



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code 3724313

Semester – II

Subject Name: Advanced Foundation Engineering

Type of course: Core-IV

Prerequisite: Knowledge of Soil Engineering and Geotechnical Engineering.

Rationale: Foundation is an important component of any civil engineering structure. The structural loads of buildings, bridges, towers, and other civil engineering works must be transmitted to the underlying natural soil or rock material using a foundation system that is safe, stable, and economical. The course on *Advanced Foundation Engineering* provides the students necessary geotechnical engineering skills to analyze and design shallow and deep foundation systems under different static and dynamic loading and soil conditions.

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)		
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Bearing Capacity & Settlement Computations: Developments - need of Foundation Engineering, selection of type of foundation, Bearing capacity of shallow foundations and its relevant theories including IS method - Homogeneous - Layered soils - Soft and Hard Rocks - Evaluation of bearing capacity from in-situ tests, settlement computations: immediate-consolidation settlement-layered soil and rocks-construction period correction-evaluation from in-situ tests - code recommendations	10
2	Interactive Analysis and Design of Foundations: Analysis of foundation - Contact pressure under footings, – contact pressure distribution-factors influencing contact pressure distribution beneath rigid and flexible footings, individual - strip - combined footings and mat foundations conventional - elastic approach - soil structure interaction principles -Soil Structure Interaction problems- concentrically and eccentrically loaded cases- Idealized soil behavior – Foundation behavior, Interface behavior, Analytical techniques.	07
3	Design of Raft foundations- types of rafts, stability and rigidity of the soil structure system, allowable soil pressures for rafts in cohesionless and cohesive soils, Design of raft by rigid beam method and Winkler method, Solution based on elastic half space and based on elastic theory.	06
4	Pile Classifications & Load Transfer Principle: Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – piling equipments and methods – effect of pile installation on soil	09



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	condition – criteria for pile socketing - responsibility of engineer and contractor. Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – Wave equation application – Interpretation of field test and pile load test results – Settlement of piles and pile group - codal provisions.	
5	Dynamic analysis of foundations: dynamic soil properties, natural frequency of machine foundation-soil system, different types of machine foundations, static and dynamic criteria for soil-foundation system, design of block foundations per IS code.	05
6	Foundations on Expansive Soils and Collapsible soils: The nature, origin and occurrence, Identifying, testing and evaluating expansive soils, typical structural distress patterns and preventive design & construction measures.	03
7	Well foundations: different types, stability analysis and basic concepts	02

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: Students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Analyse the bearing capacity of the soil for shallow foundations and deep foundations, use of appropriate formula	25
CO-2	Design aspects of Raft foundations for achieving uniform settlement for special structures	15
CO-3	To analyse and adopt design skills of vertical piles and pile groups for various types of loading and soil conditions.	25
CO-4	To carry out dynamic soil analysis and select suitable type of foundation under dynamic loads, design well foundation	20
CO-5	To understand typical characteristics of expansive or collapsible soils and design suitable foundation for such type of soils.	15



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List of Experiments:

1. Bearing capacity computations using Box shear, Traixial shear, SPT, PLT, CPT, Pile load test and other in-situ tests
2. Settlement computations using Consolidation test, layered soils, soft marine clays
3. Dynamic soil bearing capacity computations: Block vibrations test

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. Development of spread sheets/computer programmes for the design of shallow, raft, pile and well foundation.
2. Design of machine foundation for a problem preferably selected from industry.
3. Design of foundation of real-life structure using open-source/commercial software

Major Equipment:

Working Hydraulic Prototype models of earthen dams and its various components.

List of Open Source Software/learning website:

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