

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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQX-XXX

Course Title: Machine Foundation

L-T-P: 3-1-0

Credits:04

Subject Area: PEC

Course Outlines:

Various types of machine foundations; Estimation of damping and plastic coefficients, Introduction of relevant IS codes; Design Sub-grade Parameters; Foundations under Reciprocating Machine; Hammer Foundations; Framed Foundations; Isolation and Screening; Methods of decreasing vibrations on existing foundations; Isolation of vibrations; Screening of vibrations; Structural Design: General principles of design; Construction aspects; Case histories of failures of machine foundations.

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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQX-XXX

Course Title: Seismic Slope Stability: Earth Dams & Retaining Walls

L-T-P: 3-1-0

Credits:04

Subject Area: PEC

Course Outlines:

Characteristics of embankment dams; Site selection for an embankment dam; Assessment of Seepage Pressures; Stability Analysis of Earth Dams; FEM for Earth Dams; Modeling aspects; Earth Pressures Under Static and Dynamic Conditions; Consideration of movement of structures in static/dynamic pressures: Richards-Elms method, permanent seismic displacements; Design of Retaining Wall; modes of failure of different type of retaining walls, Earth pressures for gravity/counter-fort walls; Structural design of wall and its foundation; Stability of wall-soil system; Slip circle analysis.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQN-

Course Title: Constitutive Modeling in Soil Dynamics

L-T-P: 3-1-0

Credits:04

Subject Area: PEC

Course Outlines:

Stress-Strain laws of soils; Basic concepts of plasticity, yield function, flow rules-dilatancy, strain hardening and softening laws; Mohr-Coulomb and Tresca Models; Critical State Models; Bounding Surface Models; Basic Formulation of Soil in Finite Element Analysis; Two Phase Formulation, saturated soil; Finite element discretization of saturated soil; Transient response of saturated soil, consolidation, liquefaction.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQX-XXX

Course Title: Offshore Geotechnical Engineering

L-T-P: 3-1-0

Credits:04

Subject Area: PEC

Course Outlines:

Importance and necessity of offshore foundations, different modes of failure, load spectrum, a priori information from offshore geophysical investigation, scour, recent advancement in analytical solutions, serviceability assessment, design methods, nonlinear p-y analysis, API design method, PISA design method, ISO design method, mooring systems, design of gravity anchor, design of drag anchor, design of suction caissons, jack-up spudcan, performance of spudcan under dynamic operational condition, design of pipeline and risers, FE modeling of a typical monopile foundation, implications of site-specific factors on the performance of foundation.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT: Departments of Earthquake Engineering

Subject Code: EQN-XXX

Course Title: Numerical Methods for Dynamic Systems

L-T-P: 3-1-0

Credits: 04

Subject Area: PEC

Course Outlines:

Elementary concepts of vector spaces, subspaces; Column and row space of a matrix; orthonormal bases, vector and matrix norms, errors in floating point arithmetic. Formulation of stiffness matrix for prismatic, non-prismatic frame elements, global stiffness matrix, response analysis of frame structure using stiffness method. solution of large system of equations for dynamic problems, Implementation details for band and/or skyline solvers, vector processing and parallel processing. techniques in the eigen solution of large problems. Interpolation and extrapolation, numerical differentiation and quadrature methods. Response by the Integration of ODEs with emphasis on accuracy and stability, integration of stiff ODE, concepts of A-stability and stiff-stability.