



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3160613**

**Semester – VI**

**Subject Name: Foundation Engineering**

**Type of course: Program Elective**

**Prerequisite: Knowledge of Geotechnical Engineering, Soil Mechanics and Fluid Mechanics**

**Rationale:** Loads of all civil engineering structures must be transmitted to the soil or rock through a foundation system that is safe and economical. The course on *Foundation Engineering* provides the necessary technical knowledge to select, analyze and design various types of foundation systems under different loads with full understanding on soil investigation, its requirements, interpretation of data and its application. Various types of foundations and their analytical solution help students to design suitable foundation with respect to soil and site condition and type of structure.

**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
1	<b>Foundation Classification and Soil exploration/investigation:</b> 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-depth of boring, Soil samples and samplers- Methods of sampling, field penetration tests: SPT, SCPT, DCPT. Introduction to geophysical methods, Bore log and report writing and Data interpretation.	8
2	<b>Shallow Foundation:</b> Introduction, significant depth, design criteria, modes of shear failures. Detail study of bearing capacity theories (Prandtl, Meyerhoff, Terzaghi, Skempton, Vesic etc), bearing capacity determination using IS Code (IS 6403), Presumptive bearing capacity. Settlements: components of settlement & its estimation (IS 8009), permissible settlement, Proportioning of footing for equal settlement, Allowable bearing pressure. Bearing capacity from in-situ tests (SPT, SCPT, PLT, DCPT), Factors affecting bearing capacity. Bearing capacity of raft/mat foundation as per codal provisions, Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design.	10
3	<b>Pile Classifications &amp; Load Transfer Principle of Pile foundation :</b> 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	10



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	from static formula, dynamic formulae (ENR and Hiley), penetration test data & Pile load test (IS 2911). Pile group: Carrying capacity, Group Efficiency and settlement. Negative skin friction.	
4	<b>Foundations on problematic soil &amp; Introduction to Geosynthetics :</b> Significant characteristics of expansive soil, footing on such soils, Problems and preventive measures. Under-reamed pile foundation-its concept, design & field installation. Introduction to geosynthetics-types and uses.	6
5	<b>Retaining walls and Diaphragm walls :</b> Types (types of flexible and rigid earth retention systems: counter fort, gravity, diaphragm walls, sheet pile walls etc.), Analysis of retaining and diaphragm walls	8

### Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
05	15	25	15	05	05

**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. Foundation Engineering, Peck hanson & Thronburg(1974). John Wiley & Sons,.
2. Analysis and design of Substructures- Swami Saran (2009), Oxford & IBH
3. Foundation Engineering Naryana S Naik(2012), Dhanphat Rai publishers, New Delhi
4. Winterkorn, H.F. and Fang, Y.F., Foundation Engineering Handbook, Van Nostrand Reinhold, 1994.
5. Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford, 1998.
6. Swami Saran, Gopal Ranjan, "Analysis & Design of Foundaions & Retaining Structures", Sarita Prakashan.
7. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
8. Grigorian, Pile Foundation for Buildings and Structures in collapsible Soil, Oxford & IBH Publishing Co, Pvt. Ltd., New Delhi, 1999.
9. Bowles, J.E., "Foundation Analysis and Design, 5th Edition, McGraw Hill, New York, 1995.

### Course Outcomes:

Sr. No.	CO statement Students will be able to	Marks % weightage
CO-1	Select appropriate soil investigation/testing technique/method and get true sub soil parameters used for selection of type of foundation as per codal guidelines.	20



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CO-2	Select and design appropriate (Shallow/ Deep) foundation system for different structures, that satisfy the allowable bearing capacity and settlement requirements based on soil properties,	30
CO-3	Design vertical piles and pile groups for various types of loading, soil conditions and settlement requirements.	25
CO-4	Design and analyze retaining walls, sheet piles and diaphragm walls under static loads	15
CO-5	Explain engineering behavior of expansive soils and selection of suitable foundation type for such soils, suggest suitable type of geosynthetics for various foundation issues and its proper implications.	10

### List of Experiments/ Tutorials:

- Bearing capacity computations using Box Shear Test, Triaxial Test, UCS, Vane Shear test, SPT, PLT, CPT, DCPT, Pile load test, Geophysical tests and other in-situ tests
- Settlement computations using Consolidation test, Settlement calculations for layered soil and Soft Marine clay
- Swell pressure and swell index test for expansive soils
- CBR test

**Major Equipment:** SPT, PLT, SCPT, DCPT, Triaxial machine with pore pressure measurements

### List of Open Source Software/learning website:

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

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