Finite Element methods in Geotechnical Engineering 01GT0203 (PC)

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 Geotechical engineering

Credits Earned:4

Students learning outcomes:

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

1. Select the appropriate element and mesh for FE analysis for given problem
2. Evaluate the type of problem and develop the FE-model.
3. Estimate the stresses and strain in soil through FE analysis for given physical problem

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	2	0	4	50	20	30	25	25	150

Detailed Syllabus

Sr No.	Title of the unit	Number of hours
1	**Introduction**	
	Matrix Algebra – Inversion of matrix – solution of large number of simultaneous equations,	2
	FEM Hisotry and its applications	1
	Discretization of continuum, types of elements, displacement models, convergence requirements	3
	Equations of equilibrium and compatibility, stress-strain relations, plane stress and plane strain and axi-symmetric problems	3
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	3
	constant strain triangle, linear strain triangle	3
	Quadrilateral elements	2
3	**Numerical Integration Gauss Quadrature Technique**	**3**
4	**Using Natural coordinates /Isoperametric formulation** Computations of element properties shape function Strain displacement matrix and stiffness matrix for	
	bar elements beam elements, truss elements	3
	constant strain triangle, linear strain triangle	3
	Quadrilateral elements	2
5	**Introduction to nonlinear analysis**	
	Techniques of nonlinear analysis, Constitutive modeling for soils, Non linear- soil parameters	**3**
6	**FEM software**	
	Pre processor & Post processing techniques	1
	Applications to study of embankment dams, problem of strip footing, excavations, stress distribution around opening etc.	4

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
10%	25%	10%	35%	20%	00%

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

Recommended Study Material:

Reference Books:

1. Finite Element Method Desai & Able
2. A First Course in the Finite Element Method – D. L. Logan
3. Finite Element Method – Y. M. Desai, T. I. Eltho and A. H. Shah
4. Introduction to Finite Elements in Engineering - Chandrupatla, R.T. & Belegundu, A.D

Web resources:

1. http://nptel.ac.in/courses/112104116/
2. http://nptel.ac.in/downloads/105108141/

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