Marwadi University

Master of Technology

Geotechnical Engineering

Finite Element methods in Geotechnical Engineering
01GT0305 (PEC)

Objective of the Course: Objectives of introducing this subject at first year level in Masters of civil engineering are:

1. To enable student with fundamentals of Finite element method
2. To impart the knowledge and skill of analyzing physical problems with FE software
3. To Understand the basic functions of FE based software and its applications in Geotechnical engineering

Credits Earned: 3

Students learning outcomes:

After the successful completion of the course student will be able to..

1. Select the appropriate element and mesh in FE analysis for given problem
2. Derive the shape functions and stiffness matrix for various elements.
3. Estimate the stresses, strain, seepage, stability and deformations of geotechnical structures in soil through FE analysis for given physical problem
4. Create FE model on commercial package software and anlayse the same.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE (M)	Internal (I)	Viva (V)	Term Work (TW)	
3	0	0	3	50	20	30	25	25	150

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Detailed Syllabus

Sr No.	Title of the unit	Number of hours
1	**Introduction**	12
	Matrix Algebra – Inversion of matrix – solution of large number of simultaneous equations, FEM History and its applications, Discretization of continuum, types of elements, displacement models, convergence requirements, Equations of equilibrium and compatibility, stress-strain relations, plane stress and plane strain and axi-symmetric problems	
2	**Displacement approach of FEM**	
	Using Generalized coordinates Computations of element properties shape function Strain displacement matrix and stiffness matrix for bar elements beam elements, truss elements	8
3	**Applications of Natural coordinates:**	
	Isoperametric formulation, Numerical Integration Gauss Quadrature Technique, Computations of element properties shape function Strain displacement matrix and stiffness matrix for bar elements beam elements, truss elements constant strain triangle, linear strain triangle Quadrilateral elements	10
4	**Applications to Geotechnical engineering**	
	Analysis of foundations, dams, underground structures and earth retaining structures. Analysis of flow (seepage) through dams and foundations. Consolidation Analysis, Linear and non-linear analysis. Techniques of nonlinear analysis, Constitutive modeling for soils, Non linear- soil parameters	12

Suggested Theory Distribution

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
5%	10%	25%	25%	25%	10%

Instructional Method and Pedagogy:

1. Use of Learning Management system like canvas
2. Demonstration through ppt and videos and lectures
3. Brainstorming and group discussion sessions
4. Collaborative learning
5. Project based learning
6. Learning by doing

Recommended Study Material:

Reference Books:

1. Introduction to Finite Element Method Desai & Able,CBS publisher Delhi,2005
2. A First Course in the Finite Element Method – D. L. Logan, 3rd Edition, Thomas Asia pvt led, 2004
3. Introduction to Finite Elements in Engineering Chandrupatla, T. R. & Belegundu, A. D.,, 3rd edition, Prentice – Hall of India Pvt. Ltd., New Delhi, 2002.
4. Finite element analysis in geotechnical engineering: Volume One - Theory , David M. Potts, ICE publishing, 1999
5. Finite Element Analysis in Geotechnical Engineering: Volume two - Application , David M. Potts and Lidija Zdravković , , ICE publishing, 2001

Web resources:

1. http://nptel.ac.in/courses/112104116/
2. http://nptel.ac.in/downloads/105108141/
3. https://www.bentley.com/en/products/product-line/geotechnical-engineering-software/plaxis-3d
4. https://www.finesoftware.eu/geotechnical-software/
5. http://www.itascacg.com/software/FLAC3D

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