GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Civil Engineering

Course / Subject Code:

Course / Subject Name : Ground Improvement Techniques

w. e. f. Academic Year:	2024-2025
Semester:	1st Semester
Category of the Course:	PEC

Prerequisite:	Knowledge of Geotechnical Engineering.
Rationale:	This subject is introduced with a view that student can identify and explore various problematic soils based on sub soil exploration report. Understanding each ground improvement technique based on its mechanics and its effectiveness under particular regional conditions. Learning various design parameters for particular method based on both field experience and international standards. Suggesting suitable ground improvement technique based on available technology, need of construction industry and cost analysis.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Reinforcing their knowledge for determination of engineering properties of different soils and interpreting the results.	U,R
02	Identifying various engineering problems associated with soft and compressible soil deposits.	N,U
03	Design and implementation of various soil improvement techniques.	C,E
04	Selection of appropriate soil improvement technique based on the soil type and application.	N,U,E
05	Determine of various properties of different grouts, which is a necessary knowledge for grouting design for various engineering applications in the field.	N,U.R
06	applications of grouting, the awareness of which would help in the field to decide the suitability of grouting for solving an engineering problem.	A,N,U

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				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

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction Concepts of soil type and its physical and mechanical relevance on engineering properties of soil including soil structure changes, Engineering properties of soft, weak and compressible deposits and problems associated with these deposits.	6	15
2.	Mechanical modification dynamic compaction, impact loading, compaction by blasting, vibro-compaction; pre-compression, stone columns; Hydraulic modification: dewatering systems, preloading and vertical drains, electro-kinetic dewatering, compaction piles heavy tamping, deep mixing, vibro-replacement, granular columns, micro piles, ground freezing and thawing, heat treatment, its concept and application, geothermal piles	17	35
3.	Chemical modification and Stabilization Modification by admixtures (lime, cement, lime-fly ash, hydroxides, carbonates etc., inorganic stabilizers), stabilization using industrial Wastes,. Lime columns, bituminous stabilization.	8	20
4.	Grouting Classification, Grout materials, physical and chemical properties, strength, Rheological aspects of coarse and fine grouts, penetrability andperformance aspect of coarse and fine grouts, Various application of grouting	7	15
5.	Soil Reinforcement and its Application: Type of soil reinforcement, selection of stabilization/improvement of ground using Geotextiles, Goegrid, geomembranes, geocells, shallow foundations on reinforced earth, analysis and design of shallow foundations using geosynthetic reinforcements, road designs with geosynthetics	7	15
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**20**	**20**	**20**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. A.C. Houlsby, Grouting Manual, Water Resources Commission, Australia-1977. 3. R.H. Karol, Chemical Grouting, Applied Science Publishers-1986.
2. A.V. Shroff& D.L. Shah, Grouting technology for dam construction and tunneling, Oxford & IBH Publishers, 2nd addition, 1999
3. Bell F G, "Foundation Engineering in Difficult Ground", Butterworth, 1978.
4. Koerner R M, "Construction and Geotechnical Methods in Foundation Engineering",
5. McGraw Hill Publishing Co. Ltd., 1984 7. Hausmann M.R. „Engineering Principles of Ground Modification" McGraw Hill 8. Publishing Company, New York - 1990.
6. Proceedings of the Conference on Soil Stabilization, Massachusetts Institute of Technology, June 18-30, 1959.
7. Rao V.V S, "Ground Improvement techniques
8. Van Impe W.F, "Soil Improvement technique and their evaluation"
9. Zeevart L, "Foundation Engineering for Difficult Subsoil Conditions"

(b) Open source software and website:

NPTEL lecture series

MIT open source material

Suggested Course Practical List: If any

1. Determination of various index properties of problematic soil (specific gravity, liquid limit, plastic limit, shrinkage limit, relative density, soil classification)

2. Determination of various engineering properties of soil (permeability, shear strength, compaction, swell pressure)

3. Determination of various physical and chemical properties of grout (fluidity, bleeding potential, gelation, gel strength, specific gravity, Ph, colour change, water retentivity, syneresis)

4. Chemical analysis of soil

List of Laboratory/Learning Resources Required:

1. Complete tri-axial system with pore pressure measurements,
2. unconfined compression system,
3. automated soil compactor,
4. California bearing ratio (CBR) machine,
5. permeameter (Flexiwall&Blaine's),
6. pH and Electrical conductivity probes/meters,
7. Viscometers

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