GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL AND INFRASTRUCTURE ENGINEERING
GEOTECHNICAL ENGINEERING - II
SUBJECT CODE: 2164003
B.E. 6th SEMESTER

Type of course: Core Subject in Civil and Infrastructure engineering

Prerequisite: Geotechnical Engineering – I

Rationale:

Geotechnical Engineering – II is providing conceptual understanding and applications of foundation engineering for infrastructure sector. With the help of this knowledge students may be able:

1. To build the necessary theoretical background for design and construction of earthwork and foundation systems.
2. To understand the techniques involved in the geophysical investigation of soil for earthwork and foundation systems.
3. To learn about types and purposes of shallow and pile foundation systems including their design aspects
4. To aware of feasibility of foundation solutions to different types of soil conditions

Course Objective:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE	PA(M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr.	Topics	Total hours	Module Weightage
1	**Module I Theory of lateral Earth pressure:** Introduction Types of earth pressures, Different theories of earth pressures, Displacement-related earth pressure, Rankine and Coulomb theory, Friction circle method, Terzaghi's analysis, Development of bearing capacity theory, Development of uplift capacity theory	**05**	**12%**
2	**Module II Stability of Earthen slopes:** Stability analysis of a slope and finding critical slip surface; Limit equilibrium analysis, Different methods of analysis. Sudden Draw down condition, effective stress and total stress analysis; Seismic displacements in marginally stable slopes; Reliability based design of slopes, Methods for enhancing stability of unstable slopes.	**05**	**12%**

3	**Module III Soil Exploration and Geophysical Investigation:** Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation based on soil condition, Objectives and planning of exploration program, methods of exploration-Auger boring, wash boring and rotary drilling-depth of boring, soil samples and soil samplers-representative and undisturbed sampling, field penetration tests: SPT, SCPT, DCPT. Introduction to geophysical methods, Bore log and report writing, data interpretation.	**04**	**10%**
4	**Module IV Shallow Foundations:** Introduction, significant depth, design criteria, modes of shear failures, Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, Effect of Water table on Bearing Capacity, Presumptive bearing capacity. Settlement, components of settlement & its estimation, permissible settlement, Proportioning of footing for equal settlement, allowable bearing pressure. Bearing capacity from in-situ tests (SPT, SCPT, PLATE LOAD), Bearing capacity of raft/mat foundation as per codal provisions, Concept of contact pressure under rigid and flexible footings. Floating foundation.	**10**	**24%**
5	**Module V Pile foundations :** Introduction, load transfer mechanism, types of piles and their function, factors influencing selection of pile, their method of installation and their load carrying characteristics for cohesive and granular soils, piles subjected to vertical loads- pile load carrying capacity from static formula, dynamic formulae (ENR and Hiley), penetration test data & Pile load test (IS 2911). Pile group: carrying capacity, efficiency and settlement. Negative skin friction.	**10**	**24%**
6	**Module VI Ground Improvement Techniques:** Different types of problematic soils and their geological formation principles of treatment-loading. Treatment of loose sands- Compaction piles, dynamic compaction, vibroflotation technique, controlled blasting for compaction, Grouting techniques.	**04**	**9%**
7	**Module VII Geosynthetics & Reinforced Earths works :** Introduction, Types of geosynthetics like geotextiles, geogrids, geonets, geocells, geo-composites, their manufacturing methods, reinforcing of earthwork for embankment and foundation using geosythetics	**04**	**9%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	**25**	**20**	**15**	**15**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above

Reference Books:

1) P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson Education.
2) B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd., Delhi.
3) Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
4) Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
5) V. N. S. Murthy; Soil Mechanics & Foundation Engineering; Sai Kripa Technical Consultants
6) Ranjan and Rao; Basic and Applied Soil Mechanics; New Age International Publishers
7) Bowles JE., Foundation Analysis and Design., 1997, The McGraw-Hill Companies, Singapore.
8) Craig RF., Craig's Soil Mechanics., 2004, Taylor and Francis, New York, USA.
9) Das BM., Advanced Soil Mechanics, 2008, Taylor and Francis, New York, USA.

Course Outcome:

After learning the course the students should be able to:

1. Select the type of foundation for the given site condition and loading parameters.
2. Determine the pressure acting on retaining wall and suitable resisting system
3. Understand the stability of slopes under different site conditions
4. Understand the factors governing shallow and deep foundation
5. Select suitable ground improvement techniques for prevailing site conditions
6. Select the suitable method of sampling to find out the various engineering properties of soil
7. Determine the bearing capacity of soil under different site conditions

Term-Work:

The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial.

Practical examinations shall consist of oral based on term-work and above course.

List of Practicals:

1. Standard Penetration Test
2. Plate load test
3. Free Swell Index Test
4. Auger Boring
5. Consolidation Test
6. Triaxial Shear Test
7. Unconfined Compression Test

List of Open Source Software/learning website: **www.nptel.iitm.ac.in/courses/**

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The Power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.