



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3722022

SUBJECT NAME: Soil Structure Interaction

SEM -II

Type of course: Program Elective-IV

Prerequisite: Basic Structural Engineering, Soil Mechanics, Foundation Engineering,

Rationale: To retain earth in an engineered way as per requirement and to determine soil response both under static and dynamic loadings is one of the major tasks for structural engineers. As soil is heterogeneous material, it is very difficult to retain it under different situation. Many theories are available to analyze and design such structures. To deal with any type foundation and earth retaining structure, the knowledge of its behavior on field is very important to take proper engineering decisions in practical situations

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE(E)	PA (M)	ESE (V)	PA(I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to SSI: Introduction to SSI, Importance of SSI, Applications and Examples of SSI for geotechnical engineer, Effect of structure roughness / smoothness on soil behaviour.	03	10
2	SSI problems: General soil-structure interaction problems- Shallow foundation, Sheet piles, Mat/Raft foundation, pile raft foundation,etc., Contact pressure and soil-structure interaction for shallow foundation, Fixed/ Flexible base, Differential foundation settlement for high rise buildings, Pressure settlement prediction from constitutive laws.	11	28
3	SSI Models: Elastic continuum, Winkler's model, Multi parameter models, Hybrid models, Codal provisions, discrete models and finite element models	07	14
4	Seismic Soil-Structure Interaction - Dynamic response of soil, strain-compatibility, and damping characteristics of soil-structure. Machine foundation - soil interaction, Shake-table tests, SSI in time domain (dynamic stiffness and Green's functions).	08	18
5	Soil-Pile Behaviour: Introduction, axial and laterally loaded piles, load-	08	22



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	displacement behaviour, Modified Ramberg Osgood Model, pile group, interaction effect in pile group, soil-pile modelling in FEM, Elastic continuum and elasto-plastic analysis of piles and pile groups. Non-linear load-deflection response, Pile-raft system		
6	SSI in Retaining Structures: Curved failure surfaces, their utility and analytical / graphical predictions from Mohr – Coulomb envelope and circle of stress, Earth pressure computations by friction circle method, Earth pressure on wall with limited / restrained deformations, Earth pressure on sheet piles, braced excavations, Design of supporting system for excavations.	05	08

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	30	20	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Bowels, J.E., "Analytical and Computer methods in Foundation" McGraw Hill Book Co., New York.
2. Desai C.S. and Christian J.T., "Numerical Methods in Geotechnical Engineering" McGraw Hill Book Co. New York.
3. Soil Structure Interaction, the real behaviour of structures, Institution of Structural Engineers, 1989.
4. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co.
5. Kameswara Rao, N.S.V., "Dynamics soil tests and applications", Wheeler Publishing, New Delhi, 2000
6. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier 1979
7. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford, 1998
8. ACI 336. (1988), Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute, 1988.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage



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CO-1	Apply various theories applicable to SSI and will have capacity to idealize soil response in order to analyze and design rigid and flexible foundation elements subjected to different loadings.	20
CO-2	Calculate Contact pressure and settlement under shallow foundations, mat foundation, pile-raft foundation, settlement computation from constitutive laws.	20
CO-3	Analyse retaining structures through various analytical and graphical approaches, and design supporting structures for excavations	15
CO-4	Analyse sub-structural and super-structural element using various SSI tools based on hybrid models, discrete models and FEM approach and elastic theory approach.	25
CO-5	Analyse vertical piles, laterally loaded piles and pile-raft system and foundations subjected to dynamic forces/seismic forces.	20

List of Experiments/Tutorial:

Tutorial work shall consist of presentations / problems / preparation of learning material based on above topics. Apart from above assignments a group of students has to undertake one open ended design problem based on engineering application.

List of Open Source Software/learning website:

1. NPTEL lecture series
2. MIT open source material