GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02000291

Subject Name: Soil Structure Interaction

w.e.f.Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Courses

Prerequisite:	Basic Structural Engineering, Soil Mechanics, Foundation Engineering,
Rationale:	There are many geotechnical problems involving complicated geometries, loadings, and different soil properties which generally require the solution of ordinary or partial differential equations, which are not possible to obtain with the help of analytical mathematical solutions. Hence, Structural Engineers need to rely on numerical methods, such as the finite element method, finite difference method, and boundary element method etc., for acceptable solutions. Among these numerical methods, finite element method is such a widely accepted method that can be systematically programmed to accommodate complex and difficult problems..

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Indentify various theories applicable to SSI and will have capacity to idealize soil response in order to analyze and design foundation elements subjected to different loadings
02	Perform Contact pressure and settlement computations based on SSI and constitutive models.
03	Apply Winkler's hypothesis and analyise foundations based on elastic theory, Calculate earth pressure on different retaining structures
04	Apply SSI in analyzing machine foundation and need of various parameters and predict lateral capacity of piles
05	Analyise retaining structures through various analytical and graphical approaches, and design supporting structures for excavations

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	ESE (E)	PA/ CA (M)	PA/CA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No.of Hours	% of 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	05
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	15	30
3.	SSI Models: Elastic continuum, Winkler's model, Multi parameter models, Hybrid models, Codal provisions, discrete models and finite element models	07	20
4.	Seismic Soil-Structure Interaction - Dynamic response of soil, straincompatibility, and damping characteristics of soil-structure. Machine foundation - soil interaction, Shake-table tests, SSI in time domain (dynamic stiffness and Green's functions).	09	20
5.	Soil-Pile Behaviour: Introduction, axial and laterally loaded piles, load-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	10	25
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**25**	**25**	**10**	**10**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asperRevisedBloom'sTaxonomy)

References/Suggested Learning Resources:

(a) 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.

(b) Open source software and website:

1. https://nptel.ac.in/courses/
2. https://ocw.mit.edu/courses/civil-and-environmental-engineering/

List of Experiments/ Tutorials:

1. Tutorial on Beams resting on Elastic Foundations, Infinite Beams, Finite Beams and Laterally loaded piles.
2. Tutorial on Raft/Mat foundations and retaining structures/Graphical method
3. Modelling using software’s; ABACUS/STADDPRO / ANSYS, etc.

Suggested Project List: ---

Apart from above tutorials/experiments a group of students has to undertake one open ended problem/design problem. Few examples of the same are given below:

1. Analysis of Finite Beams with different loadings and comparing shear force, bending moment, soil pressure, with conventional design parameters.

2. Deflection and Settlement Computations for laterally loaded piles using Software's

3. Design of Pile-Raft foundation using open-source/commercial software.

Suggested Activities for Students: --- Visit to Structural Consultant/Research Organization and Explore use of AI/ML in SSI application. .

* * ** * **