GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Geotechnical Engineering

Subject Code: ME02076021

Subject Name : Advanced Foundation Engineering

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

Prerequisite:	Geotechnical Engineering, Foundation 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.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Select different types of foundations based on site conditions.
02	Analyze the bearing capacity of the soil for shallow foundations and deep foundations, use of appropriate formula
03	Design aspects of Raft foundations for achieving uniform settlement for special structures
04	To analyse and adopt design skills of vertical piles and pile groups for various types of loading and soil conditions.
05	To understand typical characteristics of expansive or collapsible soils and design suitable foundation for such type of soils.

TeachingandExamination Scheme:

Teaching Scheme(inHours)			Total Credits L+T+(PR/2)	AssessmentPattern andMarks				TotalMarks
				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

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Course Content:

Unit No.	Content	No.of Hours	% of Weightage
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	12	25
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.	6	15
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	6	15
4.	Pile Classifications & Load Transfer Principle: Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – 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.	10	25
5.	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.	05	10
6.	Introduction to Special Foundations: Foundations for offshore structures, Well foundations, buried structures, Earthquake prone structures; Foundations on problematic soils like expansive soils, Polluted soils etc.	06	10
	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. Donald P Coduto, Foundation Design: Principles and Practices, Pearson Education India, 2014.
2. R. Salgado, The Engineering of Foundations, Mc Graw Hill, 2006
3. Teng W. C., "Foundation Design", Prentice Hall of India Ltd., 1962
4. Tomlinson, "Foundation Design and Construction", Pearson Publications, 2001
5. Satyendra Mittal, “Pile foundation design and construction”, 2nd Edition, CBS Publishers & Distributors Pvt. Ltd., 2017
6. Winterkorn H. F., and Fang H., "Foundation Engineering Hand Book", Van Nostrand Reinhold Co, New York, 1975
7. An-Bin Huang and Hai-Sui Yu., Foundation Engineering Analysis and Design, CRC Press, Taylor and Francis group,2018, 1st Edition.
8. Gopal Ranjan and Rao ASR, Basic and applied soil mechanics, New Age Publications, Delhi, 2016, 3rd Edition.
9. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
10. Grigorian, Pile Foundation for Buildings and Structures in collapsible Soil, Oxford & IBH Publishing Co, Pvt. Ltd., New Delhi, 1999.
11. Bowles, J.E., "Foundation Analysis and Design, 5th Edition, McGraw Hill, New York, 1995
12. Lymon C. Reese, William M. Isenhower, Shin-Tower Wang- Analysis and Design of Shallow and Deep Foundations (2006)
13. IS 6403-1981 (Reaffirmed 2002): Code of Practice for determination of Bearing Capacity of Shallow Foundations
14. IS 1080-1985 (Reaffirmed 2002): Code of Practice of Shallow Foundations in Soils

(b) Open source software and website:

1. https://nptel.ac.in/courses/105/104/105104162/
2. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-364-advancedgeotechnicalengineering-fall-2003

List of Experiments/ Tutorials:

1. Bearing capacity computations using Box shear, Triaxial shear, SPT, PLT, CPT, Pile load test and other in-situ tests
2. Settlement computations using Consolidation test, layered soils, soft marine clays

Minimum 5 assignment questions from above topics

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. Development of spread sheets/computer programs for the design of shallow, raft, pile and well foundation.

2. Settlement Computations using Software's

3. Design of foundation of real-life structure using open-source/commercial software.

Suggested Activities for Students: --- Site Visit to refer Construction of Foundations for various structures like Metro rail; Bridges; Sports Complex, Entertainment Parks, etc.

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