

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: CIVIL ENGINEERING
SUBJECT NAME: FOUNDATION ENGINEERING
SUBJECT CODE: 2180609
B.E. 8th SEMESTER

Type of course: Core

Pre-requisites: 1. Geotechniques & Applied Geology (GTAG)
 2. Strength of Materials and Soil Mechanics

Rationale: Foundation Engineering is very fundamental subject consisting of selection of proper type of foundation as per sub-soil profile and type of structure. Any civil engineering structure needs strong and stable foundation which depends on proper understanding of soil behaviour, determination and interpretation of soil parameters, determination of stresses in soil. The design of any foundation system is based on understanding of soil parameters and its implication based on through interaction with type of structure. The course on *Foundation Engineering* provides the students basic knowledge on foundation selection, foundation forces, foundation design and its stability under seismic forces. Various types of foundation and their analytical solution helps the student to design suitable foundation with respect to soil and site condition.

Teaching and Examination Scheme

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

Content:

Sr. No.	Topics	Total hours	Module Weightage
1	Selection of foundation and Sub-soil exploration/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-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.	06	18
2	Shallow Foundation: Introduction, significant depth, design criteria, modes of shear failures.	10	25

	Detail study of bearing capacity theories (Prandtl, Rankine, Terzaghi, Skempton), bearing capacity determination using IS Code, 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), Factors affecting bearing capacity including Water Table., Bearing capacity of raft/mat foundation as per codal provisions, Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design.		
3	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.	07	22
4	Foundations on problematic soil & Introduction to Geosynthetics : Significant characteristics of expansive soil, footing on such soils, Problems and preventive measures. Under-reamed pile foundation-its concept,design & field installation. Significant characteristics of silt and loess, problems & remedial measures footing on such soils, introduction to geosynthetics-types and uses.	05	18
5	Retaining walls : Types (types of flexible and rigid earth retention systems: counter fort, gravity, diaphragm walls, sheet pile walls, soldier piles and lagging).	07	17

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	25	15	-

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) 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, Bangalore

- 6) Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) Ltd.
- 7) Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi
- 8) Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.

IS Codes :

- 9) 1. Code of practice for determination of bearing capacity of shallow foundation IS:6403
- 10) 2. Code of practice for design and construction of pile foundation- IS:2911 (Part I to IV)
- 11) 3. Method for standard penetration test for soil- IS:2131
- 12) 4. Code of practice for subsurface investigation for foundation- IS:1892
- 13) 5. Code of practice for structural safety of buildings: Shallow Foundations- IS:1904
- 14) 6. Code of practice for calculation of settlement of foundations- IS:8009**

Course Outcome:

After learning the course the students should be able to:

- (a) Select appropriate soil investigation/testing technique/method and get true sub soil parameters used for selection of type of foundation as per codal guidelines.
- (b) Select and design appropriate/suitable foundation system (shallow/Deep) for different structures, that satisfy the allowable bearing capacity and settlement requirements based on soil properties,
- (c) Design deep foundation satisfying bearing capacity and settlement requirements,
- (d) Design and analysis of retaining walls and sheet piles under static loads,
- (e) Understand the engineering behaviour of expansive soils and selection of suitable foundation type for such soils.
- (f) Selection of alternate materials like geosynthetics and its application in foundation problems.

At least 15 problems based on above topic.

- 1) Plate load test (PLT)
- 2) Standard Penetration test (SPT)
- 3) Static and Dynamic Cone Penetration test (SCPT-DCPT)
- 4) Triaxial Shear Test (CD condition)
- 5) Consolidation test (on soft marine clays)
- 6) Swell Pressure test
- 7) CBR test

Open Ended Problems:

- Collection of samples of soil and identification of their types
- Collection of literature on types of foundation
- Development of spread sheets/computer programmes for the design of shallow and deep foundation.
- Design of foundation of real-life structure using open-source/commercial software
- Design of retaining wall for any underpass/bridge of your local city.

List of Open Source Software/learning website:

<http://nptel.ac.in/>

<http://ocw.mit.edu/courses/civil-and-environmental-engineering/>

ACTIVE LEARNING ASSIGNMENTS: 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.